

Rothstein, J. Meeting Learning objectives: Using an Alternative Text (2008)

This study examines the effects of using an alternative science text by seven sixth grade English as a Second Language (ESL) students for a specific unit. This was compared to the use of the mainstream text by eight other sixth grade ESL students. The students' reading comprehension skills were evaluated through their results on the Measure of Academic Progress. Questionnaires and interviews along with text analysis and student assessments were used in this research. The opinions and experiences in teaching ESL students of two science teachers are also assessed in this analysis. This project revealed that by giving sixth grade ESL students access to science text material that was closer to their comprehension ability than the mainstream text, they were able to meet the learning objectives of the lesson more successfully.

MEETING LEARNING OBJECTIVES: USING AN ALTERNATIVE TEXT

by

Joseph Rothstein

A Capstone submitted in partial fulfillment of the requirements  
for the degree of Master of Arts in English as a Second Language

Hamline University

Saint Paul, Minnesota

August 2008

Committee:

Ann Mabbott

Anne DeMuth

Brian Erlandson

To my wife Shelley for her patience, support and continuous encouragement and to my children Elijah, Elizabeth, and Nathaniel who were my main source of distraction and motivation.

## TABLE OF CONTENTS

Chapter 1: Introduction.....	1
Chapter 2: Literature Review.....	7
Learning Science.....	7
Language of Science and Using Science to Learn Language.....	9
Educational Background of ESL Students and the World View of ESL Students.....	11
Attitudes and Tasks of Science Teachers.....	15
Language of Science Textbooks and Adapting the Language of Textbooks .....	18
Chapter 3: Methods.....	21
Methodology and Rationale.....	22
Subjects and Setting.....	23
Measures of Academic Progress.....	24
Instruments and Procedures.....	25
Chapter 4: Results.....	32
Student Feelings About Learning Science.....	32
Teacher Interviews.....	36
Text Material.....	38
Post Test.....	43
Chapter 5: Conclusion.....	45
Appendices	
A. Student Questionnaire.....	52
B. Focus Group.....	54

C. Preparation for Teacher Interview.....	56
D. Teacher Interview Questions Pre Modification.....	58
E. Teacher Questions Post Modification.....	60
F. Post Test.....	62
References.....	65

## List of Tables

Table 3.1: Comprehension Level Ranges.....	25
Table 3.2: Number of Students at Each Comprehension Level.....	25
Table 4.1: Results from Student Questionnaire.....	33
Table 4.2: Results from Readability Assessments.....	42
Table 4.3: Results from Post Test.....	45

## CHAPTER ONE: INTRODUCTION

Since they need to learn in a second language, English as a Second Language (ESL) students face more challenges in school than the average student. In spite of these challenges, they are still held to the same academic standards as every other student. They are asked to try and keep up in a setting that struggles to make accommodations or modifications for the fact that the language of academics in the United States is not their first language.

One of the main subject areas that U.S. schools focus on and insist on proficiency in is science, a subject where students are expected to learn a wide arrange of specific vocabulary and language structures as well as learning how to think in a manner far different than every other subject that they are being taught in school. Furthermore, ESL students are often expected to be able to learn science without adequate access to the background knowledge that they need to be successful. Many of these students have not had any formal schooling before coming to the United States, which leads to their not having the necessary science education experiences for learning grade level material. The science textbooks and other resources that are available for students the majority of the times are not at an appropriate language level for ESL students.

As educators we are not here to make the learning process more difficult. Quite to the contrary we should be working to make it easier, more efficient, and more effective. This study will explore to what extent an alternative text helps ESL students learn science. There are five main objectives that I have in doing my research:

- (1) To determine how the group of students that I work with felt about learning science in general, with and without alternative text material;
- (2) To find out what main learning objectives are the most essential when the students are learning the unit “Seeing Light”;
- (3) To learn about science teachers’ experiences in working with ESL students.
- (4) To determine what language structures are used in the writing of the unit that might get in the way of the ESL students’ comprehension of the text material;
- (5) To find out if the students who had access to an alternative text while learning the unit scored higher on the end of unit assessment than students who did not have access to these materials while learning the unit.

I have been teaching ESL in a large middle school in the Upper Midwest for the past nine years. In my experience teaching in that middle school, it has become very evident to me that our ESL students’ needs are not being adequately met when it comes to science education. During the school day these students are scheduled for an enrichment/support class that I teach. In that class, I see first-hand the problems that my students are facing with their understanding and comprehension of science. They get frustrated and give up easily because they have not been taught any types of skills with which to work through this material and they do not have access to materials that are at their instructional level. From text analysis, I have been able to determine that none of the materials that they have access to are well suited for their English proficiency level. The sixth grade textbooks are written at grade level, they are still above my students’

reading ability. Their language structure is not at all designed for ESL students. The supplemental science materials are also a constant source of frustration for ESL students.

Trying to figure out how to deliver content effectively to these students often frustrates the science teachers. They are at a loss as how to deliver the material in a way that the students will comprehend the necessary objectives and find the instruction useful. Teachers need to adapt tests, assignments, labs, and other items so that the information is accessible to the students (Colburn & Echevarria, 1999). Teachers do not know where to look to find differentiated reading material suitable for these students. Often, all they are doing to modify their material is simply reducing the requirements of an assignment or test. However, decreasing quantity will not ensure that ESL students are learning a specific concept. It seems that all decreasing quantity does is leave the students at an even greater deficit as to what they are required to learn

Because I am the ESL teacher, mainstream teachers often turn to me to modify and adapt the materials for an area of education in which they are the experts. They forward tests and assignments to me so that I can work on them with the students during the students' enrichment/support class. Even though students are enrolled in a support class, it should still be the responsibility of the mainstream teachers to make student ability level changes to their lessons. I should only be there to support them and assist them to ensure that the academic language needs of the ESL students are being met. I can also work with science teachers to find other sources of content material that are more appropriate for the students' academic language needs. One of my roles as an ESL teacher is to help all of the teachers in our building reach our ESL population.

As time passes, the graduation requirements continue to grow. With the No Child Left Behind Act, ESL students are being held to a higher standard than they were even a few years ago. In step with the federal laws, the state of Minnesota is raising the bar for students in this state. The subject of science is the next one that will soon be part of the Minnesota Basic Standards Tests (MBST). The state Legislature approved a new law in May 2004 that increases the rigor of the current academic standards in science (Erickson and Seagren, 2004). The higher the standards are, the more challenges ESL students face when it comes to being successful in school. Teachers are also being forced to increase the standards in their teaching without getting the necessary support to do so. How can all of this be expected to happen if the parties are not given suitable tools with which to work?

Every day I continue to see the students struggle and the science teachers growing ever more frustrated; as a language expert I would like to see what I can do to help alleviate some of this problem. By making available differentiated materials as well as other essential resources that are written in a manner closer to the language ability of these students, wouldn't they start to learn and truly understand more of what is expected of them? It will also work as a means to help science teachers accomplish their goals in delivering content, ultimately making it more accessible to ESL students.

Making available differentiated materials may impact ESL students and science teachers in many positive ways. For students it may allow for a better rate of content comprehension, which would eventually lead to fewer gaps in their learning, which may ultimately lead to greater academic success. The students would be less likely to miss out on concepts that are prerequisites for future learning of science and it could give them the

skills they need to make reading science texts easier by making them familiar with the nontechnical vocabulary and sentence structures commonly used in science texts (Sutman, Allen, and Shoemaker, 1986). Differentiated materials ideally could lead to increased classroom participation, decreasing the amount of unproductive time in their science class.

Science teachers could be taught how to find and put together differentiated materials to better meet ESL students' needs. They could also be given these resources for one key unit that they teach each year. Having access to differentiated materials will allow students to focus more specifically on the main concept being taught. The students will be able to concentrate on the main objectives that the teacher has identified. Ideally having these materials available could cause the teachers to feel more effective in their teaching, hopefully making concepts understandable to all students.

By helping science teachers arm themselves with this information, they are less likely to perceive ESL students as a burden. It may also help the science teachers better understand that English language learning should not be seen as a weakness, a sign of inferiority, or that ESL students are not as smart as others in their classrooms. This knowledge could help them to overcome these misconceptions.

In doing my research on this topic I found there was little information that addressed the issue of offering ESL students an alternative text for learning science. I do not believe that the issues surrounding what is best for these students while they are learning science have been adequately explored. It is my goal to better understand some of the important issues surrounding this topic. By doing this I will hopefully be able to do some things in my school to increase the level of science learning.

In the next four chapters I will be trying to answer the question: To what extent does an alternative text help ESL students learn science? I will do this by discussing some recent literature on the topic in Chapter Two. Chapter Three will go on to outline the methods that I used to answer my research question. Chapter Four will look at the results of my research and how they speak to my question. In Chapter Five I will then summarize my research and discuss what this research may mean for sixth grade ESL students and their science learning.

## CHAPTER TWO: LITERATURE REVIEW

This chapter will summarize some of the recent literature that discusses several aspects of my topic. The first section will look at ESL students and their relationship to

learning science. Next I will look at the impact of ESL students' educational background and how it affects learning. I will then be looking at these students and their relationship to science teachers, where I concentrate on the effects of teachers' personal background toward learning and teaching. The following section will discuss some of the commonly accepted strategies for effective science teaching for ESL students. Finally I will look at the issue of academic language as it relates to science. The review of this information will hopefully lend some insight as to how to best determine what alternative text materials need to be developed or identified by ESL teachers and science teachers to help ESL students master the science content unit "Seeing Light."

### Learning Science

There are a number of learning strategies that students need to learn and comprehend science. According to Chamot & O'Malley (1986) these strategies fall into one of three areas: metacognitive, cognitive, and social/affective and are explained below.

#### Metacognitive Strategies

The major metacognitive strategies--where students plan, monitor, and evaluate their learning, which they should know how to use are—*advance organization* and *selective attention*. For *advance organization* they need to know how to ask: What is my purpose for solving a problem or doing an experiment? What is the question being asked? and What will I use the information for? When it comes to *selective attention* they need to ask and understand, What is the most important information to pay attention to?

#### Cognitive Strategies

The most important cognitive strategies—where students interact with the information to be learned, changing or organizing it either mentally or physically—that ESL students need to be able to use are *elaborating prior knowledge*, *resourcing*, *taking notes*, and *making inferences*. To be able to *elaborate prior knowledge* they need to know how to ask: What do I already know about the topic or type of problem?, What experiences have I had that are related to this? and How does this information relate to other information? When it comes to *resourcing*, they should ask, Where can I find additional information about this topic? Encyclopedia? Science book? Library? When learning how to *take notes* they should be asking, What is the best way to record or summarize the data? Table? List? For *making inferences* they should know how to ask themselves, Are there words I do not know that I must understand to solve the problem?

#### Social/Affective Strategies

The chief social/affective strategies—where students interact with others to assist learning, or use attitudes and feelings to help their learning; they should know are *questioning for clarification*, *cooperating*, and *self-talk*. When *questioning for clarification* they should be able to ask themselves: What help do I need? Who can I ask? How should I ask? When it comes to *cooperating* they should ask How can I work with others to answer the question or solve the problem? As a part of *self-talk* they should say to themselves, Yes, I can do this task—what strategies do I need?

#### Language of Science and Using Science to Learn English

To address some of the gaps that ESL students have in learning strategies and study skills, Carrasquillo & Rodriguez (1996) point to four general language principles that should be applied to instruction in all content areas. First is that vocabulary and technical

terms should be explicitly taught. Second, language functions, such as explaining, summarizing and classifying must be incorporated into the class and emphasized as part of effective teaching. Third, different content areas have different language structures and discourse features, which can impede the academic performance of ESL students and need to be made clear. Finally, there are different language skills, such as listening for academic explanations, reading for specific information, or writing reports, that must be highlighted in the classroom for different educational purposes. Many ESL students have not mastered these and need direct instruction in these skills. Carlson (2000) states that all students, including ESL students, benefit from a curriculum that emphasizes the teaching of concepts in depth and focuses on process and critical thinking skills. Although these principles are not exclusive to ESL students, it is imperative that they are also applied in classrooms with ESL students in them.

Academic subjects, such as science, have a linguistic register—norms and patterns of language use essential to the practice of the discipline (Halliday, 1978). The science register uses academic language functions that include formulating hypotheses, proposing alternative solutions, describing, classifying, using time and spatial relation, inferring, interpreting data, predicting, generalizing, and communicating findings (Chamot & O'Malley, 1986). ESL students generally have not developed the skills needed to access these academic language functions by sixth grade, so they need to be exposed to them as soon as possible when they enter middle school. This will help ensure that they can get caught up in their ability to learn and understand science as well as help get them up to grade level with language proficiency. As Casteel & Isom (1994) and Lee & Fradd (1998) indicate, the development and use of language functions such as

describing, predicting, hypothesizing, reasoning, explaining, and reflecting, are equivalent to the process used in learning science, thus conveying these language skills to ESL students is key.

The idea of learning language to help in science learning is further supported by Stoddart, Pinal, Latzke & Canaday (2002) when they described the relationship between learning science and language learning as being complementary to each other. Through the use of language in science inquiry, students develop and practice complex language forms and functions. By using language functions such as description, explanation, and discussion in inquiry science, students improve their understanding of the main concepts. Once the foundation for these skills is put into place, it can start to lead ESL students to become better critical thinkers.

Science provides a context in which students can develop reading and writing as well as math skills. As Amaral, Garrison, & Klentschy (2002) point out, students need a content area such as science to apply their reading, writing, and other thinking skills. It seems like a very practical choice of content areas to choose to help ESL students develop their academic English. O'Toole (1992) explains that science enjoys a high status among students. It is seen as something real, useful, and important, and therefore science may be a good vehicle for learning language.

One of the best ways to teach the content and language of science is to engage students in activities that promote verbal interaction and collaboration, or interactive science teaching (Simich-Dudgeon & Egbert, 2000). Even science teachers who do not have any type of ESL training can increase their awareness about the differences between language and content demands of the science curriculum and the language and content

knowledge of their students. For successful instruction of science and language, instructors need to identify the types of cognitive tasks that students are called on to perform in their second language. Tasks with higher-level demands, such as analysis, synthesis, and evaluation, can be required of ESL students, but they also represent important intersections between language and content (Cummins 1989; Collier 1995). In addition to creating the most favorable environment for learning and providing students with appropriate scaffolding to ensure success, cognitive psychologists, as well as many linguists, suggest that teachers teach language, thinking and subject matter simultaneously (Beyer, 1998). Science teachers need to be given the support to help bring together the important elements of science with the language instructions that all ESL students need.

#### Educational Background of ESL Students and the World View of ESL Students

Although learning science is a challenge for most students in our schools, it is challenging in a whole different way for ESL students. Even students with intermediate to advanced communicative competence in English are generally not prepared with the language skills necessary for success in the science classroom (Buxton, 1998). Academic content is especially difficult for English language learners because of the two dimensions involved: (1) the context-reduced, or abstract, nature of most academic language and (2) the actual complexity of the cognitive task (O'Malley and Chamot, 1990). For the majority of ESL students, both the content and academic language introduced to them in science are new. Teachers from both the science and ESL areas need to find ways to help them overcome these additional challenges. Teemant, Bernhardt, Rodriguez-Munoz, & Aiello (2000) state that if ESL students have not had a

positive science experience by the time they are through middle school, teachers have missed an opportunity with them to become engaged in science and if too much time goes by, it is very difficult for second language learners to make up for the content they miss.

Cummins (cited in Herrell, 2000) differentiates between social language (basic interpersonal communication skills [BICS]) and academic language (cognitive academic language proficiency [CALP]). BICS is language that is easily available through social interaction and that helps students to ask or answer simple, low-level questions. However, to succeed in school, ESL students must achieve CALP, the level of language proficiency necessary to benefit fully from academic English instruction. Cummins has also identified what needs to be added to instruction to make it comprehensible for students with diverse language backgrounds. He identifies two dimensions of language: cognitive demand and context embeddedness. He indicates that content instruction needs to be high in cognitive demand, even for students who have low language proficiency. The addition of context supports the students' understanding of more cognitively demanding language, such as language of content instruction in the classroom. ESL students need proficiency-appropriate science material to ultimately move their development in learning English. For this progress to happen, they must have the content material at a level that is comprehensible to them.

Another aspect of their learning that must be addressed is that students have a very difficult time learning content concepts that are abstract. ESL students have far less background knowledge from which to work from, making abstract content concepts even more difficult to grasp. For optimal instruction, the students need to be able to put

concepts together in a manner that is meaningful and tangible to them. In order to make instruction meaningful and tangible, Gibbons (2003) points out that science material should be presented in a manner that allows ESL students the opportunity to construct knowledge through concrete experiences such as advanced organizers, cooperative-learning activities, graphs, tables, illustrations, and interactive writing.

As ESL students come to sixth grade, they are usually still not at grade level in how they are able to learn academic subject areas. Buxton (1998) states that in middle school, these students not only need help in the development of their academic language skills but they also need explicit instruction in how to learn academic content. However, these students are seldom given adequate opportunities to develop effective learning strategies and study skills. Students who have spent significant time in pullout ESL programs also frequently have gaps in their subject matter knowledge when compared to mainstream students at the same grade level. These gaps can be due to the nature of the ESL program in which the students have participated in and/or the students' educational background before entering schools in this country (Buxton, 1998). With the apparent shift from pullout ESL to inclusion programs in elementary schools, one part of this gap may be overcome partially due to changes in the program model. The other parts may never be fully overcome on the front end as students continue to join our schools from other parts of the world, often with limited schooling. By not offering ESL students equal access to the more challenging academic subjects, we are continuing to put them at a disadvantage in their overall ability to be successful in our education system.

Another aspect to address in the difficulty that ESL students have in learning science is that cultural differences may also lead them to produce alternative hypotheses

and interpretations than those expected by the teacher (Simich-Dudgeon & Egbert, 2000). These cultural differences may lead to student views that are not in sync with scientific concepts. Peacock (1995) points to studies that show that children begin school with a wide range of ideas about scientific ideas, and these can persist even when contradictory experiences are provided. And so many of the concepts, when presented in a second language such as English, are inaccessible to pupils, not only because of their difficulties of comprehension but also because different languages often do not have comparable concepts or terms equivalent to the concept in English. Finally, ESL students may also differ in their level of mathematical knowledge, which is important to consider because science experimentation requires a good understanding of mathematics skills like counting measuring, comparing, estimating, approximating, and solving equations (Cantoni-Harvey, 1987). Therefore, math may also need to be taught in the science lesson.

#### Attitudes and Tasks of Science Teachers

The relationship between ESL students and their mainstream teachers is crucial to help to ensure more effective teaching and learning. The ability of the teachers to understand some of the issues that second language learners face is a link to allowing the students the opportunity to better understand the class material. The life experiences of a teacher will also have an impact on this rapport. Pajares (1992) gives further background about research in the area of teacher beliefs that shows that teachers' beliefs may be a stronger predictor of behavior than knowledge when a teacher implements a designed lesson, including the organization and definition of tasks associated with the lesson.

Petterman (1993) and Tobin (1993) reviewed the research on teachers' thought processes and indicate that the beliefs teachers hold about teaching and learning, including beliefs about their students, have a significant influence on the teachers' behavior. For teachers, decisions and actions regarding educational practices depend on and are guided by both their beliefs and their knowledge (Abell & Roth, 1992; Brickhouse, 1990; Bybee, 1995; Clark & Peterson, 1986; Pajares, 1992; Pomeroy, 1993). Wherever science teachers are coming from, their personally held beliefs and values are going to have an enormous impact on what is going on in their classrooms. These beliefs should be influenced by those who are trained, skilled and have experience in working with these students; ESL teachers need to help these teachers further develop their understanding and beliefs about ESL students. An accurate sense of the students' cultural backgrounds and ideas of second language acquisition must be imparted to mainstream teachers. If teachers have an accurate knowledge of these things, then they can best meet the ESL students' needs in their classrooms.

Science teachers should be aware that ESL students have difficulty with the discourse, text structure, language functions, and extensive vocabulary of science. Even though these students may have developed the ability to communicate socially with peers and others in their homes and communities, their academic language skills may be far below grade level. This lack of academic language is further challenged by science texts and tasks. This may be in part because science texts make it difficult for ESL students to identify the facts. For example, science texts develop concepts and skills through the use of argumentative, procedural, and descriptive genres and use different fonts, font sizes, colors, pictures and graphic organizers to signal the organization and the importance of

concepts and skills. Because these graphic elements involve so many signals, they can be confusing for those not used to them. In addition, the grammatical structure of scientific texts—frequent use of passive voice, sentences with multiple embeddings of dependent and independent clauses, complex noun phrases and structures like “if...then...” that indicate causality—may be different for students who are learning English (Simich-Dudgeon & Egbert, 2000).

To determine what type of teaching strategies to attempt to use with ESL students, teachers need to take in to account many different factors. In my experience, science teachers need support as to when to use which strategies while they are working with ESL students. My focus is to look at finding more effective text resources and appropriate strategies for science teachers to use with the ESL students that will better meet their academic language needs.

One of the primary instructional goals of science education for culturally and linguistically diverse students should be to make clear to students the ways of knowing, communicating and valuing in science, while at the same time exploring alternative scientific world views and the contributions of diverse cultures to the body of scientific knowledge. Science teachers should include a focus on inquiry and explanation and the corresponding discourse skills and patterns (Buxton, 1998). When ESL students start to see the connections between science and the world that they already know, their ability to learn science more effectively will increase. Good science teaching, whatever else it may require, links inquiry into science with inquiry into the diversity of children’s ways of talking and knowing, in an ongoing, routine fashion (Bodwell, 1998). It is imperative for science teachers to factor in the full background of ESL students. None of these

influences can be overlooked even when teachers have the most appropriate text material available to the ESL students. To support the necessity of connecting science to students, Linn (1992) gives some suggestions on science curriculum for culturally and linguistically diverse students:

Such a curriculum would: (a) help students construct personal understanding of what they are taught, rather than simply absorb information; (b) identify models of scientific occurrences that both address everyday problems faced by students and build a firm foundation for subsequent science courses; (c) cover topics in depth so as to minimize students' reliance on memorization strategies...; (e) make proper use of technological tools, such as computers, that can enhance science education reform. (pp.830-832)

It is clear that there need to be ways for science teachers, with the support of ESL teachers, to make science content comprehensible for all of the ESL students and to connect what the students bring to the classroom, educationally, culturally, and linguistically, to what is being taught.

#### Language of Science Textbooks and Adapting the Language of Textbooks

One of the most challenging aspects of science learning for ESL students can be the text material that they are given access to. In my experiences I see that they are usually given texts that are written three to four grade levels above their reading comprehension ability. They are expected to sort through this information and at the same time try to pick up on the key science concepts. Cummins (1983) identifies three dimensions of text material: (1) abstract-non-abstract; (2) elaborated-situated; (3) informational-involved. He has pointed out that written science text material is highly

literate in relation to these dimensions, and therefore makes more demands on learners, particularly second language learners. It is important to find ways to use texts, as they are an important part of the learning process. Peacock (1995) suggests that science learning involves acquiring and using a wide range of concepts which are often not a part of children's everyday experience, and which are only encountered in school science lessons through text. ESL students still need to be exposed to this wide range of concepts and finding the text material that meets their language needs is a large part of the challenge.

Grammatical forms and structures in written science texts become increasingly complex in higher grade levels. Use of the passive voice, multiple embeddings, long noun phrases serving as subjects or objects in a sentence, if...then constructions, and other expressions indicating causality are some of the features of language that may make science texts difficult for ESL students to understand. An example of a difficult structure is the following: "Growing a new plant from a part of another plant is called vegetative propagation." In a sentence like this, the student must read to the end to notice that the noun phrase which acts as the subject of the sentence is in fact a definition for a new term (Chamot & O'Malley, 1994).

A common practice is to simplify the text material by reducing the amount of the reading material assigned. It is believed that this will allow ESL students access to content that they cannot understand only because it was simplified. However van Rooyen (1990) stressed that simplifying text can weaken the material and does not always improve performance on reading and comprehension. Second language learners do not always need things simplified, as it does not always enhance comprehension.

Simplifying the grammar or vocabulary can deny students the access to the very language that they need.

### Summary

This review has looked at several aspects of science instruction and ESL students. I have looked at the link between ESL students and science learning and what the process may be like for this group of students as well as the impact of their educational background and how it affects learning. I also covered information about the connection between ESL students and science teachers. I attempted to isolate some of the key factors involved in teaching science to second language learners. The next section focused on what is seen as effective teaching of science for ESL students. I then addressed what I perceive to be the largest hurdle in the learning of science content for these students, which is the text material. By analyzing these key areas I have been able to establish the importance for going forward to create some modifications to science content for ESL students. The next chapter will cover the methods that would help answer my research question: To what extent an alternative text help ESL students learn science?

## CHAPTER THREE: METHODS

### Introduction

In this chapter, I outline the methods that I have used to help answer my research question. I will also give my justification as to why I chose the methods that I did and explain how I tried to implement each method. According to Crandall (1994), more evidence is needed to support the effectiveness of integrated instruction and the use of various texts. Because of this, I chose to try and conduct research on the effect that differentiated texts have on comprehension of science content material by sixth grade ESL students. I collected information on the comprehension scores using two different texts that had differentiated versions of the same content material. I also tried to gain insights from the views of ESL students and science teachers toward science learning and teaching. I chose the methods that I did because I feel that they allowed me to best answer the question: To what extent can alternative text materials help ESL students master the Science content unit “Seeing Light”?

There are five main objectives that I had in collecting my data:

- (1) To determine how the group of students that I researched felt about learning science in general, with and without alternative text material;
- (2) To find out from science teachers what main learning objectives are the most essential when the students are studying the unit “Seeing Light”;
- (3) To learn about science teachers’ experiences working with ESL students;
- (4) To determine what language structures are used in the writing of the unit that might get in the way of the ESL students’ comprehension of the text material;
- (5) To find out if the students who had access to an alternative text while studying the unit scored higher on the end of unit assessment than students who did not have access to these materials while studying the unit.

#### Methodology and Rationale

I used three methods to help answer my research question. The first method that I used were two types of survey research because a survey can be used to better understand how things are really operating in one’s own classroom or to describe the abilities, performances, and other characteristics of the learners or teachers (Brown and Rodgers, 2002). Survey research fit my study because there were several characteristics that I wanted learn about the views and attitudes of the participants and because I wanted to know more about the nature of what was happening in these science classrooms.

One kind of survey research that I used was questionnaires. I used this type of research to try and meet my first objective, which was to determine how the group of students that I researched felt about learning science in general, with and without alternative text material. For these questionnaires, I used a scale that is commonly referred to as a Likert Scale which Brown and Rodgers (2002) indicate as being generally

useful for getting at respondents' views, judgments, or opinions about almost any aspect of language learning. The other type of survey research that I used was interviews, which were used because they are most useful for discovering what the issues are in a particular area of study (Brown and Rodgers, 2002). This type of research was used to try and meet my second and third objectives, which were to find out from science teachers what main learning objectives are the most essential when the students are studying the unit "Seeing Light" and to learn about science teachers' experiences in working with ESL students. I felt that this was an appropriate kind of research because I was looking for the participants' feelings and opinions about learning this science unit. I also used descriptive research to allow me to easily compare the data that I was collecting. It also helped me to consider what some of the implications of my findings might be.

### Subjects and Setting

In doing some my research I worked with two different groups of sixth grade ESL students. One of the groups had seven students and the other one had eight students. In total there were 15 students who participated in the research. All of them were at the intermediate level in their English language proficiency as determined by our building's ESL department's criteria. These criterion include the student's Test of Emerging Academic English (TEAE) scores; Measures of Academic Progress (MAP) scores; Minnesota Comprehensive Assessment (MCA) results and teacher ESL teacher recommendation. The two groups were predetermined based on whom they had as their mainstream science teacher and what ESL Integrated Language Arts (ILA) section they had me for. The group of eight students was the control group who were taught the material with the mainstream text material. The group of seven students was the

treatment group and was taught the material using the alternative text material. All of the content material teaching was done in the students' mainstream science class and all of the questionnaires, focus groups, and posttests were administered in my classroom.

#### Measures of Academic Progress

When I analyzed the students' MAP scores, I focused on two main sub sections of the reading test. Evaluation Comprehension, which is a student's ability to assess the material and form a precise idea about the content, and Interpretive Comprehension which is the students ability to understand the text as having a particular meaning or significance. I tried to determine if their score put them in the range of Secured Skill, Emerging Skill, or Future Skill.

This information gives a very strong indication that all of the students are in the Emerging and Future Skill range for both of these reading comprehension areas. Knowing this information pointed out that all of the ESL students that were in my study do not yet have the reading skills and academic English needed to help them fully understand and comprehend the science content reading material that they are given in class. It is clear that they need access to content material that is much closer to their reading abilities if they are going to understand the main learning objectives of the science lesson. It was imperative that I was able to see what the comprehension abilities of the students were. I needed this information to help determine what text material was going to best meet their needs. The results of the MAP seemed to be the best indicator that I had available to me to help in determining what their comprehension levels were. The results helped me know if they were going to be able to comprehend the different text materials.

Table 3.1

*Comprehension Level Ranges on the Reading portion MAP*

<b>Sub Category</b>	<b>Secured</b>	<b>Emerging</b>	<b>Future</b>
Evaluation Comprehension	220 and above	119-190	118-164
Interpretive Comprehension	228 and above	198-227	166-197

Table 3.2

*Number of Students at Each Comprehension Level*

<b>N = 15</b>	<b>Secured</b>	<b>Emerging</b>	<b>Future</b>
Evaluation Comprehension	1	4	10
Interpretive	0	10	5

**Instruments and Procedures**

To determine how the group of students that I researched felt about learning science in general and with and without alternative text material (objective 1), I used a questionnaire with a group of 15 sixth grade ESL students. One group of seven students was the group that learned the science unit with the modifications and the other group of eight students learned the unit without any modifications. The questions were written following the general guidelines laid out by Brown and Rodgers (2002). I gave the questionnaire (see Appendix A) to two groups of students. I created the questionnaire

trying to answer a few key questions like how the students felt about learning science and what they thought about the importance of science. By presenting the questions in a questionnaire, I was able to administer them to the whole group at one time, and I was also able to spend some time going over each question and explaining the questionnaire to all of the students at one time. It also allowed me some time to reduce any anxiety the students may have been feeling as they shared this information with me. I then had a focus group (see Appendix B) after studying the unit with only the students that had the lesson with modifications. The focus group was trying to elicit how the group of students that had the modifications felt about studying a science unit in the manner that they did, how it might have been different from other science learning experiences that they have had and if they felt it improved their comprehension of the unit. I chose this method because I knew it would not be realistic to try and individually interview all of the students that were involved. During the focus group I took notes on the students' responses. I was looking to try and guide their conversation so that I could analyze their responses. I tried to make sure that I moved things toward the general topic that I was focusing on.

To find out what main learning objectives are the most essential when the students are learning the unit "Seeing Light" (objective 2) and to learn about science teachers' experiences in working with ESL students (objective 3), I chose to do a teacher interview. I sent some informal information (see Appendix C) about the interview to two science teachers ahead of time with the hope that if they had some time to think about what I was looking for, I would get more complete and accurate information. I wanted to make sure that they had some time to plan their answers to help insure their usefulness.

Shortly after I gave them the advance information, I sat down with them separately for 30 minutes and asked them a list of questions (see Appendix D) such as, “What science lesson do you feel will have a significant benefit to ESL students and why?” I was flexible in the questioning that I did to ensure that we could work off of the information that they were sharing with me during the interview. In addition to trying to find out what the two or three main learning objectives were, I wanted to know what types of things they had done in the past with ESL students to help increase their understanding of the information. What types of strategies had they tried in the past with ESL students in their classrooms? This information helped me in determining how I would assess the students at the end of the lesson.

I also did a post interview (see Appendix D) with the science teacher who used the modifications with the ESL students in their class while teaching the unit. I wanted to see how they were able to implement the modifications in their teaching of the unit. I also wanted to see if they felt that this was an effective way of better reaching the ESL students that they taught. I feel that a teacher interview was the best possible way to get the information that I wanted for this objective. I have a close relationship with the teachers that I was working with and I felt that they were open and honest with the information that they shared with me. During the time that I have known them, they have shown a great interest in trying to see that all of their students, especially their ESL students, are given every opportunity to be successful. I wrote all of the responses down so that I could focus on making sure that my objectives in doing the interviews were being met. After the interview I was looking at their responses for ideas that allowed me to tease out the information that I was trying to get.

To figure out what language structures are used in the writing of the unit that might get in the way of the ESL students' comprehension of the text material (objective 4), I analyzed the structure of the science texts by using the work of Halliday and Hasan (1976) as a guideline. One language structure that I was looking for was to see if the written material had cohesion, which is an obvious feature of a text, providing surface evidence for the text's unity and connectedness. I tried to look for this to help decide if the text material matched the students' schemata or knowledge regarding text structures. If I did not find that the mainstream text material had cohesion it would help me to know that the students cannot easily follow from one part to another. I also tried to identify if the texts had coherence, which is a property of meaning or interpretation. If this was not present in the mainstream text material, the students might not be able to tell which ideas are most important or determine how underlying ideas are related. I also looked for endophoric reference that relates to context within the text or exophoric reference that relates to context outside the text. This would tell how much prior knowledge the students would need to have before fully being able to comprehend the material and their ability to understand the context of the information presented.

I linked this analysis with the students MAP reading scores that that our district uses. The MAP is a state-aligned adaptive computerized test that measures academic growth over time, and accurately reflects the instructional level of each student. I analyzed their scores in the reading section of the test in the areas of 'Evaluation Comprehension' and 'Interpretive Comprehension.' I found out if their scores in those areas are in the range of 'Secured Skill', 'Emerging Skill', or 'Future Skill.' Once I determined what range they were at, I had a more accurate sense if the mainstream

science text material truly was written in a way that matched their comprehension abilities. Knowing that the mainstream science textbook is written at about an eighth grade reading level, these scores gave me an indication if the students are even close to that level of reading comprehension. Since I found a major discrepancy in their comprehension abilities and the text material level, I knew that I would have to find an alternative text material for ESL students to use for the lesson.

In further analyzing the two text materials, I also did a readability assessment for each of the texts, which took a sample of text and calculated the number of sentences, words, syllables, and characters in the sample. The assessment that I used took the output of these numbers and plugged them into a reading formula to give the results for the Flesch Reading Ease, the Fog Scale Level, and the Flesch-Kincaid Grade Level. The Flesch Reading Ease formula outputs a number from 0 to 100 - a higher score indicates easier reading. An average document has a Flesch Reading Ease score between 6 - 70. As a rule of thumb, scores of 90-100 can be understood by an average 5th grader. 8th and 9th grade students can understand documents with a score of 60-70; and college graduates can understand documents with a score of 0-30. The Fog Scale is similar to the Flesch scale in that it compares syllables and sentence lengths. A Fog score of 5 is readable, 10 is hard, 15 is difficult, and 20 is very difficult. Based on its name, “Foggy” words are words that contain 3 or more syllables. The Flesch-Kincaid Grade Level produces a U.S. school grade level; this indicates the average student in that grade level can read the text. For example, a score of 7.4 indicates that an average student in 7th grade understands the text. I chose to use these readability assessments to better determine the reading level and grade level of the materials and to help determine if the students can read the

material. The Flesch Reading Ease Formula is considered as one of the oldest and most accurate readability formulas. The other two gave me some data that allowed me to compare other important elements of readability.

To find out if the students who had access to modified materials while learning the unit scored higher on the end of unit assessment than students who did not have access to these materials while learning the unit (objective 5), I used the post-test with both groups of students. The test focused specifically on the learning objectives that were identified with the help of the science teachers. I wanted to see if the group that learned the unit with the modifications could show through the assessment that they understood the material more completely than the other group. I administered the test to both groups just after they finished the unit. I wanted to make sure that they both had the information as fresh as possible. I chose this method because it allowed me to focus on the learning objectives that were identified. I was also able to use the questions in a way that would give me the best sense of whether or not they learned the information that they needed. I focused on using test questions that I felt were written at level closer to their language abilities to ensure that it gave them the best chance to show what they truly knew and understood. I also wanted to make sure to use a variety of types of questions. I looked to use some true or false questions that required them to determine the correct information if a question was false. Because Gibbons (2003) points out that science material should be presented in a manner in which ESL students have the opportunity to construct knowledge through concrete experiences, such as illustrations and interactive writing, I felt that it was important that they were able to identify things on a visual

diagram. For this reason I also wanted to give them a chance to do some fill in the blank-short answer writing questions.

In the next two chapters I discuss the results of my research; these results help to answer my main research question, to what extent does an alternative text help ESL students learn science? I then summarize my research and reflect on what all of this research might mean for sixth grade ESL students and their science learning.

## CHAPTER FOUR: RESULTS

The results of my research have shed light on some of the issues related to middle school students learning science content material. It has given me a better understanding of how students feel toward learning science. In addition, the research has helped me

discover how science teachers work to identify the main learning objectives of a unit that they are preparing to teach. My research provided a more clear indication of what language structures are used in science text material that our district uses and how these structures might interfere with an ESL student's comprehension of the material. It then allowed me to better determine if making available text material that had simplified language structures would make it possible for the ESL students to learn the unit objectives more effectively than ESL students who only had access to the mainstream reading material.

### Student Feelings About Learning Science

#### Student Questionnaire

After reviewing the responses to the questionnaire it is evident that overall, as O'Toole (1992) indicated, the students like learning about science and understand the importance of learning science material with the knowledge that it could help them in the future. The responses given by the students to questions one, two and six support this view. The majority of the respondents either strongly agreed or agreed to all three of these questions. The responses to questions eight and nine also shed some light on the fact that although they may enjoy science and understand the benefits that could come from learning it, they are having a difficult time with comprehending the content material. According to the responses from questions five and nine it seems a major factor that leads to this difficulty may be that they do not understand much of what they are reading in part because of how it is written. Once this failure of understanding happens they do not seem to know where to get more information about the topic or how to better understand what they have read. This could ultimately lead to their inability to

understand the main ideas of a lesson. Teachers cannot allow this to continue on through middle school because, as Teemant, Bernhardt, Rodriguez-Munoz & Aiello (2000) have mentioned, if ESL students have not had a positive science experience by the time they are through middle school, teachers have missed our opportunity with them. The complete results of the survey can be seen in Table 4.1.

Table 4.1

*Results from Student Questionnaire*

<b>Question</b>	<b>N = 15</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
1. I like learning about science.		<i>6</i>	<i>6</i>	<i>3</i>	<i>0</i>
2. I feel that learning science is important.		<i>3</i>	<i>8</i>	<i>4</i>	<i>0</i>
3. I like doing my science homework.		<i>1</i>	<i>6</i>	<i>6</i>	<i>2</i>

(continued next page)

Table 4.1 (continued)

4. Science is one of my least favorite subjects in school.		<i>0</i>	<i>4</i>	<i>7</i>	<i>4</i>
5. I dislike reading my science book.		<i>3</i>	<i>6</i>	<i>6</i>	<i>0</i>
6. Learning about science will help me in the future.		<i>5</i>	<i>9</i>	<i>1</i>	<i>0</i>

7. When I do not fully understand something when I am learning science I know where to go to find more information.	<i>0</i>	<i>7</i>	<i>7</i>	<i>1</i>
8. I understand most of the main ideas when I am learning about science.	<i>0</i>	<i>6</i>	<i>5</i>	<i>4</i>

*Results from Student Questionnaire*

<b>Question</b>	<b>N = 15</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Disagree</b>	<b>Strongly Disagree</b>
9. Many of the words in my science book are too hard for me to understand.		<i>5</i>	<i>8</i>	<i>2</i>	<i>0</i>

(continued next page)

Table 4.1 (continued)

10. I would enjoy learning more about science if I could understand all of the information.		<i>6</i>	<i>7</i>	<i>2</i>	<i>0</i>
11. I do not feel comfortable participating in class while I am learning about science.		<i>7</i>	<i>6</i>	<i>2</i>	<i>0</i>

## Focus Group

Having the focus group (See Appendix B for questions) with the seven students who learned the unit with modified text material gave some insight into how effective the modified text material was. Almost all of them enjoyed this lesson more, compared with other science that they have recently learned. Right away their interest in the lesson was increased because during the pre-reading of the material they could sense that material was written in a manner that they could more easily understand. Most of them indicated that they felt that they were able to better understand the lesson because the text material was “easier to read.” They felt that there were not so many big, confusing words to have to work through and each new idea was presented in relatively straightforward manner. They stated that they were much more comfortable doing the class work and participating because they felt more confident in what they knew. They seemed to feel that the overall learning of the main ideas of this lesson just felt easier. Many of them said that they just understood more the first time they were reading it through and they did not have to spend extra time going back over things and still not figuring out what they needed to. All of them strongly stated that if they had text material similar to what they had for this lesson, they would have a much easier time with science and probably even enjoy it more in the future. It was clear that the group usually didn’t feel “comfortable” learning science because it was always so difficult for them to really understand what they were reading and what was expected of them.

## Teacher Interviews

### Teacher Interviews Pre-Modification

Interviewing two teachers before the modifications (see Appendix D for questions) gave me two interesting and unique perspective about their teaching of science and working with ESL students in their classrooms. Both of the teachers indicated that the most important lesson that ESL students (and all students) need to understand well to help ensure their future understanding of science concepts is the scientific method. Because we were well into the school year, this was a lesson that I was not able to use for this research. It is a lesson that they cover in the first month of school. Through these two interviews I was able to determine that the lesson that I would analyze and modify was the lesson on “Seeing Light.” They both felt that this was one of the many lessons that ESL students had a difficult time with and it would work well for the research that I was doing.

Both of the teachers indicated frustration in trying to find ways to teach the key learning objectives of their lessons to ESL students. They stated that most of the ESL students did not have many of the academic skills in place that are needed to completely learn science lesson objectives. This corresponds with what Buxton (1998) asserts, that even students with intermediate to advanced communicative competence in English are generally not prepared with the language skills necessary for success in science class. Because of lack of time and access to differentiated materials, the teachers found it very difficult to find alternative text material that would work well for the ESL students. Usually what they end up having to do is to just reduce the amount of material that they require ESL students to read. They both said that this is problematic because then the ESL students were not able to learn all of the objectives of the lesson. The teachers find it difficult to choose only a few objectives that the ESL students should focus on. Being

forced to choose only a few of them really reduced the ESL students' ability to learn all of the essential concepts that they needed to progress in their science learning. In discussing the specific text material that was being used in their classrooms, both teachers gave the opinion that the material was "too wordy" and really confused the students because it was not very direct in what it was trying to say and that too much information was compacted into each section. They were both at a loss as to how to handle this. One of the teachers said they could sometimes find some basic information about a topic online. They said the problem with doing that is that what they were finding on the internet did not really match the content that they were teaching. They also felt that it was too time consuming to do for all of the lessons that they were teaching. I was able to gain some important insights from both of the teachers. They were able to help me focus in on what I needed to do by indicating what they believed were some of the barriers to helping ESL students in their classes succeed.

#### Teacher Interview Post Modification

During the interview with the teacher who taught using the alternative text (see Appendix E for questions), I sensed that the teacher felt good that she had an alternative text to use in trying to teach all of the objectives to the ESL students. The teacher really liked the fact that the ESL students seemed to understand things a lot easier and that seemed to give the students confidence during science class. The students' ability to focus in on the important information improved their ability to learn the lesson objectives that had been determined by the science teacher. The teacher said that the different text material really benefited the ESL students in her class, who were able to use the alternative text at the same time the rest of the class was using the mainstream text. They

could follow along and it was not very obvious to their peers that they had a different text. When I asked if the ESL students were more willing to participate and raise their hands in class, the teacher indicated that they definitely were. Through this interview I was able to understand how the whole process went for both the teacher and the students.

### Text Material

#### Grammar Analysis: Mainstream Text

The first grammatical feature that I was looking for in the text material was cohesion. The regular text material seemed to have cohesion. There were at least eleven places where I identified cohesion. For example the text used the phrase “it is” where the phrase was being used to refer back to main idea of the paragraph where that main idea was one of the parts of an eye that was being described and defined. In these situations “it” is being used as a subjective personal pronoun acting as the subject of the sentences. There was also the use of other pronouns throughout the text material such as “they” and “this,” where the pronouns always referred back to the first sentence of the paragraph. Each new paragraph described and defined a different part of the eye, which was the main idea of the paragraph. Another cohesive device that was present in the text material was the repetition of key words. All of the vocabulary which were the various parts of the eye were used at least three times in the paragraph that the eye part was being described and defined. The next grammatical feature that I tried to identify in the mainstream text material was coherence. The material did seem to have coherence. There were clear links among the main ideas and the theme of the material and it was organized in a logical manner.

The next grammatical feature that I looked for was if the text had endophoric reference that relates to context within the text or exophoric reference that relates to context outside the text. In the mainstream text material I mostly found exophoric reference. There did not seem to be endophoric reference from paragraph to paragraph because each of them all stood on their own. Each one was a description and definition of one part of the eye with no reference to any of the other parts. It did have exophoric reference because there several times where descriptions of outside ideas were used to compare to what concept was being presented. For example, "...your eyelids act like little windshield wipers,...." "Some lenses in eyeglasses are..." (Pasachoff, 2000). These are clearly a reference to something outside of the text. It was essential that I realized what some of the grammar structures of their current text material were. This allowed me to better understand the difficulties these ESL students were facing while trying to comprehend their science material. It also could give me the ability to more easily find text material that is closer to their comprehension skills. For the specific unit that was being studied I found that the mainstream textbook seemed to have some grammatical features that could inhibit the ESL students' ability to comprehend the content.

#### Grammar Analysis: Alternative Text

The first grammatical feature that I was looking for in the alternative text material was cohesion. This text did not seem to have the same type of pronoun reference that the mainstream text had. Each time, the actual science term was repeated which does still indicate that this text also had cohesion. For example the text said "You see an object when light from the object enters your eye. The eye is the human sense organ that detects

light” (Bernstein, Schachter, Winkler & Wolfe, 1998). This type of cohesion seems to be one that would make reading comprehension easier for ESL students. It is very clear to them each time something is being defined or further explained. Similar to the mainstream text, the alternative material also seemed to have coherence. There were very clear connections among the content of the material and it was clearly organized and had a logical order to it.

I was also looking for endophoric and exophoric reference in the alternative text material. The only endophoric reference that seemed to be present was from one sentence to the next within a specific topic section. Beyond that there was no reference between one section and the next. Each concept seemed to stand on its own. Unlike the mainstream text, this text did not seem to have exophoric reference. There were no real connections to any outside ideas or concepts. Everything seemed to be explained relatively simply with information that pertained to that section’s topic. This really seems to be a feature that makes it easier for my students to comprehend the material. Most things are stated very directly and there is relatively little background knowledge needed. Better understanding some the language structures of the alternative text material gave me the indication that it should be a more appropriate science text for my students. The alternative text gave the impression that it was giving information in a manner that could more easily be comprehended.

### Readability Assessment

The readability assessment gave me a very accurate comparison of the two text materials. I found that the mainstream text was more difficult and probably not the best

choice for instructing sixth grade ESL students in science. The alternative text seemed much more appropriate for the students that I work with.

Table 4.2

*Results from readability assessments*

<b>Type of Assessment</b>	<b>Mainstream Text</b>	<b>Alternative Text</b>
Number of Sentences	6	6
Words per Sentence	13.7	10.8
Character per Word	4.7	4.2
Flesch Reading Ease	75.35	91.71
Fog Scale Level	8.4	4.9
Flesch-Kincaid Grade Level	6.1	3.2

In looking at the readability comparison, the Flesch Reading Ease results show that the mainstream material is at the low end of the difficult range. It indicates that material is more appropriate for eighth or ninth grade students. It probably is not the most appropriate for sixth grade intermediate ESL students. Whereas the alternative text is at a level that can be understood by the average fifth grader, which is much closer to my ESL students' reading comprehension levels. As for the Fog Scale Level the mainstream text material is closer to the difficult level while the alternative text is considered right at the readable level, once again indicating that, based on number of syllables and sentence length, the alternative text seems to be matched much better with intermediate ESL students. The Flesch-Kincaid Grade Level score indicates that the mainstream text material is closer to a sixth grade reading level but the alternative text is several grade levels lower and much closer to the actual reading comprehension level of my students (*Readability Assessment*. n.d.).

## Post Test

### Results

The post test that was administered to all 15 students who were involved in my research had 24 questions. There were eight questions where they had to identify things on diagrams, eight true or false questions where they had to answer true or false and then change the statement if it was false, and eight short answer questions. Their scores were not as telling as I was anticipating (see Table 4.3). All 15 students except for one did quite well on the test. The short answer section was one area where the students that had the alternative text material did better than the other group. This could have happened because the students that used the alternative text understood the material a little more

fully and were able to express that knowledge better than the students who used the mainstream text material.

I chose to only look at the scores from each section of the test rather than the whole test because I felt that those results gave me the most accurate and complete information about the comprehension of the material. I do believe that all of the students' scores were slightly better than they might have otherwise been because of the fact that they were working more closely with me as a part of this research. They all seemed to be a little more focused on the material and were making sure they did their best. In chapter five I will be giving an overview of my research project and what all of it might mean to my students, my colleagues, and myself now and in the future.

Through the various methods that I used to try and find out to what extent can alternative text materials help ESL master a specific science content unit' I was able to expand my understanding of this issue. By using a variety of methods in my research, I was better able to try and meet all of the data collection objectives that I had. In the next chapter I will summarize my research and reflect on what all of this research might mean for sixth grade ESL students and their science learning.

## CHAPTER FIVE: CONCLUSION

As ESL teachers we are faced with many challenges. There are many expectations put on us as language experts. Personally, one great frustration that I face on a daily basis is that of my ESL students constantly struggling in their mainstream science class. They are always having a difficult time understanding the material because the textbook is written at a level well above their comprehension abilities. I suspect that the fact that texts are beyond their comprehension levels causes them to get discouraged and lose the motivation to continue to work hard and try to do well.

In addition, their science teachers come to me expressing frustration and looking for support as to how to better help these students succeed in their classrooms. Their requests led me to try and determine what effects differentiated texts would have on comprehension for science content material for sixth grade ESL students. I wanted to see if there was even one simple thing that I could help the science teachers do to be more effective in helping ESL students reach the lesson outcomes. I was trying to answer the question: To what extent does an alternative text help ESL students learn science?

### Reflections

Doing this research helped to shed a positive light on how ESL students view their science learning and the experiences that they have in science class. Once a student can get over the initial challenges of sorting out how they can effectively learn science, they really become engaged and enjoy the knowledge they gain. I also gained some insight as to what type of text material seems to be the most appropriate for my students. As O'Toole (1992) points out, science enjoys a pretty high status among students. It is seen as something real, useful, and important. It appears the difficulty of the written

material offered in science is a very negative factor for these students. However, it seems as though they are just getting bogged down in the difficult text material. With text material that is written in a manner they can understand more clearly and easily they enjoyed their learning a great deal more. This increased level of comfort while learning the lesson because of a more comprehensible text led them to have more confidence in their science class. This increased comfort level and rise in confidence is a very significant aspect that many ESL students do not always feel in their mainstream classes. Anything that can be done to increase ESL students' comprehension level of content material as well as to improve their confidence in these classes should be done as often as possible.

Making available resources that will help ESL students comprehend the main objectives of a lesson to mainstream teachers is something that needs to be improved on and increased. While doing my research it was very evident that the science teachers that I worked with did not feel adequately prepared to accomplish these goals for ESL students. When they have set material to use for their teaching, they feel very limited in what else they can use to better reach ESL students. One of the goals of the education system should be to help make available as many ESL support resources as possible to mainstream teachers. It is encouraging to see that more and more is being done each year. Whether it is making available alternate material for the teachers to use or teaching the teachers some skills to improve their ability to work with ESL students, they are all very positive steps forward toward more effectively meeting the needs of these students.

Analyzing the two text materials led me to several interesting points although this is still an area of the research that needs to be looked into further. It did not seem

surprising that the mainstream text seemed to have cohesion and one would think that if the text material had cohesion it would be easier for ESL students to follow and understand. In my opinion the opposite seemed to be the case. The overall use of pronouns throughout the text material gave me the impression that the students had to slow down and try and figure out what the pronouns referred to. The fact that the alternative text also had cohesion gave one indication that it might be more suitable for ESL students. A cohesive device that was present in both text materials and appeared to have helped the students during their reading was the repetition of key words. These technical vocabulary terms are pieces of information that ESL students need to see over and over again, especially when the students are first being introduced to a new concept. The more times they see the word being used in the definition and explanation, the more likely they might grasp the idea being presented.

The other grammatical feature that brought about some interesting ideas to consider was the use of exophoric reference. Although nothing concrete was determined in this study and this still needs to be investigated, some general observations were made. The fact that outside ideas were being brought into the text added another level for the students to try and comprehend. With a limited amount of background knowledge ESL students are not in a position to make those types of connections or understand the comparisons made by exophoric reference. Anytime that the amount of outside reference is limited, the easier time most ESL students should have focusing on what main ideas are being presented. This is especially true when they are learning a technical and specialized topic such as science. The lack of exophoric reference in the alternative text seemed to potentially be one reason that students that used it did overall better on the

lesson's assessment. On the surface it would have seemed as though the ESL students would have done well with text material that was written at a level just above the English proficiency level. It was interesting to observe that even though the science text material that is used in the mainstream classrooms are using generally common and appropriate grammatical features, it is still written in a manner that limits the ESL students ability to comprehend the most important content. The alternative text did not seem to present the same limitations to the ESL students' comprehension ability.

By analyzing their MAP scores, it was apparent that the students that were involved in my research were still developing their comprehension skills. Being as far behind with their academic English as these students were, created a huge obstacle in their ability to keep up in their grade level mainstream classes. So if the text material is written at a higher level than their reading level, that puts them even further behind in their ability to comprehend the main objectives of a lesson. There is a clear indication that the content material that ESL students have access to needs to be much closer to their comprehension ability. With more ability-appropriate content material and continuing ESL academic language support, the chances that these students will be successful in the mainstream will continue to improve.

By doing this research I believe that I have found that looking at some specific grammatical features such as cohesion, or if endophoric or exophoric reference may have helped in determining if the mainstream text material was at an appropriate comprehension level for my ESL students. I have the idea that some of our district's annual assessments could be used to help improve the success that ESL students have in their mainstream classes. By using some of the knowledge gleaned from this research,

the mainstream teachers that I work with and I can hopefully become more efficient in reaching this segment of our student population at our school. If I can give my colleagues access to the information learned in this research, other ESL teachers in our building can try and utilize my findings when working with other mainstream teachers at our school.

Although there was close analysis done while conducting this research, there were many factors that held me back from making it even more useful. One of the aspects that might have been considered is factoring in some of the ESL students' mainstream peers. Accessing information about the majority of the student population could have been useful to gain a better grasp of their science learning and the teaching as the content and materials are primarily geared toward mainstream students. An additional limitation to the research that I conducted was that it was very focused on only one science unit. It might have been beneficial if there had been a way to be able to analyze more text material. Ours is only one of a relatively small number of school districts using this science material.

An important aspect of the research to consider is that regardless of the content area, mainstream teachers need to have a better working knowledge of ESL students and how to meet their academic needs. It has been shown that ESL students fall behind academically if they do not learn the content of the curriculum as they acquire English (Stoddart, Pinal, Latzke, & Canaday 2000). Educators in our society need to make sure we find as many ways as possible to help ESL students learn that content so that they can continue to make progress with both their academic English and the content classes that are the foundation of their education. These limitations are things that could be

addressed if further research is done on this topic. Others can use what was learned here as a starting point for helping to analyze specific content material that they and their district are using. Other ESL teachers in our district can also use some of these ideas because they will also be able to examine MAP data and put that together with text material analysis to meet their specific needs. The success of ESL students in their core content classes is one of the most important aspects of their school education. It is imperative that the content material that they have access to allows them to comprehend the content class objectives as well as further their academic English progress.

## Appendix A

### Student Questionnaire

1. I like learning about science.

Strongly agree

Agree

Disagree

Strongly disagree

2. I feel that learning science is important.  
Strongly agree      Agree      Disagree      Strongly disagree
3. I like doing my science homework.  
Strongly agree      Agree      Disagree      Strongly disagree
4. Science is one of my least favorite subjects in school.  
Strongly agree      Agree      Disagree      Strongly disagree
5. I dislike reading my science book.  
Strongly agree      Agree      Disagree      Strongly disagree
6. Learning about science will help me in the future.  
Strongly agree      Agree      Disagree      Strongly disagree
7. When I do not fully understand something when I am learning science I know where to go to find more information.  
Strongly agree      Agree      Disagree      Strongly disagree
8. I understand most of the main ideas when I am learning about science.  
Strongly agree      Agree      Disagree      Strongly disagree
9. Many of the words in my science book are too hard for me to understand.  
Strongly agree      Agree      Disagree      Strongly disagree
10. I would enjoy learning more about science if I could understand all of the information.  
Strongly agree      Agree      Disagree      Strongly disagree
11. I do not feel comfortable participating in class while I am learning about science.  
Strongly agree      Agree      Disagree      Strongly disagree

## **Appendix B**

### **Focus Group Questions**

The main objective of this focus group is to try to elicit what the trial group of students felt about learning a science unit in the manner that they did and how it might have been different from other science learning experiences that they have had.

Focus group questions:

1. How did you feel about learning that science lesson?
2. How did you find this lesson compared to other science lessons that you have had?
3. How did this lesson affect your interest in learning science?
4. Please describe how this lesson helped you to better understand the main ideas of what was being taught?
5. How did this the teaching of this lesson affect your ability to understand important vocabulary words?
6. How did this lesson affect your desire to do the class work and homework?
7. What is your opinion about learning science with the type of lesson that was used?
8. How might learning science like this help you with learning science in the future?
9. Please describe how learning this unit affected your comfort level of participating in class.
10. In your opinion, was learning this lesson easier than other science lessons? Explain.

## **Appendix C**

### **Preparation for Teacher Interview**

First of all, thank you for taking the time to work with me on this project. Before we get together for more formal interviews I wanted to highlight a few things. I feel this will allow for the interviews to be much more efficient. It will give you an opportunity to think about some of the information that I will be asking about and it should be useful as a reference during the interviews. I am planning on about thirty minutes for each of the interviews.

1. How do you identify the key objectives for each of the units that you teach?
2. What are your past experiences with ESL students in your science class?
3. What types of modified teaching strategies have you tried in the past when teaching ESL students?
4. How do you perceive the ESL students that have been in your classrooms? i.e. Do they participate in the same way as mainstream students? Do they seem to be as successful as mainstream students? Do they seem to learn science in the same ways as mainstream students? Do they comprehend the key objectives for the units?
5. Are there any ESL modified materials that are included with our curriculum? If so do you use them and how?
6. What are some of the things that you feel should be done to improve the overall comprehension of science material for ESL students?

## **Appendix D**

### **Teacher Interview Questions Pre Modification**

1. What science lesson do you feel will help ESL students the most in their overall understanding of science concepts? Why?
2. What are the key learning objectives for this lesson, that you feel ESL students must know?
3. What specific teaching strategies have you tried to use with ESL students in the past?
4. In your past experiences teaching this lesson how have ESL students done?

5. Have you done any modifying of this lesson for ESL students in the past?
6. What types of modifications do you feel would be most successful while teaching this lesson?
7. What are some of the limitations that you feel modifications might have on your teaching of the lesson?
8. How do you think that the text material could be modified to allow the ESL students to still meet the main learning objectives?
9. Are there other supplemental materials that could be used to help meet these objectives?

## **Appendix E**

### **Teacher Questions Post Modification**

1. Were you able to implement any of the ESL modifications while teaching this unit?
2. If so, specifically what parts of the modifications were you able to use?
3. When were you able to implement them?
4. If not, what reasons would you give for not being able to use them?
5. Do you feel that the ESL students comprehended the key objectives for this unit?  
If yes, do you think the modifications help them do that?

6. Do you think that the ESL students were more willing to participate in class because of access to these modifications? i.e. Were they more active in group settings? Did they raise their hands more often to share their ideas with the rest of the class?
  
7. What changes would you make to the modifications to make them more teacher friendly?
  
8. Are there any other things that you feel would lead to ESL students being able to meet the learning objectives of this lesson?

## **Appendix F**

### **Post Test**

**Appendix G**  
**Mainstream Text Material**

**Appendix H**  
**Alternative Text Material**

## REFERENCES

- Abell, S., & Roth, M. (1992). Constraints to teaching science: A case study of a science teacher enthusiast. *Science Education*, 76, 581-595.
- Amaral, O.M., Garrison, L., Klentschy, M. (2002). Helping English learners increase achievement through inquiry-based science instruction. *Bilingual Research Journal*, 26 (2), 213-239.
- Bernstein, L., Schachter, M., Winkler, A., Wolfe, S. (1998). *Concepts and challenges in physical science* (3<sup>rd</sup> ed.). Parsippany, NJ: Globe Fearon.
- Beyer, B. (1998). Improving student thinking. *The Clearing House*, 71, 262-267.
- Bodwell, M.B. (1998). Cheche Konnen professional development in linguistically diverse classrooms. *Hands On!*, 21 (1), 20-23.
- Brickhouse, N. (1990). Teachers' beliefs about the nature of science and their relationship to classroom practice. *Journal of Research and Development in Education*, 15 (4), 13-18.
- Brown, J.D., & Rodgers, T. (2002). *Doing Second Language Research*. Oxford: Oxford University Press.
- Buxton, C.A. (1998). Improving the science education of English language learners: Capitalizing on educational reform. *Journal of Women and Minorities in Science and Engineering*, 4, 341-369.
- Bybee, R. (1993). *Reforming science education—Social perspectives and personal reflections*. New York: Teachers College Press.
- Cantoni-Harvey, G. (1987). *Content-Area Language Instruction*. Reading, Mass.: Addison-Wesley.
- Carlson, C. (2000). Scientific literacy for all. *The Science Teacher*, 67 (3), 48-52.
- Carrasquillo, A.L. & Rodriguez, V. (1996). *Language minority students in the mainstream classroom*. Philadelphia: Multilingual Matters Ltd.
- Casteel, C.P., & Isom, B.A. (1994). Reciprocal processes in science and literacy learning. *Reading Teacher*, 47, 538-45.
- Chamot, A. & O'Malley, M.J. (1994). *Implementing the Cognitive Academic Language Learning Approach*. Reading, MA: Addison-Wesley Publishing Company.

- Chamot, A. & O'Malley, M.J. (1986). *A cognitive academic language learning approach: An ESL content based curriculum*. Wheaton, MD: National Clearinghouse for Bilingual Education.
- Clark, C.M., & Peterson, P.L. (1986). Teachers' thought processes. In M.C. Wittrock (Ed.), *Handbook of research on teaching*. New York: Macmillan.
- Colburn, A. & Echevarria J. (1999). All students benefit from integrating English with science. National Science Teachers Association. *Science learning for all: celebrating cultural diversity*.
- Collier, V.P. (1995). *Acquiring a second language for school. Directions in Language & Education*. Volume 1, Number 5: Washington D.C.: National Clearinghouse for Bilingual Education.
- Crandall, J. (1994). *Content-centered language learning*. (Report No. EDO-FL-94-06). Washington DC: Office of Education Research and Improvement. (ERIC Document Reproduction Service No. ED 367 142).
- Cummins, J. (1989). *Empowering minority students*. Sacramento: California Association for Bilingual Education.
- Cummins, J. (1983) Language proficiency and academic achievement. In J. W. Oller (Ed.) *Issues in Language Testing Research*. Rowley, MA: Newbury House.
- Gibbons, B.A. (2003). Supporting elementary science education for English learners: A constructivist evaluation instrument. *The Journal of Educational Research*, 96, 371-379.
- Halliday, M.A. (1978). *Language as social semiotic*. Baltimore: University Park Press.
- Halliday, M.A. & Hasan, R. (1976). *Cohesion in English*. London: Longman.
- Herrel, A.L. (2000). *Fifty strategies for teaching English language learners*. Upper Saddle River, NJ: Merrill.
- Krashen, S. (1981). *Principles and Practice in Second Language Acquisition*. London: Prentice-Hall International.
- Lee, O., & Fradd, S.H. (1998). Science for all, including students from non-English-language backgrounds. *Educational Researcher*, 27 (4), 12-21.
- Linn, M. (1992). Science education reform: Building on the research base. *Journal of Research in Science Teaching*, 29, 821-840.

- Mason, C.L. & Barba, R.H. (1992). Equal opportunity science. *Science Teacher*, 59 (5), 23-26.
- O'Malley, J.M. & A.U. Chamot. (1990). *Learning Strategies in Second Language Acquisition*. Cambridge: Cambridge University Press.
- O'Toole, M. (1992). Both bridge and barrier: The potential and problems of science for the second language learner. *TESOL in Context*, 2 (1), 13-17.
- Pajares, M.F. (1992). Teacher's beliefs and educational research: Cleaning up a messy construct. *Review of Educational Research*, 62, 307-322.
- Pasachoff, J.M. (2000). *Science explorer: sound and light*. Upper Saddle River, NJ: Prentice-Hall.
- Peacock, A. (1995). An agenda for research on text material in primary science for second language learners of English in developing countries. *Journal of Multilingual and Multicultural Development*, 16, 389-401.
- Peterman, F. (1993). Staff development and the process of changing: A teacher's emerging beliefs about learning and teaching. In K. Tobin (Ed.) *The practice of constructivism in science education*. Hillsdale, NJ: Lawrence.
- Pomeroy, D. (1993). Implications of teachers' beliefs about the nature of science: Comparison of the beliefs of scientists, secondary science teachers, and elementary teachers. *Science Education*, 77, 261-278.
- Readability Assessment*. (n.d.). Retrieved September 17, 2008 from <http://www.readabilityformulas.com/free-readability-formula-assessment.php#flesch>
- Reid, D. (1990). The role of pictures in learning biology. *Journal of Biological Education*, 24 (3), 161-172.
- Rosebery, A., Warren, B., & Conant, F.R. (1992). Appropriating scientific discourse: Findings from language minority classrooms. *Journal of the Learning Sciences*, 2 (1), 61-94.
- Simich-Dudgeon, C. & Egbert, J. (2000). Science as a second language. *Science Teacher*, 67 (3), 28-32.
- Stoddart, T., Pinal, A., Latzke, M., & Canaday, D. (2002). Integrating inquiry science and language development for English language learners. *Journal of Research in Science Teaching*, 39, 664-687.

Sutman, F.X., Allen, V.F., Shoemaker, F. (1986). *Learning English through science: A guide to collaboration for science teachers, English teachers, and teachers of English as a second language*. Washington D.C.: National Science Teachers Association.

Teemant, A., Bernhardt, E.B., Rodriguez-Munoz, M., & Aiello, M. (2000). A dialogue among teachers that benefits second language learners. *Middle School Journal*, 32 (2), 30-38.

Tobin, K. (1993). Constructivist perspectives on teacher learning. In K. Tobin (Ed.) *The practice of constructivism in science education*. Hillsdale, NJ: Lawrence.

Van Rooyen, H. (1990). *The disparity between English as a subject and English as the medium of learning (a final report of the Threshold Project)*. Pretoria: Human Sciences Research Council.