

How to Help English as a Second Language Students Increase Understanding of
Earth Science Core Content Knowledge and Science Literacy with the Use of after
School Vocabulary Review Sessions

By

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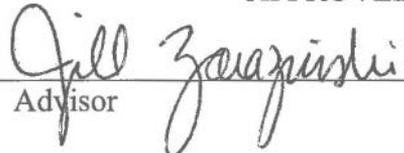
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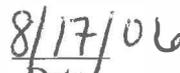
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Abstract

With the population of English as a second language (ESL) student entering our school systems increasing, and the importance for all students to have a mastery of science concepts, there needs to be a solution to help these ESL students that struggle with science. My students are all in ninth grade taking earth science and struggling with the content of the Regents course. After a conversation with each of the seven ESL students I decided to begin after school vocabulary intervention review sessions. For the second half of the year the students would meet one day each week and review all of the current vocabulary and review past Regent Exam questions. The students were able to make gains on exam scores as well as achieve a greater understanding of with the material than they had during the first half of the school year. Through the study I was also able to formulate new ideas using cooperative learning techniques and vocabulary intervention strategies which I will implement in future classes.

Chapter 1: Introduction

Problem Statement

I have been teaching earth science for the last two years and have enjoyed the learning experience. One of the problems that have come to my attention since the beginning of my first year of teaching is trying to help English as a Second Language students (ESL) learn earth science and achieve science literacy. “As we grapple with the kinds of issues and concerns raised by the clash of cultures in academia, we continue to make adjustments which, in turn, generate new questions about our practices” (Zmael, 1995, p 519).

These students struggle with language barriers due to their limited experience and/or time being in a United States high school. Even if they have a good grasp on the language, they often struggle with the core content of the earth science course. The ESL students I have had over the past two years have been some of the hardest working students I have worked with. It has been difficult for me to see them earning low marks at the end of the grading periods knowing how much work they have put forth. I am also faced with the issue of trying to prepare these students for the New York State Regents exam at the end of the year. I have often contemplated altering the assessments I give at the conclusion of all of the units to reflect how much work they put in to the course, not how well they speak the English language. The problem with this alteration would be the possibility that I would not adequately be preparing them for the Regents exam. I also need to make sure they complete the difficult lab activities so they fulfill New York State requirements and have the opportunity to take the exam. I need to find a reasonable solution to try and help these students learn earth science, prepare them for the final

Regents exam, and increase their scientific literacy without eliminating the lab portion of the course or changing the formal assessments that prepare students for the culminating exam at the end of the year.

Significance of the problem

I teach a difficult course, and there is large amount of curriculum and information that comes quickly. I also make sure that I keep my expectations of the students very high by giving challenging exams, quizzes, and labs. The course requires the students to learn the concepts and then apply what they have learned to numerous problems asked in a variety of ways. These problems can be extremely difficult for students that are concrete operational thinkers, and ESL students who do not have a firm grasp on the English language can have difficulty making formal operational connections between different science concepts.

This academic school year I have seven ESL students in my classroom who have been working extremely hard since September. These students have been receiving failing marks and audit scores for the first half of the year in my grade book. I have struggled with this problem since last year which was my first full year of teaching earth science. I have attempted to change these students' seats in the classroom as well as pairing these students with students who excel in earth science. I have also attempted pairing these students with students who speak the same language. All of my attempts have resulted in only small success with student scores and satisfaction with their marks in the class. I need to find a way to help these students succeed in earth science as well as achieve science literacy and eventually have success with the grades they receive in my class.

At the half way point of this year I decided to have the ESL students meet with me after school and discuss their midterm scores which were extremely low. We discussed a number of issues that caused them to have difficulty with the class and the midterm. Throughout the conversation I was able to learn a lot about these students and the expectations they have from their parents as well as themselves. We also discussed a number of differences between their previous academic cultures, and their current status with earth science. After the conversation with the students I found that I needed to find more specific areas where these students were struggling in blended science classes. I also needed to learn what I could do to help these students learn the difficult earth science concepts.

Purpose

The purpose of this action research is to identify the reasons that cause these ESL students to struggle in my blended earth science classroom. I also want to explore the benefits of an after school vocabulary and review session. I want to see if they can learn earth science, pass the Regents exam, and achieve the grades they are working so diligently toward.

The population of ESL students is growing and the challenges to help these students increase their science literacy and pass difficult state exams are becoming more evident. Science is an important subject for all students to master because of the potential impact it has on their lives. If ESL students are not learning core content science material they will be behind as they enter post secondary education and other science classes. As a science teacher, I need to help these students find enjoyment and inspiration in science with the hopes that some of these same students will pursue further education in science.

Rationale

One of the first problems that emerged from my after school discussions with the students were that they needed help with the vocabulary from class. The students did not have any means to translate many of the terms we used in the class. As such, I needed to find a way to increase their vocabulary, and find other activities that would help them learn and understand the concepts of earth science.

Summary

This action research project has a number of questions and goals to accomplish. Where do these students struggle the most in earth science? What can I do to help these students increase their knowledge of earth science and science literacy? Can these students achieve success with earth science by working with vocabulary?

One of my goals is to find the reasons why many of these ESL students struggle in blended classrooms. Another goal is to find alternative ways to help these students not only in the classroom but also with standardized state exams. In addition, the effects of after school vocabulary review session need to be explored. The last goal is to be able to understand the barriers these students face and how to better teach these students to be successful within earth science.

The ESL students will be taking the unit exams throughout the duration of this study. I will measure success using the individual unit exam scores the ESL students achieve. The exams will also help me to identify what particular subjects the ESL students may struggle with.

Chapter 2: Literature Review

There is an incredible amount of research on instructional techniques for better success of ESL students with regards to attempting new educational concepts to help these students succeed in blended classes. According to Winter (2000), “the steady increase in the enrollment of foreign-born students in American education has led to the adoption of a number of innovative platforms for ESL education” (p. 76). Trying to find new approaches that would be implemented into classes can be difficult, but there needs to be changes made in the way teachers instruct these students so they can achieve success.

According research conducted by Abedi (2002), ESL students do not score as well on achievement tests compared to native speaking students, and the gap in proficiency between ESL students and non-ESL students is greatest on exams that require large amounts of reading and writing using the English language. For instance, ESL students are less successful on English and history exams compared to science and math exams (Abedi, 2002). This is an issue for earth science because the final exam is English intensive. There are numerous questions that require students to read and answer questions from a series of short paragraphs. The multiple choice questions also tend to have a fair amount of reading to understand what the question may be asking. The exam itself is challenging enough with the amount of content that it tests.

Other schools and programs have experienced success teaching ESL students. These programs have been researched to find what makes them successful. Four schools in British Columbia have found success with ESL students. A comparative one-year study of these schools revealed a number of key aspects that set these programs apart

from other ESL programs currently in existence. Interviews were conducted with teachers and administrators in an attempt to determine what makes them successful. Data was also collected with the collections of texts and schedules, policy statements, reception protocols, and descriptions of school activities. The schools and programs were deemed successful based on graduation rates, and the number of ESL students that continued their education after high school. Kouritzin's, (2004) findings indicated that the teachers and the administrators were advocates of resources for the ESL programs. These schools also had ESL students and their families actively participate with the planning, and the program decision-making process. One last aspect was the community support of the ESL programs, which opened doors for the students to take part in a vast amount of community resources. These programs were successful because a number of key components existed, but the most important aspect was that staff and students were both fully devoted to the success of the ESL program (Kouritzin, 2004).

Roessingh, (2002), completed a synthesis and meta-analysis report on schools that have had successful experience with ESL programs based on graduation rates and standardized test scores. One of the reports indicated the five most essential keys to a successful ESL program are administrative support, collaboration between colleagues, increased time exposure with students, direct and explicit learning objectives, and a strong advocacy for ESL students (Roessingh, 2002).

Where do ESL students struggle the most in earth science?

ESL students in English speaking schools struggle with a number of aspects of mainstream education. These problems can begin with ESL students expressing themselves incorrectly in writing. Other problems can occur with specific and difficult

science vocabulary, and difficulty understanding assignments and exam questions (Shakya & Hornsfall, 2004). If students do not understand the vocabulary used in any particular science it is incredibly difficult for them to have a full understanding of specific topics.

One of the goals of all higher education institutions is to have students work towards higher levels of thinking. One of the difficulties working with students who have been previously educated in other countries and are not native to the English language in knowing the levels in which these students have worked at before. If students were not rewarded for higher level thinking skills in their previous schools they are more than likely not going to be able to produce higher level thinking work in their English speaking classes (Dooley, 2004). Understanding the difficulties these students encounter in blended classes can be an extremely difficult task.

One issue that can complicate teaching ESL students in blended classes is identifying ESL students who have learning disabilities. Therefore, it is difficult to provide the proper services needed to help these students succeed (McCradle, Mele-McCarthy, Cutting, Leos, & D'Emilio, 2005).

One of the issues facing science teachers who teach ESL students in mainstream classes is the difficulty of preparing students for the state assessments. One possible solution for helping these students would be to simplify the language on these exams. By assisting ESL students with the language of the exams they can increase their chance of achieving quality scores. This would allow the students to focus on the core content of the classes rather than the English used on the exams. Rivera and Stansfeild (2003) conducted a research project to analyze the positive or negative effects of simplifying the

language on achievement exams. The results showed that some students do not benefit from the simplification of the language because they did not have a need for it to be simplified. Other students that did need the language simplification greatly benefited from the adjustments. Rivera and Stansfeild's (2003) article shows the importance of assessing these students and their English competency levels before they enter into blended science classes. This is yet another reason why it is important for mainstream teachers and ESL teachers to collaborate about each particular student's needs as they relate to that class and the achievement exams.

How can educators help ESL students increase science literacy and their knowledge of earth science?

Trying to improve lesson plans for ESL students in blended classrooms can be a daunting task for any new teacher. Even seasoned veterans struggle with this responsibility. One step that core teachers can make to help this growing population of students is to spend time collaborating with ESL teachers. According to Huang (2004), "people still view literacy and content learning as two separate enterprises" (p. 99). This philosophy needs to change to allow more growth with lessons constructed for ESL students.

While working on the Ontario Literacy Assessments a number of veteran English teachers were paired with ESL language teachers (O'Byrne, 2004). This collaboration began an effort to better help ESL students to be more successful in English speaking classrooms and work towards achieving the English language standards. These teachers were able to better understand why certain students constructed sentences without using Standard English syntax. In the past these students weren't successful in these English

classes because teachers were not giving credit to sentences that weren't properly ordered. After spending time collaborating with the ESL teachers these same English teachers were able to form a number of leveled assessments to help these students progress and work towards proper sentence structure, English syntax (O'Byrne, 2004).

One of the models often considered when trying to prepare lessons that help engage and increase levels of understanding for ESL students in science is cooperative learning. This type of model helps the ESL students build relationships with English speaking or native speaking students and also help them to learn difficult science vocabulary. Small learning groups help students use the vocabulary and language exchanges in comfortable groups (Young, 1996). When using the cooperative learning model a number of objectives need to be considered. One of the most important aspects of cooperative learning that needs to be prepared for is the pairing of the students. There have been many research papers devoted to the benefits of cooperative learning, but one research study conducted by Liang (2004) focused on the opinions of learners. The participants in the study were high school students in Vancouver British Columbia, and data was collected with interviews, observations, and naturalistic interviews. The results varied, but two important aspects of cooperative learning emerged. One of which was the significance of clear objectives for the cooperative learning groups, and secondly the need for positive pairings for students in these classes. Some of the complaints from the study conducted in Vancouver were that the groups were too noisy, and there were often not opportunities for the ESL students to demonstrate their individual abilities to the teacher (Liang, 2004). While using cooperative learning lessons it is important that the students are paired correctly. Not all native speaking students are ready to work in groups

with ESL students. Some English students may feel that they need to do all of the work and just let their ESL partners copy work so the group can finish quickly. Another possible problem scenario may be that English-speaking students do not have a sufficient grasp on the material in order to help the ESL student to learn the concepts. Peer tutoring can be another possible option to help ESL students. Problems may also arise when the peer tutors become confused when ESL students use vocabulary incorrectly or have improper sentence structure that may not properly convey their meaning (Harris, & Silva, 1993).

Aswegen and Dreyer (2004) conducted research with teachers using the teacher-centered vs. student-centered models for teaching ESL students in the blended classroom. The study focused on determining the nature of an ESL teacher's tasks and the extent with which the teacher was implementing the student centered model. The study also focused on the factors which may stand in the way of teachers using the student centered model in their classrooms. The data for the study was collected using questionnaires, interviews, and observations. The first focus of the study revealed a majority of the educators' time was spent with assessments, and preparation, and very little in comparison with student contact and research. The findings also indicated that teachers in the study needed to redesign their ideas of teaching to fit a more student-centered model. Aswegen and Dreyer (2004) also concluded that there is a need for more training and teacher education on the learner centered model to help teachers implement these techniques into their classroom.

Many schools across the country have had success with sustained silent reading (SSR) programs with English speaking students. One study was conducted to determine

the impact of a SSR program with 125 ESL high school students. The students in the program read for twelve to fifteen minutes per day, and were encouraged to also read at home. At the beginning of the 16 week study the students were tested with a Stafford Diagnostic Reading Test, which revealed that the students were reading at just below a fourth grade level. At the conclusion of the study the results showed that 56 percent of the students reported that they enjoyed the SSR reading sessions. A standardized exam at the conclusion of the reading session also indicated that 62 percent of the students felt they significantly improved their reading abilities (Carlo, August, McLaughlin, Snow, Dressler, Lippman, Lively, & White, 2004).

One of the major difficulties facing science teachers is helping ESL students become scientifically literate. A possible solution for science teachers working with ESL students is to write lesson plans that are constructed to specifically teach science literacy. The objectives of these types of lessons should incorporate seeking information, reporting, describing, comparing, classifying, and analyzing different types of information. These objectives will enhance ESL students' understanding of the nature of science (Carrier, 2005). Inquiry type lessons can also achieve these objectives. Lessons which guide students to make observations about particular scientific ideas will help the students understand the nature of science as well as learning science literacy objectives. Science teachers can also create inquiry lessons that have framed sentences for the ESL students to complete. The students can fill in the blanks with science vocabulary and not get stuck with grammatical errors (Carrier, 2005).

Taking notes and summarizing information for students who are ESL learners can be extremely difficult task, and can lead to confusion and frustration. Note taking skills

are extremely important for students to have success in any science class. Summarization of vocabulary can help these students increase success. One technique students can use to summarize information is to create index cards with the vocabulary terms from each lesson as they learn them. Students will also preview the textbook to find pictures and diagrams that may relate to the unit's area of focus. As a class the students will then read the text and highlight the key terms as they appear and identify the main ideas. The teacher will then give the students the summary frames which the students will fill in using the note cards and the highlighted text. These frames can be successful as long as students do not attempt to rush through the early steps of the process. The repeated exposure to the material can aid with ESL students' development of science vocabulary as well as science literacy (Hornet, & Bozan, 2005).

Can ESL students achieve better success with earth science by working with vocabulary?

Previous studies have been conducted in a number of academic settings using vocabulary enhancements for ESL students with a variety of science subjects. One research project involved 254 bilingual and monolingual students in nine different fifth grade classes. The classrooms were in California, Virginia, and Massachusetts. The California and Massachusetts classes mainly involved Spanish speaking students, while the classes in Virginia schools consisted mostly of students from Puerto Rico. Data for this study was collected with a pretest for evaluation of science vocabulary comprehension, and then a posttest after the vocabulary intervention. The vocabulary interventions lasted fifteen weeks and focused on teaching vocabulary and word learning strategies. The students in the study were introduced to twelve words at the beginning of each week, and then instruction was given for 30-40 minutes four days a week. The

instruction during the interventions was focused on having the students generate as many sentences as possible with the vocabulary. The students also completed reading passages with the target vocabulary words within the text, and word associations with the new vocabulary. The results of this study indicated that the students showed significant gains and that the vocabulary interventions can be effective for bilingual and monolingual students (Carlo, 2004).

Using graphic organizers and word charts can also serve as useful tools for teaching ESL students difficult science curriculum units. ESL students can organize the vocabulary as they learn the material. Word organizers can also help ESL students incorporate their science knowledge and their writings skills in order to increase their depth of knowledge of the content material. These tools can help the students construct powerful and meaningful relationships with the vocabulary. One research project involving 35 secondary education students with different language abilities illustrated that students can achieve higher levels of content knowledge through linking and categorizing science content vocabulary. Graphic vocabulary organizers will not only help with content knowledge but they can also help ESL students understand the nature of science and increase science literacy (Huang, & Morgan, 2004).

At the conclusion of earth science courses all students must to pass the New York State Regents Exam. This exam can be extremely difficult for any students that have only been exposed to the English language for a limited amount of time. One possible solution to helping these students throughout the year is using alternative assessments to evaluate the ESL students' prior knowledge before they get to earth science. One study conducted involving ESL students prior to taking a one hundred level Foundation of Biology course

at the college level were enrolled in a 14 week marine environment course. The course in marine environment was designed to give the ESL students' hands on experiences with the concepts and skills needed to complete the Foundation of Biology course. The marine environment course also introduced the ESL students to important biology vocabulary words that they were expected to learn during the course. Data for the study was collected using a pre-assessment exam, and a post-test given after the 14 week course, and questionnaires for students prior to beginning the marine environment course. The results indicated that the students greatly benefited from the marine environment course. The test results also showed that the students had retained a great deal of knowledge they had gained during the course (Feltham & Downs, 2002). This model of assessment and instruction was extremely successful at the college level, and would most likely work at the secondary level of education. One possible model could be a summer school program that could introduce students to earth science concepts with hands on activities. The activities could serve as an introduction to science vocabulary as well as the nature of science.

Another option to help ESL students increase literacy is to teach these students the content in their native language. Programs around the country have used these types of classes to educate students utilizing their native languages before they are enrolled in blended classes to finish learning the content. "A twenty-year debate has divided educators over the question of the use of native language in the education of language-minority children whose English-language skills are not developed enough for regular classroom work" (Porter, 1990, p. 147). In the state of California 25% of its 6 million students are ESL students. This means that there are 1.5 million ESL students enrolled in

schools in the state (Arellano-Houchin, Flamenco, Merlos, & Segura, 2002). In California teachers use this method to pre-teach students in their native language. Once students had an understanding of the material they were moved into a blended class where all of the instruction was in English. Proposition 227 eliminated bilingual education in California, which forced teachers to change their instruction techniques. As a result, students that would have been learning this core material in their native language were now placed in classes where they had to learn the language and the course content. One study that was conducted interviewed teachers in these schools to examine the impact of Proposition 227. Researchers found that teachers had to change their teaching strategies, and training was not provided to help teachers facilitate this change (Arellano-Houchin. et al., 2001).

The ESL population in our New York State schools is growing and more and more students are encountering barriers in a class where English is the dominant language. The importance of educators to address the needs and learning capabilities of these students is becoming more evident. More research needs to be conducted to help these students reach their full potential. Most of the research indicates a few key issues that need to be addressed to help ESL students in blended classes these students are struggling with vocabulary and the difficult words they encounter in science classes. It is important that these students spend more time with hands on tools that will allow them to experience and learn the vocabulary for their particular science classes. Another key aspect that needs to be present is a positive and collaborative relationship between blended classroom teachers and ESL teachers. There needs to be open-ended communication between these teachers to be able to put in place the proper plans that are

tailored to each ESL students needs while in the blended classes. The last essential component is to be flexible while teaching this population of students.

Chapter 3: Applications and Evaluation

Introduction

This study aims to find resolution for helping ESL students understand earth science as well as achieve higher levels of science literacy. This year I have seven ESL students who are taking earth science and are able to participate in my after school vocabulary review sessions once a week. My action research project deals with these review sessions and these seven students. I have focused my research on finding the answers to three main questions; a) what is causing ESL students to struggle in my blended earth science class; b) are there any benefits for after school vocabulary review c) can the ESL students in my classes achieve the better grades in my earth science class?

I teach in an incredibly diverse district with roughly 3,500 students. This district's socioeconomic status is diverse with many students who coming from middle to high income families; 4.6% are eligible for free lunch. The school is also known for the high passing rate on the earth science Regents exam. During the 2004-05 school year 98% of the students that took the exam scored between 55 -100%. The school also has a large amount of students that go on to pursue higher education. In the 2004-05 school year, 73% of the students continued at four year colleges and, 17 % went on the to two year institutions. Four percent of the students have limited English proficiency (University of the State of New York, 2006).

Participants

The students in my classes are mainly ninth graders with a few tenth graders that did not pass the previous year, or took the course as an audit credit. Students who may not be fluent enough with the English language to attempt the course will sit through the

whole year from start to finish but not take the final exam or receive a grade. These students complete all of the labs and the homework while they are auditing, but will only receive audit credit in the grade book. The hopes are that the students who audit earth science will learn the language enough to be able to take the course the following year. My classes also have a wide range of ability levels and learning styles.

The seven ESL students I have this year in my earth science class are two tenth grade students and five ninth graders, three girls and four boys. The ESL students speak a number of different languages. Four of the students speak Chinese, one of the students is from India and speaks Tamil, another from Korea and speaks Korean, and the last from the Philippines and speaks Taglog. Each of these students had been in the country between 2-4 years, and has limited language abilities. All of the students also come from homes where the first language at home is their native language. Each of these students receives test modifications and services with the ESL teacher in the building. For fifty minutes each day these students work on English language skills. These students also received extended time and alternate test modifications with the ESL teacher.

I have been teaching earth science for two and one half years. I completed my bachelor's degree in Geology from SUNY Potsdam in 2001. That fall I began a job in the district where I currently teach as a teaching assistant with the special education department. While working as a teaching assistant I began my masters in Secondary Science Education at SUNY Brockport. I began teaching earth science in the spring of 2004. The students I have this year represent the second group of students I have worked with for an entire academic year.

Procedures of Study

Since the second half of the school year I have been meeting once a week with the seven ESL students. I conducted after school vocabulary interventions for 90 minutes each week. The review sessions were not mandatory but the students all attended every time we had a scheduled review. On two occasions one of the students needed to leave early and only was at the review for thirty minutes. These sessions started with the students asking questions about the work that we were completing in class and/or lab. This portion of the review usually lasted ten to fifteen minutes depending on the difficulty of the topic. After I had answered all of the questions we would then begin to review the vocabulary of the unit. Each individual unit has a list of vocabulary words that are covered and students are required to learn. For each of the words I would either draw a diagram, or actually show them a physical example of the word. For example using the smart board and modeling the vocabulary term rock cycle I would draw the actual cycle and label the specific sections. After all of the vocabulary words had been covered we concluded the sessions by using the classroom smart board and completed past earth science Regents questions from an online database. Each of the students would take turns writing on the board and answering the questions from the database.

Instruments for Study

The research used data which was collected through the use of surveys distributed to the ESL students (see Appendix A). The surveys focused on determining what the students struggled with the most in earth science, and what they needed the most work with during the after school review sessions. The first eight questions were created using a 5-point Likert scale, and the last three questions were free response.

Table 1

Questions from survey

A.) What is the most difficult topic you have encountered while taking earth science?

B.) Where do you find the most difficulties while taking earth science?

With question (A) I was trying to determine what topics the students were finding the most difficult. With this information I was able to focus my reviews and determine if the vocabulary intensive units were the most difficult. With question (B) I wanted to understand which portion of the earth science course the students found most difficult. The course has numerous components. For example, there is the lecture, lab, testing, and homework. I needed to understand which of these components could be modified to help the ESL students.

The survey questions I gave the students focused on trying to determine where these students thought they struggled most with earth science. Each of the seven students completed the survey at the beginning of one of the after school review vocabulary sessions. The surveys took the students fifteen minutes to complete. The survey had two parts the first eight questions were answered on a 5-point Likert scale while the second component contained three extended answer questions (see Appendix A).

Within the three extended answer questions of the survey, the first question focused on determining how many years each of the students had been exposed to the English language. It was important to consider how long these students have been using the English language before after school reviews began. The other two questions on the

survey focused on discovering what topics were most difficult for the ESL students, and what other difficulties the students may have had with earth science. These questions were important for this action research but also for focusing the reviews sessions for the final exam.

Additional data for this project was collected while making observations of the students while they worked together after school. The ESL students were in small groups at one table making it very easy for me to make observations while they worked with the vocabulary and explained a number of different concepts to one another in their own language. Using the smart board and the question bank of old Regents questions I was able to see the students read through the problems and then think their way to the answer.

Chapter 4: Results

Data Analysis

A statistical analysis of the ESL students test scores before and after the reviews were compared to their native speaking classmates. The data was used to evaluate the effectiveness of the after school review sessions on students individual test scores.

The data collected from the surveys proved to be incredibly helpful for planning the after school vocabulary review sessions. The data indicated that 4 out of the 7 students found class exams to be difficult. For the question that related to the difficulty of the lab activities, only 1 of the 7 students agreed with the statement that the labs were difficult, the rest of the students felt that the labs were not difficult. All of the students that have been through elementary school in other countries with extensive math programs and being that many of the labs are math intensive, excelled while completing math questions on earth science labs. One question asked students if the earth science vocabulary was difficult to translate into their own language. The results indicated that 4 of the 7 participants did agree it was difficult to translate into their own language, with one student who strongly agreed that vocabulary translation was difficult. The remaining two students were neutral regarding vocabulary translation. Student responses to these questions coincided with responses to short answer survey questions that asked students to explain what they found most difficulty while taking earth science. Answers to this question indicated that 6 of the 7 students felt vocabulary was the most difficult aspect of earth science. One question that asked the students what topic was the most difficult with earth science indicated that the students felt that the rock unit fell into this category. In fact 4 out of 7 students felt the rock unit was the most difficult. Also 2 of the 7 students

thought the weather unit was equally as difficult. Both of these units of the earth science curriculum are vocabulary intensive. These units require the students to memorize a number of different characteristics about rocks, and atmospheric conditions in order to be able to answer the exam questions. The ESL students from my classes do struggle more with units that are vocabulary intensive because of the difficulties they face with the English language.

While the ESL students worked together in the small group to review vocabulary and practice review questions on the smart board I was able to make a number of observations that will eventually lead to a future study. The students that spoke the same first language were able to read questions in English and then explain how to solve the problems to their peers that spoke the same first language. This method helped same language students to be able to find numerous understandings about the material that they had previously struggled with. Students who did not speak the same language were always willing to help the other students using English when ever they struggled with more difficult problems. These students were also genuinely excited about finding new understandings of vocabulary words and enjoyed teaching their peers.

The last observation I was able to make throughout the after-school review sessions was that students were able to make connections with the vocabulary words when they were able to see the actual physical representation. The ESL students enjoyed using the earth science manipulative materials. Using words that did not lend themselves to hands on learning I was able to find images on the Internet that represented those same words. Through my observations I was able to see the importance of discussing each

vocabulary word using the hands on models or images so the students could make valuable connections.

Statistical analysis was used to compare two exams completed by the ESL students and a class of 23 English speaking students. The first exam that was analyzed was completed during September of 2005, the first month of the earth science course. The second exam analyzed was completed by all of the students in February of 2006. This test was one month after the review sessions for the ESL students had begun. The mean exam scores as well as standard deviation, and mean z-scores are located in tables 2 & 3. The test scores and z-scores are located in tables 4 & 5.

Table 2

Pretest Results

	<u>Mean Exam Score</u>	<u>Standard Deviation</u>	<u>Mean z-scores</u>
ESL Students	56.8	12.9	-1.1
Entire Class	74.1	15.6	N/A

The mean score for the entire class on the pretest was a 74.1% while the ESL students mean score was a 56.8%. The ESL student's z-scores ranged from -2.1 to +0.4. The standard deviation of the mean for the pretest was 15.6 points. The mean of the student's z-scores was calculated to be -1.1. Looking at the mean z-score of the ESL students tests indicate that the ESL students scored 15.6 points lower on the exam compared to their entire class.

Table 3

Post test results

	<u>Mean Exam Scores</u>	<u>Standard Deviation</u>	<u>Mean z-scores</u>
ESL Students	66.8	10.3	-0.5
Entire Class	74.1	15.6	N/A

The mean score for the post test for the entire class on this exam was a 73.6%, while the ESL students mean score was a 66.8%. The z-scores for the ESL students ranged from -1.1 to +0.9 compared to the standard deviation of the class which was 14.1 points. The mean of ESL student's z-scores was a -0.5. The ESL students did receive better grades but the marks were still lower than their personal expectations. The low mean z-score number indicated that the ESL students post test scores averaged half a standard deviation lower compared to the entire class. However, this number marks an improvement for the ESL students.

The ESL students did receive better test scores on the exam that took place after the after school review sessions had begun. As a group they improved their mean test score by ten points. The entire class' mean score remained unchanged for the two exams, while the ESL students were able to decrease the gap between themselves and the rest of the class. The mean of the ESL student's z-scores on the post test was six tenths better than their mean z-score on the pretest that was taken at the beginning of the year. Not only was this an improvement but the ESL students were able to achieve marks that were closer to the marks of their English speaking classmates.

Table 4

Pretest scores

Test scores

ESL students

41 55 59 52 80 54

ESL students & native English speaking classmates

41 55 59 52 80 54 80 67 90 43 83 72 96 82 96 82 96 72 85 78 90
74 80 74 80 69 70 87 78 85 52

ESL student z-scores

- 2.11789 -1.22131 -0.96513 -1.4136 0.379866 -1.28536

Table 5

Post test scores

Test scores

ESL students

62 65 67 58 87 62

ESL students & native speaking classmates

62 65 67 58 87 62 76 76 96 56 64 78 93 89 90 67 80 91 91 65 82
93 42 73 69 73 69 73 69 73 47

ESL student z-scores

-0.82022 -0.60784 -0.46626 -1.10339 0.949598 -0.82022

Chapter 5: Conclusions and Recommendations

Discussion

Before starting this project I was unable to help ESL students achieve the grades they worked so hard toward in my classes. I often would spend extra time with them during lab and class activities trying to explain the directions and help these ESL students work through difficult problems. This action research project has shown me a number of strategies to help these ESL students be successful with earth science.

The statistical analysis of the pretest and the post test showed gains that the ESL students made after attending the review sessions. The mean exam score for the ESL students improved by ten points while the entire class maintained the same mean score. The mean of the z-scores for the ESL students decreased indicating that the score of the ESL students were getting closer to their English speaking classmates. This data proves that the after school review sessions are helping the ESL students achieve better exam scores.

The surveys administered in this study helped me comprehend a number of different views the students had about the earth science course that I had not previously understood. The ESL students did not feel the labs were difficult, but they did feel they had difficulties working on the earth science exams. The survey also indicated that these students felt that the most difficult units with earth science were the rocks and the weather unit. This may prove to be extremely helpful when I begin to set up the end of the year reviews for the final exam and perhaps future school year plans. I also was able to structure my after school vocabulary review sessions to focus more on unit vocabulary and less with mathematic portions of the specific units.

The observations I made during the after school vocabulary review sessions made me realize there is more that can be done to help ESL students in blended classrooms. I observed these students helping each other with their native languages as well as working through the English language to help their fellow students understand difficult problems. Through these same observations I have a new goal for the future which is to help develop an ESL peer tutoring group. The students who are a part of the after school review sessions this year could gain enough earth science background and science literacy to be able to help the ESL students that will take earth science the following academic year.

Action Plan

I have also realized that there is more work to be done. I need to continue with the after school review sessions, because in the short time since the reviews have began, the ESL students who have been involved have seen moderate success with their exam scores. I have also observed the knowledge they have gained with the after school review sessions on their labs and their class work. In addition, I need to work with the ESL teacher to begin to put in place a similar program for next year to help the incoming ESL students. I want to begin the peer tutoring group for the new ESL students, as well as continue with vocabulary review sessions. The after school review sessions are helping but there is more work to be done to really help these students achieve science scientific literacy, and achieve the grades they are working towards in earth science.

The findings of this study have been shared with my team of earth science teachers who also teach blended classes. I have also shared the results of this study with the ESL teacher who teaches in the same building. The ESL teacher agreed with my

conclusions and was willing to begin working together to create a peer tutoring group. The results of this study were also shared with my department administrator who had followed this project from the beginning and was excited about the work I was doing with this particular group of students

Recommendations for Future Research

In the future I am going to continue to monitor the ESL student's success on exams in comparison with their English speaking classmates. In addition to monitoring these exam scores I am also going to give the students an exit survey. The review sessions are helpful but will always be a work in progress. It will be important for me to monitor the views of the students so the review sessions can be modified for next year to help the new ESL students in my classes. I am also going to complete a statistical analysis to compare the ESL student's midterm exam scores to the final exam scores as well as a comparison between the ESL students and the rest of the students in my classes. This project really began after the January midterm examination. At the end of this school year I will be able to see more conclusive data with regards to the effectiveness of the after-school reviews. To ensure that this action is going to be carried out I need to keep at least one afternoon per week free to meet with ESL students that want to work with vocabulary as well as having use of a classroom smart board. I also plan to study the effects of an ESL peer tutoring group on earth science exam scores for the following academic school year.

Summary

I have come to the realization through this study that these interventions can be successful, and that the topics within my curriculum that are more vocabulary intensive

require more time during the interventions. I have also discovered that ESL students can greatly benefit from discussion of the topic using their own language. This is a preliminary study that will have positive outcome for the way I help English as a second language students in my classroom. I have been spending a lot of time with this group of students every week after school and I have enjoyed being able to see the success with their grades and their overall understanding of the subject matter.

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Appendix A

Survey Questions

Code Number: _____

Date _____

1 = Strongly Disagree

2 = Disagree

3 = No strong feelings either way

4 = Agree

5 = Strongly Agree

Earth science exams are difficult	1 2 3 4 5
Earth science labs are difficult	1 2 3 4 5
Class instruction is hard to follow	1 2 3 4 5
I enjoy earth science labs	1 2 3 4 5
Earth science homework is difficult to complete	1 2 3 4 5
School Island assignments are difficult	1 2 3 4 5
Earth Science vocabulary is difficult to translate to your first language	1 2 3 4 5
I enjoy learning about earth science	1 2 3 4 5

1.) How many years have you been exposed to the English language?

2.) What is the most difficult topic you have encountered while taking earth science?

3.) Where do you find the most difficulties while taking earth science?