

**PROBLEMS WITH SCIENCE TEACHING AND LEARNING FOR ENGLISH
LANGUAGE LEARNERS IN ONE DIVERSE ELEMENTARY SCHOOL**

A Record of Study

by

KAREN MARGARET RODRIGUEZ

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

August 2012

Major Subject: Educational Administration

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Approved by:

Co-Chairs of Committee,	James Scheurich Terah Venzant-Chambers
Committee Members,	Gwenn Webb-Hasan Lynn M. Burlbaw
Head of Department,	Fredrick Nafukho

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ABSTRACT

Problems with Science Teaching and Learning for English Language Learners in One
Diverse Elementary School. (August 2012)

Karen Margaret Rodriguez, B.S.Ed., Texas State University;

M.Ed., University of Houston

Co-Chairs of Advisory Committee: Dr. James Scheurich

Dr. Terah Venzant-Chambers

This qualitative study centered on science instruction and learning that occurred in a Title I elementary school in a suburban district in southeast Texas. Twelve teachers were interviewed in order to understand their perceptions of their classroom practices in terms of science instruction and learning for English Language Learners (ELL). This study also analyzed information gathered from teacher lesson plan and classroom observations. The participants' awareness of the instructional practices necessary for ELL student achievement in science was evident through analysis of interview transcripts. However, after observation of actual classroom instruction, it became apparent that the teaching and learning in most classrooms was not reflective of this awareness. This study proposes that this disconnect may be a result of a lack of quality professional development available to the teachers. The study also outlines and describes the characteristics of quality professional development and its relationship to focused instruction and continuous student improvement.

DEDICATION

For my father, James S. Newkirk, whose belief in me was limitless. Throughout this process, I continue to feel your presence, love, and encouragement.

For my daughters, Natalie and Julia, who have been my sources of strength and pride. As I have watched you grow into wonderful young women, you have helped me to stay focused on what is *really* important. I am proud to call you my daughters, and even more proud to call you my friends.

Finally, for my husband, John, for whose support and patience, I am eternally grateful. Thank you for your feedback on this work, and more importantly, thank you for your understanding when I was less than gracious when receiving it. I could not have completed this study without you.

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CHAPTER I

INTRODUCTION

Knowledge of science is essential for all members of our society, and our students must be able to understand and apply scientific ideas (De la Cruz, 2001). The American Association for the Advancement of Science (AAAS) has established a national education goal to build scientific literacy for *all* students and to ensure they “obtain the scientific knowledge, skills, and habits of mind needed to make personal decisions; engage in science-technology-society debates, and be productive members of our global society” (AAAS, 1993, p. xi). Lee (2005) suggests that in order for schools to produce a citizenry that is adequately educated in science and technology for the 21st century, the issue of student diversity must be addressed. However, according to the National Science Foundation (NSF) (2006), while mathematics scores on national assessments have demonstrated gains in many demographic subgroups, performance in science has not improved. For example, between 1996 and 2000, average science scores of students participating in National Assessment of Educational Progress (NAEP) declined at grade 12 and remained the same at for the fourth and eighth grade participants (NSF, 2006). Additionally, the NSF (2006) confirms that students from lower income families lag behind other students creating achievement gaps. These gaps commence as early as kindergarten, and for some students widen through their school

This record of study follows the style of *Journal of Science Teacher Education*.

career. The International Association for the Evaluation of Educational Achievement (2007) in its *Trends in International Mathematics and Science Study* (TIMSS), also confirms achievement gaps in science between White students from middle class backgrounds and students of color as well as students from economically disadvantaged backgrounds.

What follows in this chapter is, first, a discussion of accountability issues surrounding a lack of progress in academic proficiency in science as evidenced by the fifth grade science TAKS scores at one diverse elementary school, Salas Elementary. Salas Elementary is located in a suburban school district in southeast Texas within the Excel Independent School District (EISD). (The names of the school and district in this study are pseudonyms.) Second, there is an overview of the context and background that frames the study, the problem statement, the statement of purpose, and accompanying areas of research. And, finally, Chapter I concludes with a discussion of the rationale and significance of the study.

Accountability Issues

In the United States, the number of students that can be classified as English language learners (ELL) has risen dramatically (Genesee, Lindholm-Leary, Saunders, & Christian, 2006). This increase in the ELL population is significant in light of education reform that calls for high standards and strong accountability for all students (Genesee, Lindholm-Leary, Saunders, & Christian, 2006). For example, the No Child Left Behind (NCLB) law of 2001 (PL 107-110) requires that all students achieve high academic standards in the core subject areas. This legislation requires schools to report test scores

across demographic groups and to work toward yearly improvements for all students as well as eliminating achievement gaps between student groups (Duschl, Schweingruber, & Shouse, 2006). Additionally, for the first time, in 2007, this law required science testing to be carried out nationwide (Finneran, 2003). However, in the past, little consideration was given to effective science instruction at the elementary level (Beiswenger, Stepan, & McClurg, 1998; Dickenson, Burns, Hagen, & Locker, 1997; Shepard, 2000). Math and reading received greater attention at the elementary school level due to their roles in high-stakes testing (Ediger, 2001). Now, with the likelihood of high-stakes testing and accountability issues rising in connection to science instruction, teachers are left with both the predicament and the responsibility of identifying science concepts and, at the same time, developing best instructional practices (William, 2008). Thus, NCLB (2001) presents additional challenges as it outlines the responsibilities of teachers to deliver a curriculum that will foster academic growth and development with an increasingly diverse student population.

Similar to NCLB (2001), for the state of Texas, the Texas Assessment of Knowledge and Skills (TAKS) was the standardized test used in public schools during 2003 to 2011 to measure student progress in reading, math, writing, science, and social studies (Texas Education Agency, 2008). This instrument, the TAKS test, was how the Texas Education Agency assessed accountability in schools and whether standards established under NCLB (2001) were being met. The TAKS test was an assessment developed to reflect good instructional practices (Texas Education Agency, 2010). Furthermore, it was designed to assess students' knowledge of the material and their

ability to be successful in school (Texas Education Agency, 2010). Based on these assessment qualities of the TAKS exam, many consider it to be a ‘high-stakes’ system of accountability. Moreover, during the time of data collection, student success on this assessment was a requirement for graduation from Texas public high schools, another aspect of its high stakes nature. Additionally, like all other school districts in Texas, EISD, measures teachers’ job performance based on student success rates on the TAKS test, adding yet another high stakes characteristic. The following is a discussion of one EISD elementary school’s struggle to meet this high-stakes accountability standard required by TAKS.

Context of the Study

Examination of Academic Excellence Indicator System (AEIS)¹ data for Salas Elementary School for the years 2006 through 2010 reveals a lack of progress in academic proficiency in science as evidenced by the fifth grade science TAKS scores. Most fifth graders at Salas Elementary take the TAKS science test in English. As is the practice of public school districts in Texas, decisions regarding language of testing for ELL students come from the Language Proficiency Assessment Committee (LPAC). This committee, comprised of the classroom teacher, an administrator, and the bilingual coordinator, examine several pieces of information, including how long an ELL student has been in the country, data from the Texas English Language Proficiency Assessment System (TELPAS), and the Developmental Reading Assessment (DRA). In response to these rules, in the spring semester of 2011 at Salas Elementary, there were eighty-one fifth grade students who were considered to be ELLs. However, only two of these ELL

students took the TAKS science test in Spanish. This LPAC decision was made because these two children had resided in the United States for less than two years.

Based on the testing of these ELL students, the lack of their academic proficiency in science is especially apparent when these scores are compared to the average scores of all fifth grade students in EISD and the state of Texas. Nonetheless, the issue of low student proficiency in science is not unique to Salas Elementary, a school where 85% of the students are Hispanic² and 69% are classified as Limited English Proficient (LEP). LEP student scores have historically lagged behind White students in EISD in science, as well as other subject areas. In 2010, the gap between White students and LEP students was as wide as thirty-one percentage points (see Appendix A). Additionally, as of 2007, the state of Texas implemented more rigorous graduation requirements which necessitate a stronger foundation in science. However, this record of study will focus specifically within the context of Salas Elementary School.

EISD and Salas Elementary

The website³ for the Excel Independent School District (EISD) describes the district as a diverse community of well-kept houses, apartments, and condominiums in one of the most beautifully wooded sections of the major metropolitan area. In keeping with the neighborhood school concept sustained by the district, neighborhood attendance areas are established for each campus. Specifically, students go to school in the attendance area in which they live. A major freeway bisects the community, resulting in a school district where the majority of students attending school on the south side of the freeway are from White, middle to upper-income families, while most of the students

attending schools on the north side of the freeway are from Hispanic, lower-income families. A review of the Texas Education Agency's AEIS reports for schools in the EISD supports this finding.

Salas Elementary is a school located on the north side of the freeway. Most of the students that attend Salas reside in apartment complexes that border the campus. This finding is based upon my observations as a former administrator at Salas Elementary. The racial makeup of the approximately 600 students at Salas consists of 85% Hispanic, 8% African American, and 7% White. Eighty-seven percent of these students are classified as economically disadvantaged, and 65% are classified as LEP. There have been bright spots of achievement in schools on the north side. Nonetheless, while federal initiatives, such as Title I or district initiatives such as tiered levels of support, are designed to provide assistance, equity, and balance, there is little evidence they provide lasting improvement trends in achievement for Salas students, especially in the area of science.

Description of EISD Science Curriculum

It is expectation of EISD that Salas, as other schools in the district, will implement the district's curriculum. The EISD's science curriculum is based on the web-based lesson planner and management application *forethought* from *eduphoria!*. This *eduphoria!* website provides the teachers with a detailed plan of what objectives should be taught and how they should be taught (see Appendix B). During 2010, individuals from the EISD department of teaching and learning and school improvement specialists representing each campus, convened to plan out EISD's scope and sequence

which included instructional activities for the 2011-2012 academic year. They also created a bank of activities that support these objectives. All of this work was uploaded to *forethought*. One goal of this effort was to encourage teachers to collaborate in constructing roadmaps for nine weeks of instruction. The teachers were to use these roadmaps as their guide when writing their own plans. These roadmaps also incorporated strategies that had been the focus of recent professional development, such as higher order questioning and active student participation. The following is a description of the structure of current professional development practices at Salas.

Professional Development

EISD provided numerous opportunities for professional development through a variety of avenues with a goal of supporting best practices in the classroom. This professional staff development took a variety of forms, for example through team meetings, lectures, focus groups, book studies, and professional learning communities. Furthermore, after-school trainings were offered throughout the district, but teachers at Salas were also expected to participate in the trainings that occur during an extended planning period in the afternoon. These trainings were scheduled every two weeks and were usually led by campus leadership. The campus leaders attempted to align the needs and goals of the particular grade level. Additionally, the leadership and individuals from the district's teaching and learning department were also available to model lessons, secure resources, and provided support for effective science instruction as needed. Additionally, the bilingual teachers were involved in the implementation of EISD's dual language program, based on their professional development for this program. The

following is a brief discussion of this district initiative designed to provide support to its teachers who teach Salas's bilingual classes.

Instruction Provided to English Language Learners

Bilingual education involves teaching academic content in two languages, in a native and secondary language, with varying amounts of each language used according to the program model (Aikenhead & Jegede, 1999; Amaral, Garrison, & Klentschy, 2002). Dual Language is a model that is designed for students to become biliterate in both their native and secondary language (Gómez, 2000). Bilingual students enrolled from prekindergarten through fifth grade at Salas receive instruction under the district's adopted One-Way Dual Language Program. The EISD's website defines this program as using two languages, Spanish and English, for the purpose of instruction. Under the model's design, half of daily content is taught in English and half is taught in Spanish. Math instruction is delivered in English only, science and social studies are taught in Spanish, and Language Arts instruction is divided by grade level between Spanish and English. The ultimate goal for bilingual students participating in the program is to achieve literacy in both languages.

Beginning in 2007, Drs. Leo and Richard Gómez from the University of Texas-Brownsville, came to EISD to train principals, classroom teachers, school support specialists, and other staff members on the implementation of their model of teaching for bilingual education. The first year of implementation occurred in pre-kindergarten, kindergarten, and first grade classes. With each subsequent year of the program, teachers from successive grade levels were trained. By the 2011-2012 school year, fifth

grade bilingual students who have been students in EISD since kindergarten will participate in this model of bilingual education throughout their school career.

Salas Elementary's Achievement in Science

Despite offering science enrichment activities after school, receiving additional support from district personnel, and hosting opportunities for teachers to participate in staff development activities, Salas's TAKS scores continue to demonstrate a lack of improvement for ELL students in science. A review of EISD data from the AEIS report (TEA, 2009) reveals that over the past five years, the district's fifth grade LEP students' performance on the science TAKS continues to lag behind White students. This gap was most dramatic in 2005, where 93% of White students in EISD passed the science TAKS, while only 49% of LEP students passed. While it has narrowed through the last five years, there still existed a gap of 28 percentage points in 2009 (see Appendix A). This performance gap is also evident in an examination of Salas Elementary's performance. For example, AEIS (TEA, 2009) data reveal that achievement gaps continue to exist when science TAKS scores are compared to EISD and the state of Texas. During the past five years, the gap between Salas and EISD has been as wide as 21 percentage points and has fluctuated during that time period. Although, the gap was at a historic low of 11 percentage points in 2009, a lack of consistent progress raises a concern about the stability of future performance (see Appendix C). Though much time has been spent by the administration and faculty involved in analyzing and disaggregating science data in the hopes of forming effective instruction, little thought has been given to this

question: What do teachers themselves believe to be the real problem regarding science instruction for ELLs on the Salas campus?

Problem Statement

AEIS data for the years 2006 through 2010 consistently indicated that Salas Elementary School's science scores lack academic proficiency, as compared to the scores of EISD as a whole and the state of Texas. The issue of low student proficiency is not unique to in Salas Elementary. Nonetheless, in 2007 the state of Texas implemented more rigorous graduation requirements that necessitate a stronger foundation in science. This study, though, will focus specifically within the context of Salas Elementary School, as it examines teachers' perceptions of science instruction for ELL students.

Statement of Purpose and Area of Research

This study seeks to examine Salas Elementary School teachers' perceptions and reflections on science instruction for ELL students. Although research on the improvement of science instruction has focused on student learning (Bartolome, 1994), high-stakes assessments (William, 2008), standards (Lee & Fradd, 1998), and curricular frameworks (Crawford, 2007), this study is important as it aims to explore teachers' beliefs about their own instructional practices. As valuable information can be gleaned from teachers' narratives (Tobin, Tippins, & Gallard, 1994), the knowledge generated from this research will afford new insights into teachers' perceptions of what constitutes effective science instruction for the ELL student. In addition, teachers' lesson plans were carefully examined, and observations of teaching also occurred. This inquiry

employed qualitative methodology, and participants in this study were selected through purposive sampling techniques. Twelve teachers from Salas Elementary participated in this study.

To shed light on the problem, the following research questions were addressed:

- What do teachers understand about teaching science to elementary school ELL students?
- What do teachers understand about ELL student learning in relationship to science teaching?
- What are teachers' perceptions about the role of the school leadership in support of that teaching?
- What does the structure of teachers' lesson plans indicate in terms of their awareness of effective science instruction for the ELL student?

What do the observations of instructional practices indicate in terms of teachers' awareness of effective science instruction for the ELL student.

Rationale and Significance

The rationale for this study arose from my desire to explore how teachers' perceptions of science instruction connect to what they regard as effective practices in the classroom for ELL students. I hope, based on the information gathered and analyzed for this study, school leadership will gain insight into teachers' perceptions, which will be used to improve science instruction for ELLs, and ultimately close the achievement gap between ELLs and other student groups. Moreover, I hope the results help to create significant and lasting improvement in science achievement at Salas Elementary and

throughout EISD. Additionally, exploring these perceptions is critical as 56% of EISD students are Hispanic and 33% of all students are classified as LEP (EISD, 2010).

Organization of Study

This record of study is organized into five chapters. Chapter I provides the background and context of the study, the statement of the problem to be researched, the statement of purpose and areas of research, the research questions, and the significance of the study. Chapter II consists of a review of literature that provides a comprehensive background for the study in terms of the research on science instruction for ELL students, issues regarding teachers' content knowledge and pedagogy, as well as culturally responsive teaching practices for ELL students. The literature review also includes scholarship regarding the characteristics of school leadership essential for teachers of ELL students. Chapter III details the methodology and qualitative approach used for the study, the type of research and design selected for the study, the context of the study, a description of the study participants, data collection procedures, data analysis procedures, and measures used to establish trustworthiness. Chapter IV includes the results of the study and my interpretations. Chapter V contains a summary and discussion of the results of the study, as well as conclusions and recommendations.

CHAPTER II

LITERATURE REVIEW

The purpose of this study was to explore elementary school teachers' perceptions of science instruction for their ELL students. To carry out this study, it was necessary to complete a review of the literature. This review of literature assisted in framing my record of study by identifying and focusing on several of the reoccurring themes in the research. In the first part of this literature review I discuss the research on teaching science to ELL students. Specifically, this strand of literature looked at issues of teachers' content knowledge and pedagogy. Next, I discuss the literature on practices necessary for culturally responsive science teaching for ELL students. Finally, I conclude this review with a discussion of the literature focused on leadership of science teaching for ELL students. Specifically, this research explored the characteristics of successful leadership practices that were occurring in schools with large Hispanic student populations. This final section also includes a discussion of the literature on recruiting and retaining teachers of linguistically diverse students.

Teaching Science to ELL Students

According to Shulman (1986), while assessment of teacher competencies may seem like a recent development, more than one hundred years ago, teachers participated in examinations to demonstrate mastery of subject matter in order to become a teacher. Shulman (1986) described a teacher examination administered in 1875 where content knowledge was assessed. In 1875 a teacher seeking certification would be expected to

define terms such as “adhesion” or “specific gravity” (Shulman, 1986, p. 4). Today’s science educator is expected to meet much more complex goals. Along with strong content knowledge, teachers must possess teaching practices that include knowing how to develop, in all students knowledge, basic skills, and deeper cognitive abilities that support a strong understanding of science (Duschl, Schweingruber, & Shouse, 2006).

Today, in terms of educating the linguistically diverse student, if teachers are to effectively provide science instruction, they must possess knowledge of the subject they teach along with the teaching strategies that are content specific (Kennedy, 1998; Shulman, 1987). Shulman (1987) defined content knowledge as an instructor’s expertise in the subject that of instruction. Likewise, pedagogical knowledge is defined as the expertise the teacher brings in teaching strategies (Shulman, 1987). Pedagogical knowledge is a critical piece in science teaching and understanding of its role is necessary to support effective science instruction (Magnusson, Krajcik, & Borko, 1999). Additionally, Shulman (1986) questioned the gap between content and pedagogy and proposed a special domain of teacher knowledge that he defined as pedagogical content knowledge (PCK). PCK links pedagogy and content knowledge together and examines the questions of to what extent does good teaching depend on the knowledge of subject matter? To what extent does it rely on pedagogical skill? (Ball, 2000). The following is a more detailed discussion of issues surrounding these types of vital instructional considerations a science teacher of ELL students must bring to the classroom.

Content Knowledge

Content knowledge is defined as a teacher's expertise in the subject that is taught (Shulman, 1987). Kennedy (1998) has suggested that there are two dimensions to content knowledge – quality and quantity. Through optimum content knowledge it is expected that students will ask questions that go beyond the prescribed science curriculum (Kennedy, 1998). Therefore, a large amount of content knowledge should be in place to accommodate students. Quality content knowledge goes beyond surface level knowledge and addresses students' deeper and more complex understandings (Kennedy, 1998).

Additionally, research from Ball and McDiarmid (1990) cautioned about the harm a teacher can do if they do not possess accurate content knowledge, as they may pass these inaccurate ideas to their students. They stated, "Subtly, teachers' conceptions of knowledge shape their practice—the kinds of questions they ask, the ideas they reinforce, the sorts of tasks they assign" (p. 639). This is alarming when research shows that teachers' knowledge of content and pedagogical knowledge are linked to student achievement (Monk, 1994). In their work on teacher management of subject matter knowledge, Newton and Newton (2001) suggested that teachers with incomplete subject content knowledge tended to interact less with their students and ask them fewer questions. However, teachers with a better understanding of science content asked more challenging questions and interacted more with their students, and these interactions included opportunities for students to participate in content-related dialogue (Newton & Newton, 2001).

Nonetheless, the National Science Board (2004) indicated that teachers are too often unprepared both pedagogically and lack knowledge of science subject matter. This is especially the case with the elementary school teacher (Furtak & Alonzo, 2009). Researchers have revealed that science has been a “neglected” area in an elementary school education, taking a subordinate position to reading, writing and math (Hoffman, Assaf, & Paris, 2001; Orfeld & Kornhaber, 2001). Most elementary teachers earn their teaching certificate without a science degree, and that lack of experience in science limits their knowledge base of science content (Akerson & Hanuscin, 2007). In exploring the interplay between inquiry-based instruction and content in elementary school science lessons, Furtak and Alonzo (2009) suggested that negotiating the role of content is particularly challenging for the elementary school teacher. Furtak and Alonzo (2009) suggested the elementary teacher is less likely to possess the strong science content knowledge than their high school colleagues. As the teaching of science has often taken a subordinate place to reading, writing, and math instruction (Orfield & Kornhaber, 2001), teachers have reported there is insufficient time to adequately teach science (McNamara, Stuessy, McNamara, & Quenk, 1999).

In terms of instructional considerations for ELL students, Lee and Fradd (1998) posited, rather than attributing student difficulties to limited understanding of academic content, teachers who are unaware of language background differences, may assign these difficulties to behavioral issues or learning disabilities. However, these researchers also indicated teachers can be successful in promoting high academic standards for ELL students through the integration of both literacy and science. Lee and Fradd (1998)

proposed the notion of “instructional congruence” (p. 12) which melds academic content and the student’s language and cultural experiences together to make the content meaningful and relevant. Scribner (1999) supported the notion of instructional congruence. He stated, “Because Hispanic students often are misdiagnosed and misplaced in the school’s ability grouping structure, primarily as a result of limited English proficiency, they are stuck in a “Catch-22” of low expectations, inappropriate instruction and unchallenging curriculum offerings” (p. 2). Finally, Lee’s (2005) research indicated that the education system fails to provide the adequate instructional scaffolding to effectively deliver content to ELL students in the science classroom. Furthermore, Lee (2005) suggested that English language skills should be developed in the context of a core subject. Certainly, science instruction provides a meaningful context of subject area instruction.

Nature of Science

The phrase “nature of science” (NOS) is commonly used in science education to describe the integration of philosophy, history, sociology, and psychology in the subject (Lederman, 1987). NOS is important for understanding the core values and assumptions found in the development of scientific knowledge (Lederman, 1987). Abd-El-Khalick, Bell, and Lederman (1998) defined NOS “... as a way of knowing, or the values and beliefs inherent to the development of scientific knowledge” (p. 418). These authors suggested that lessons which directly teach students about NOS provide the opportunity for all students to share their unique knowledge and experiences. According to

Lederman and Stefanich (2006), there are common tenets of NOS that are applicable to K-12 science education. These authors wrote:

[The NOS] tenets state that scientific knowledge is (a) tentative (subject to change); (b) empirically based (based on and/or derived from observation of the natural world); (c) subjective (theory-laden); (d) partly the product of human interference, imagination, and creativity (involves invention of explanation); (e) socially and culturally embedded and it necessarily involves a combination of observations and inferences; and (f) necessarily involves observations and differences (p. 59).

Bianchini, Johnston, Oram, and Cavazos (2003) conducted a case study examining the views and practices of first-year science teachers as they attempted to present descriptions of NOS and implement equitable instructional strategies in their classrooms. These authors stated, “To promote scientific literacy for all, science education reformers have long argued that teachers need to present a *contemporary* description of the nature of science to students. Teachers must describe science as a complex human activity with shared norms and values, specific methods of inquiry, and diverse ties to social and cultural contexts” (p. 420-421). Moreover, Bianchini, Johnston, Oram, and Cavazos (2003) also explained that the current research on science education advocates for the broadening of descriptions of the nature of science communicated to linguistically diverse students to include the lives, views, and values of members of underrepresented ethnic groups. This includes providing opportunities for students to “... examine the contributions of diverse peoples to the scientific enterprise;

explore connections across science, society, and everyday life; and learn to use science toward emancipatory and social justice ends” (Bianchini, Johnston, Oram, & Cavazos, 2003, p. 420).

Pedagogy

Shulman (1987) defined pedagogy as the expertise the teacher brings in instructional strategies that promote learning. Pedagogical knowledge is also a critical piece in science teaching and understanding of its role is necessary to support effective science instruction (Magnusson, Krajcik, & Borko, 1999). Magnusson, Krajcik, and Borko, (1999) described this pedagogical knowledge as the teacher understands how to assist students comprehend specific subject matter and includes the recognition that learning can be organized and adapted to meet the diverse needs of all learners.

Freire (2007) suggested that teachers must possess political clarity in order to be able to effectively create, adopt, and modify instructional strategies that both respect and challenge learners from diverse cultural groups in a variety of learning environments. Teachers with this kind of clarity recognize that their work is not politically neutral and “... that schools are socializing institutions that mirror the greater society’s culture, values and norms” (Bartolome, 1994, p. 4). Regarding instructional considerations for the ELL student, Bartolome (1994) cautioned, “Although it is important to identify useful and promising instructional programs or teacher mastery of particular teaching methods, in and of themselves, will not guarantee successful student learning, especially when we are discussing populations that historically have been mistreated and miseducated by the schools” (p. 2). Rather than focusing on teachers’ beliefs about ELL

students or schools' deficit views of subordinated students, Bartolome (1994) suggested that the solution to the achievement gap is often erroneously described in terms of finding the "right" teaching strategies that will work with students who have not responded to "normal" instruction.

In a discussion of quality science instruction for ELL students, De la Cruz (2001) noted the importance of fostering favorable and lasting impressions of science that will inspire students to continue building their knowledge. De la Cruz (2001) suggested that teachers need to alter the way they think about science and their role in teaching it. It is what the instruction looks like, and for the teacher of ELL children, it's the awareness of specific instructional strategies that will meet their needs (De la Cruz, 2001). For example, Carlo, et al. (2004) stated, "ELLs are less able to use context to disambiguate the meaning of unfamiliar words because a higher proportion of words in text is likely to be unknown to them" (p. 200). Similarly, in terms of planning effective science instruction for ELL students, Haynes (2007) suggested that teachers need to be aware that science vocabulary can be difficult for ELL students because it is filled with cognates (i.e., words of similar derivation or descent) and words with Latin prefixes or suffixes. Haynes (2007) further explained that this vocabulary can be even be more challenging, because words students may already know, such as *work* or *building* have another meaning in science. Additionally, Haynes (2007) suggested when studying science, ELL students faced additional challenges such as following multi-step directions, understanding visuals and drawings, using science labs or equipment, and making hypotheses during the discovery process in science lessons. And finally,

according to Furtak and Alonzo (2009), in many science classrooms there may be a heavy focus on students taking part in hands-on activities. These authors continue that hands-on activities are often implemented with the hopes of building positive attitudes, thus little emphasis may be placed on learning and content-related goals. As a result, student engagement in hands-on activities may not serve as a true indicator of students' understanding of scientific concepts (Furtak & Alonzo, 2009).

Scientific understanding and inquiry. *The National Science Education Standards* (National Research Council, 1996) defined inquiry as "... the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Inquiry also refers to the activities of students as they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world" (p. 26). These standards also emphasized the use of investigative inquiry as a hands-on-minds-on teaching methodology in science instruction that encourages higher order thinking. Sandoval and Reiser (2004) defined inquiry science as "... a process of asking questions, generating data through systemic observation or experimentation, interpreting data and drawing conclusions" (p. 345). This instructional methodology has also been described as an approach that properly emphasizes discovery and inquiry through science process skills that include opportunities to engage in inquiry and discovery (Staver & Small, 1990). Perkins (1992) stated, "The conventional pattern says that first students acquire knowledge. Only then do they think with and about the knowledge they have absorbed. But it is really the opposite: Far from thinking coming after knowledge, knowledge comes on the coattails

of thinking. As we think about it with the content we are learning, we truly learn it” (p.

8). Bybee (2006) described the features of inquiry in the science classroom as:

- Learner engaged in scientifically oriented questioning,
- Learner gives priority to evidence in responding to the question,
- Learner uses evidence to develop an explanation,
- Learner connects the explanation to scientific knowledge, and learner communicates and justifies the explanation (p. 9).

The use of inquiry in the classroom emphasizes true learning occurring through students’ ideas, questions, and understanding (Fosnot, 1996; Wu & Tsai, 2005). True learning does not occur simply through the delivery of knowledge by the instructor (Fosnot, 1996; Wu & Tsai, 2005) while students assume the role of passive learners (Jorgenson & Vanosdall, 2002). Eick (2003) describes inquiry as science in action – a way of doing science rather than reading it about it in textbooks or completing worksheets. As part of a quality educational experience, inquiry moves students from knowing about to knowing how and gaining a clearer understanding of the nature of science (Eick, 2003).

Allison and Harklau (2010) further described the critical role of inquiry in the classroom:

The opportunity to go beyond the text’s literal meaning through both cognitive strategies and critical literacy demands the creation of inquiry spaces where students are apprenticed in language, using practices that support their initial attempts to connect their historical and scientific understandings with other texts, their experiences, and their understanding of the world (p. 175).

Inquiry is also described as teachers providing opportunities for students to engage in process skills such as observation, classification, measurement, and conducting controlled experiments in authentic contexts (Crawford, 2007). Carey and Smith (1993) emphasize that in order for these process skills to become meaningful to the student, they must be taught in the context of authentic science activities. These activities investigate the everyday world and develop a deeper understanding rather than rote memorization of scientific facts (Marx, Blumenfield, Krajcik, Fishman, Soloway, & Geier, 2004) .

The National Resource Council (2000) has stressed the importance of teachers engaging in the practice of inquiry in the teaching of science. Yet, according to Crawford (2007), generally, teachers are not accepting of this recommendation. Indeed, teachers may lack the skills necessary to create classrooms which are inquiry-based and thus are unable to support students in expanding their understanding of science through the use of inquiry (Crawford, 2007). Therefore, one additional issue which arises is the place of inquiry in the classroom. Crawford (2007) defined inquiry as "... a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena" (p. 614). However, the debate that may arise from questions posed in the classroom may make many teachers uncomfortable. While arguing may be viewed as a negative practice, in science education, it is the method which allows learners to "... tease out as much information and understanding from the situation under discussion, as possible" (Duschl, Schweingruber, & Shouse, 2006, p. 33). According to Duschl, Schweingruber, & Shouse (2006), an even greater challenge

occurs when the teacher is required to facilitate classroom debate. Such debate requires knowledge of both science content and what is scientifically productive for children's discussion skills which some teachers may feel lies outside the scope of their role in the classroom (Duschl, Schweingruber, & Shouse, 2006). This may be especially true if the teachers view their role in more traditional terms as the chief dispenser of information (Duschl, Schweingruber, & Shouse, 2006).

Even if trainers of science teachers are successful in getting them to understand the nature of scientific inquiry, the real challenge may exist in incorporating that understanding into the curriculum which teachers need to teach (Crawford, 2007). Howes, Lim, and Campos (2008) have described inquiry based teaching as "... involving the ways in which teachers support students' questions about the natural world, and the ways in which teachers encourage students to look to the natural world for data to address these questions" (p. 190). Furthermore, according to Furtak and Alonzo (2009), how teachers understand the implementation of inquiry-based strategies has an impact on the way inquiry may occur in the classroom. These researchers posit that the use of inquiry-based strategies may actually contradict a teacher's beliefs and understandings about the teaching of science. The difficulty in reforming science instruction may not only be connected to a teacher's beliefs, but also those beliefs connected to the use of an inquiry-based approach in the classroom (Furtak & Alonzo, 2009). Therefore, another key question to consider may be what exactly does inquiry look like in the classroom in terms of student engagement? According to Crawford (2007), when inquiry is present as an instructional strategy, students have the

opportunity to engage in such activities as framing questions, grappling with data, creating explanations, and critiquing explanations. Additionally, students have numerous opportunities to develop higher order thinking skills by addressing complex questions through the use of evidence (Crawford, 2007; Genesee et al., 2006).

Student engagement in science instruction takes different forms throughout the literature. Those forms include active participation in scientific observations and experimentation (Genesee et al., 2006). There is research, though, on successful classroom instruction that has effectively implemented the use of inquiry. For example, Mason (1998) investigated the role of “talking-to-learn” in group discussion and “writing-to-learn” in individual work. In this research, fifth grade students participated in a study unit on ecology and engaged in peer tutoring and reflective writing. Mason (1998) in this study explored the educational contexts which facilitated and sustained conceptual change in science domains. Students were able to construct more advanced knowledge through these “talking-to-learn” group discussions. The emphasis on classroom discussions facilitates making meaning through interaction with other people, mediated through language. While discussion is clearly important, Mason (1998) also suggested that writing can be used “... to connect pre and new knowledge, explain concepts, clarify thoughts, and make thinking processes overt reflect on conceptions, synthesize new ideas” (p. 361). Here, Mason (1998) asserted that writing is an effective science instructional strategy and serves as a valuable tool to evaluate low comprehension levels and mastery of knowledge. Reflective writing and meaningful

learning can arise from writing when connected to authentic conversations with peers (Mason, 1998). Mason (1998) stated:

Writing that engages students in reflecting upon their own alternative conceptions, in reconciling them with new information and available evidence may be an effective tool to enhance conceptual change, particularly when combined with group critical examination of those conceptions within a collaborative learning environment (p. 361).

In terms of effective science instruction for ELL students, inquiry-based programs in science have proved to be instructionally effective for students from traditionally marginalized groups (children of color, females, and those from disadvantaged backgrounds) (Jorgenson & Vanosdall, 2002). Additionally, Cuevas, Lee, Hart, and Deaktor (2005) studied students who had the opportunity to engage in inquiry experiences throughout science instruction. In this study, instructional practice resulted in increased achievement for all students regardless of grade, achievement, gender, ethnicity, socioeconomic status, home language or English proficiency. Additionally, the greatest gains occurred with ELL students and students of low socioeconomic status (Cuevas, Lee, Hart, & Deaktor, 2005). This finding is supported by Haberman (2006), who stated, “In order to teach science however, students must be engaged in a systematic process of inquiry that leads them to question, observe, measure, analyze, and evaluate. While some [administrators and teachers] simply refer to this process as thinking, it is an unnatural act in most urban schools” (p. 41). The National Research Council (1996) suggested that inquiry which arises from the ELL student’s

own experience is essential to learning science. Research also supports that the most effective use of inquiry-based science instruction provides the ELL student with a view of scientific knowledge that can be used to solve real-world problems that are applicable to their own lives (Songer, Lee, & McDonald, 2003). However, Fradd and Lee (1999) cautioned that simply because a teacher may understand their students through sharing the same language and culture, it cannot be assumed that the teacher is familiar with expectations for science or the inquiry process. These authors stated, “Engagement in science inquiry requires more than learning to ask and answer questions. It also requires new ways of thinking and organizing instruction, including mediating students’ cultural expectations and prior knowledge with the practices of the science community” (p. 14). Similarly, Amaral, Garrison, and Klentschy (2002) have also indicated that the use of inquiry-based instruction is an effective method for teaching science to ELL learners. Their 2002 study summarized the results of a four-year project that included “kit-and inquiry-based science instruction” (p. 213). Through the practices prescribed by this type of instruction students had meaningful opportunities to actively use academic language. Results indicated that there was a positive correlation between teachers who had participated in this project the longest and the achievement of ELL students (Amaral, Garrison, & Klentschy, 2002). Specifically, Amaral, Garrison, and Klentschy (2002) concluded that the longer teachers participated in the program, the higher ELL students’ achievement was in science, writing, reading, and mathematics. These researchers also provided additional reasons why inquiry-based science may benefit ELL students such as providing a context in which students can continue to develop reading

skills as well as mathematics skills. Amaral, Garrison, and Klentschy (2002) concluded, “Because of the nature of instruction in inquiry-based science, it is considered a good approach for English learners, regardless of classroom type” (p. 236). Similarly, Haynes (2007) suggested that ELL students are able to grasp content much sooner through a hands-on inquiry method. Therefore, inquiry-based instruction seems to be an appropriate instructional practice for the support of linguistically diverse students. That is, inquiry-based instructional practices likely allow ELLs to develop deeper learning and problem solving skills in a more authentic manner.

Fradd and Lee (1999) indicated that the broad educational impact of ELL students being able to engage effectively in inquiry goes beyond learning science:

In addition to the relationship of language proficiency and literacy, effective participation in inquiry promotes strategies for learning in general. Students learning to engage in inquiry often require an understanding not only of science as a body of knowledge, but also as a set of strategies, habits of mind, and world views (p. 19).

Pedagogical content knowledge. Shulman (1986) questioned the sharp division between content and pedagogy and suggested a special domain of teacher knowledge that he defined as pedagogical content knowledge (PCK). Shulman (1986) claimed that the emphases on teacher’s content knowledge and pedagogy were erroneously being treated as mutually exclusive domains. Therefore, he proposed the consideration of the relationship between the two, calling for the study of three types of content understandings and their impact on classroom practice: subject matter knowledge,

pedagogical knowledge, and pedagogical content knowledge (Shulman, 1986).

Magnusson et al. (1999) described PCK as the *transformation* of several types of knowledge for teaching: “(a) orientations toward science teaching; (b) knowledge and beliefs about science curriculum; (c) knowledge and beliefs about students’ understanding of specific science topics, (d) knowledge and beliefs about assessment in science, and (e) knowledge and beliefs about instructional strategies for teaching science” (p. 97). In Ball’s (2000) discussion of Shulman’s work on PCK as the linking of knowledge and pedagogy, she described this concept in the following way:

Included [in PCK] is knowledge of what is typically difficult for students, of representations that are most useful for teaching a specific idea or procedure, and of ways to develop a particular idea, for example, the ordering of decimals or interpreting poetry. What are the advantages and disadvantages of particular metaphors or analogies? Where might they distort the subject matter? (p. 245).

Ball (2000) also examined the extent to which good teaching depends on the knowledge of subject matter and to what extent does it rely on pedagogical skill. Her research focused on the importance of merging content with pedagogy within the context of the teacher’s work. Ball (2000) wrote that this skill is “... fundamental to engaging in the core tasks of teaching, and it is critical to being able to teach all students well” (p. 241). She described three problems that must be addressed if we are to prepare teachers to not only know content, but how to teach that content so that all students can learn. Those problems are (1) identifying content knowledge that matters for good teaching; (2) understanding how such knowledge must be understood to be usable in teaching; and

(3) understanding what it takes to learn to use such knowledge in classroom practice (Ball, 2000).

Additionally, Sherin (2002), in her work on the relationship between content knowledge and the implementation of mathematics instruction reform, suggested that while current models of teachers' knowledge contend that both knowledge of content and knowledge about how to teach the content are essential for effective teaching, they do not explain how this knowledge is used in the act of teaching. Sherin (2002) advocated a reform that requires teachers to learn as they teach. That is, rather than using established practices, teachers must apply their existing content knowledge more flexibly. She suggested that if learning of new pedagogical routines is to occur, teachers must have the opportunity to negotiate among three areas of their content knowledge: their understanding of the content knowledge, their view of curriculum materials, and their knowledge of student learning. Sherin (2002) had set forth a framework in her research which included changes in instructional materials, pairing the use of these materials with new instructional strategies, and directing classroom discourse through posing appropriate questions for students to consider, thereby helping students to explain and justify their ideas in class.

In summary, any reform focused on science instruction for ELL students must also consider the teachers' understanding of NOS as this knowledge clearly plays a role in supporting science literacy (Abd-El-Khalick et al., 1998). Also, reforms must include strategies to enhance teachers' content knowledge of science and pedagogical skills which incorporate the use of inquiry in the instruction of science (Yore, Anderson, &

Shymansky, 2005). Moreover, reforms must be inclusive of pedagogical content knowledge where the teacher may interpret science content and find different ways to represent it, making it accessible to learners (Magnusson et al.; 1999; Schulman, 1988). However, addressing these issues without reflection on the role of culturally responsive instruction would ignore the needs of the ELL student in science instruction. Lee (2005) suggested there has been little recognition of the linguistic and cultural resources that ELL students may bring to the science classroom. Even less thought has been given to understanding how to integrate these linguistic and cultural resources with science instruction in order to enhance student learning. Therefore, the following discussion addresses the issue of the use of culturally responsive practices in the science classroom.

Culturally Responsive Science Teaching for ELL Students

In the introduction of the book edited by Reyes, Scribner and Scribner (1999) on high performing Hispanic schools, Scribner writes on the educational vulnerability of Hispanic youth. Scribner states: “While educational reform movements of the past two decades have targeted improvements that largely benefit mainstream students, a major segment of culturally and linguistically diverse students face almost impossible challenges in the process of acquiring an education” (p. 1). According to Valenzuela (1999), schooling for these students may be viewed as a *subtractive* process. She stated, “[Schooling] divests these youth of important social and cultural resources, leaving them progressively vulnerable to academic failure” (p. 3). From a review of literature, it seems that the goal of culturally responsive instruction is to support students in meeting the challenges of acquiring an equitable education. Villegas and Lucas (2002) described

a culturally responsive lesson as one that creates instructional situations where teachers use instructional approaches and strategies that recognize and build on culturally different ways of learning, behaving, and using language in the classroom. Culturally responsive instruction is one in which “... all students are encouraged to make sense of new ideas—that is, to construct knowledge that helps them better understand the world—rather than merely to memorize predigested information” (Villegas & Lucas, 2002, p. 28).

In a synthesis of research by Genesee et al. (2006), these authors suggested the characteristics of an effective instructional program for an ELL student include teachers sharing the belief that all children can learn and providing a positive, authentic school environment. In a public school setting, the goal of science education is to engage diverse groups of students in science activities and dialogue that support meaningful learning (Upadhyay, 2009). De la Cruz (2001) also suggested science instruction included opportunities for analytical reasoning that will enable an ELL student to organize ideas, understand what they are studying, explain their thinking, and problem solve.

However, Skrla and Scheurich (2004), in their work on educational equity and accountability, stated, “Even though virtually every U.S. school has a mission statement containing some form of the aphorism ‘all children can learn,’ actual practices and programs in these same schools are suffused with deficit views of the educability of children of color and children from low income homes” (p. 107-108). Indeed, one important way that teachers can affect their students’ achievement is through the

expectations they hold for them, as these beliefs about their students' abilities can either enhance or reduce their school performance (Gándara & Contreras, 2010; Scribner, 1999).

In terms of equitable science instruction for all students, Lee (2005) stated:

School science fails to provide equitable learning opportunities to nonmainstream students by (a) ignoring the ways in which their linguistic and cultural knowledge articulates with science disciplines and (b) not offering educational resources and funding at levels comparable to that available for mainstream students (p. 438).

Further, even if a teacher embraces the practices that promote instruction for all students, she may still encounter “cultural clashes” between the real life world of the student and the world of Western science (Aikenhead & Jegede, 1999; Lee, 2003). Delpit (2006) described this clash occurs in two ways:

[First] when a significant difference exists between the students' culture and the school's culture, teachers can easily misread student aptitudes, intent, or abilities as a result of the difference in styles of language use and interactional patterns.

[Second], when such cultural differences exist, teachers may utilize styles of instruction and/or discipline that are at odds with community norms (p. 166).

Knight and Wiseman (2005) also support teachers possessing knowledge of the home cultures of the students in their classroom. According to Knight and Wiseman (2005), no matter the teacher's own race, ethnicity, or socioeconomic status, they “... may not be aware of characteristics or communication patterns of diverse learners that relate to learning and performance, or they may not be aware that there are instructional

procedures that respond appropriately to diverse students” (p. 389). Lee, Luyks, Buxton, and Shaver (2007) suggested that many teachers are unaware of linguistic and cultural influences on student learning, and therefore may not consider “teaching for diversity” as their responsibility. Therefore, they may purposefully overlook cultural/racial differences, accept inequities as a given condition, or resist multicultural views of learning. Haynes’s (2007) research into students’ worldviews and their reaction to science instruction revealed that the goal must be to develop culturally sensitive teaching methods that reduce the “foreignness” students may experience in learning and applying scientific concepts. Haynes (2007) stated:

Exemplary teachers view diversity in their classrooms as a positive rather than a negative influence. You will never hear these teachers complain about having English language learners in their classes. They know that families with diverse linguistic and cultural backgrounds have unique experiences to share with their classmates. They are confident that this knowledge will enrich the native English-speaking students in their class and help them learn to respect diverse cultures. These teachers make students from diverse backgrounds feel that their cultures are important, and the students are proud when their home cultures and languages are studied in the classroom (p. 84).

According to Sergiovanni (1992), competent educators should find students’ cultural and linguistic differences rewarding and feel a moral commitment toward their education. The goal is for “enculturation” to occur in the classroom, where the culture of science synchronizes with the student’s view of the world (Wolcott, 1991). However,

Wolcott (1991) suggested that when science instruction forces a student to marginalize his world understanding and is forced to memorize scientific concepts that are not meaningful to him, the student “assimilates” his knowledge which gives way to alienation from science. So, rather than learning content in a meaningful way, the goal for the student then becomes to find quick and easy ways to pass the course (Baker & Taylor, 1995). According to De la Cruz (2001), it is critical that instruction occurs in a way that supports students in making connections between new information and things they already know. Research on schools populated by ELL students supports these results. Scribner (1999) stated, “Classroom experiences in the high-performing Hispanic schools are typified by teachers engaging students in a learning process that maximizes excellence and equity” (p. 4).

With regard to teachers’ attitudes toward students who attempt to negotiate the understandings of scientific knowledge through their own language and culture, Lee and Fradd (1998) wrote:

In science education research, researchers’ and teachers’ evaluations of children’s talk as scientific or not derive in significant part from their view of what constitutes scientific practice and ways of knowing. Often, the ways of talking, making arguments, and developing theories which are thought to constitute science are seen as distinct from the linguistic and social practices used in everyday life, especially those used in certain minority communities (p. 546).

According to Lee and Fradd (1998), students who attempt to construct scientific concepts in their own language and view them through their own cultural lens run the

risk experiencing teaching and teachers who rarely taking their contributions seriously, except to correct them. Research from Warren, Ballenger, Ogonowski, Rosebery and Hudicourt-Barnes (2001) supports these results. They wrote, “Thus, a narrow view of what constitutes scientific ways of knowing can lead to a narrow range of responses to some children’s ideas, which in turn can lead to limited participation by these children in science” (p. 547). While content area instruction necessitates student achievement of English language skills and literacy development, this requires teachers to engage in a process of integrating the nature of the academic content with the language of the student along with his cultural experiences in order to make science learning meaningful (Genesee et al, 2006; Lee & Fradd, 1998; Warren et al., 2001). In Lee’s (2005) synthesis of research on science education with ELL students, she concluded:

Learning environments that articulate the relation of science disciplines with ELL’s linguistic and cultural practices enable them to capitalize on their experiences as intellectual experiences for science learning and to explore and construct meanings in ways that relate science to their linguistic and cultural identities. Ideally, students could become bilingual and border crossers between their own cultural and speech communities and the science learning community, able to perform competently in a variety of contexts (p. 512).

In order for students to develop an understanding of science as a relevant and purposeful skill, instructional practices must connect science learning to real-life problems and situations (De la Cruz, 2001). Duschl, Schweingruber, and Shouse (2006) also provided some guidance regarding meeting the needs of ELL students in science.

They described the importance of making explicit the norms and patterns of thinking in the classroom that support science instruction. They stated, “If what is valued is left for students to figure out, then those who have had greater home experience with those patterns of thinking will have clear advantage” (p. 192). Additionally, as students begin to comprehend new ways of thinking about science, Duschl, Schweingruber, and Shouse (2006) suggest that teachers should integrate the students’ culture and language into the new knowledge in order to make it relevant, accessible, and meaningful. These authors wrote:

Students need opportunities to explicitly consider and master new ways of thinking while teachers balance challenge and comfort by ensuring that students understand that their own home norms and practices are valued even as they encounter some that are less familiar (p. 192).

Enyedy (2007) suggested an analysis of the similarities and differences in the quality of classroom interactions will provide information on how various practices are connected to learning outcomes. This knowledge, however, does little to explain the variations observed in teaching. Thus, as Enyedy, Goldberg and Welsh (2007) suggest, the question remains: Why do competent teachers in similar settings make different instructional decisions in their interactions with both the curriculum and their students?

Becoming an effective science teacher involves more than gaining new skills and knowledge. Rather it is the ability to develop a new professional identity as a “reformed minded science teacher” (Luehmann, 2007, p. 823). However, in this era of accountability, the emphasis on teaching to the test may force the teacher, who normally

engages in science instruction through culturally responsive practices such as inquiry and hands-on learning activities, to renegotiate her professional identity (Villegas & Lucas, 2002). Additionally, as Diamond and Spillane (2004) suggest, in schools with large populations of historically marginalized students, science teachers may not get the opportunity to implement the most innovative and culturally responsive teaching strategies, because of their concerns about test scores.

Research has also revealed the importance of school leadership and its impact on a school's culturally responsive practices. González (2002) found in her study of elementary schools that were successful with Latino students, the school leaders of the campuses honored and took advantage of the Spanish language and Hispanic culture. She stated, "Instead of seeing differences as deficiencies, they have a passion for high expectations and hold those involved in the school process—from staff to students and their families—to this tenet" (González, 2002, p. 25).

In the context of the superintendency, Skrla and Scheurich (2004) wrote that leaders of districts where most of the children are of color and grow up in poverty may be affected by deficit thinking. The authors stated:

Whether it is conscious or not, these superintendents' explanations of, and expectations for, what is possible educationally for the children in their districts are shaped by the larger deficit educational discourse that assumes these children will not succeed in school (p.108).

In summary, the above strand of literature indicates that much scholarship focuses on the role the teacher plays in providing quality science instruction in the

classroom. Teachers must be aware and sensitive to a student's individual learning and environmental circumstances in order to meet their educational needs (Fraser-Abder, 2010). However, the role of school leadership must also be considered. Research indicates a strong and significant relationship between educational leadership and student learning (Gamoran, Anderson, & Ashmann, 2003; Witziers, Bosker, & Kruger, 2003). In the following section I discuss the role of school leadership in supporting instructional practices in the ELL science classroom. I also discuss professional development as a way to ensure proper implementation of effective classroom strategies for linguistically diverse students.

School Leadership for Science Teachers of ELL Students

In a discussion of the importance of having visionary and purposeful leaders who can initiate and facilitate change in schools populated by ELL students, Goldenberg and Sullivan (1994) described this type of leadership as "... the cohesion that makes the other elements and components" (p. 11) of a program work together to create positive changes and without it, serious and long lasting school achievement is impossible to attain. Their research described a school improvement project focused on elementary school with a large percentage of Latino students in California. Components of this program included 1) opportunities for teachers and staff to engage in setting academic expectations for their students; 2) consistent use of achievement indicators and effective disaggregation of data that arises from the assessments; and 3) assistance by stakeholders of the campus that are capable of maintaining the goals part of the contest for initiating and maintaining school improvement; and 4) leadership that supports and

pressures. Of the four, Goldenberg and Sullivan describe leadership as the factor that is most closely associated with school improvement: “*Goals* cannot be articulated nor accepted, *indicators* cannot be developed nor implemented, and *assistance* cannot be systematically nor strategically provided” (p. 11). Further, Goldenberg and Sullivan (1994) discuss the seemingly opposing roles of school leadership – supporting and pressuring teachers. They stated:

Although these two appear to be at odds, we see them as complementary and as producing a creative tension. The skillful principal—indeed, the skillful leader—will know when to exercise one or the other or both simultaneously. We speculate that this tension is perhaps the most elusive, but important, aspect of leadership (p. 11).

González, Huerta-Macias and Tinajero (2002) and Reyes, Scribner, and Scribner (1999) each examined schools that were highly successful and served predominantly Hispanic students. These researchers sought to understand the kind of leadership these schools used to achieve and maintain academic excellence. Reyes, Scribner and Scribner (1999) work involved research in eight schools in south Texas that were largely populated by Hispanic students. González, Huerta-Macias and Tinajero (2002) examined principal leadership in three elementary schools located in the Southwest where the majority of the student population was Latino of Mexican descent. In both studies, the analysis of these campus leaders’ success revealed some common elements in their practice. The following discussion identifies these common elements and the leaders’ role in supporting quality science instruction.

Common Themes in Successful School Leadership for ELLs

Empowerment of stakeholders. An essential piece of school success included open communication and collaboration through the sharing of ideas among committee members, department heads, administrators, and teachers (Wagstaff & Fusarelli, 1999). In the Reyes, Scribner, and Scribner (1999) study, both teachers and parents were part of school based decision making teams, and each felt that their concerns and suggestions were listened to and taken seriously. The principal of the one of the participating schools suggested their success with communication between teachers and parents was because the school used a variety of communication tools including activity calendars and parent newsletters (Reyes, Scribner, & Scribner, 1999). Reyes, Scribner, and Scribner (1999) stated, “In an organization as complex as a school, open communication among administrators, staff, teachers, parents, students, and the community is essential for success. A system of open communication allows more people to become involved and participate in schools” (p. 33). González, Huerta-Macias and Tinajero (2002) also described the campuses in her study as having high levels of parent engagement. Rather than depend on traditional methods, such as the Parent Teacher Association that may not address the needs or interests of Latino families, the principals in this study enlisted support from students’ families through creating a campus atmosphere that was welcoming and accepting. In describing their “unified focus” (González, Huerta-Macias & Tinajero, 2002, p. 7), a principal in this study remarked that previously, parents and teachers expected her to solve problems, but with the expectation of collaboration, parents and teachers were empowered to find their own solutions. Moreover, this study

described a school improvement team at this school which was charged with the responsibility of goal setting, recommending provisions, and policy revisions. These leaders were successful with parents and community members. As such, the leadership in these schools supports scholarship from Valverde (1999) who emphasized not only the importance of the principal as communicator and community builder, but as someone who empowers stakeholders as they seek academic excellence.

Cultural competence. Pedroza (1993) described the principal's role as one which focuses on and builds on the diversity of the community. She stated:

A culturally competent administrator is a school leader who has clarified his/her own values and thinking regarding cultural incorporation, who has taken steps toward understanding the community culture, who has examined the relationships between his/her own cultural identity and that of the community, and who is willing to acknowledge that conflict can arise from a misalignment of perceptions or miscommunication or misunderstanding of cultural norms.

Recognizing the richness of diversity and a willingness to act as a culture broker between the school and the community defines the culturally competent administrator (p. 13).

Wagstaff and Fusarelli (1999) indicated that the leaders in the Reyes, Scribner, and Scribner (1999) study of high-performing schools, rejected deficit thinking and possessed the belief that their students "... who traditionally had been labeled as disadvantaged were just as bright and capable as those who are more advantaged" (p. 27). This finding is consistent with González (2002) who indicated that the building

leaders in her study possessed strong instructional leadership skills in ensuring culturally responsive instruction took place on their campus. She suggested it was the “culturally competent principal” (p. 26) that lies at the heart of the success for schools serving Latinos (González, 2002).

González (2002) suggested that these leaders’ work exemplified the philosophy of finding their students’ linguistic and cultural differences rewarding, and feeling a moral commitment to their students. Their goal was to create a school climate that values cultural and linguistic diversity. These results are consistent with Lee’s (2003) work on equity in science instruction. Lee (2003) stresses that there needs to be an awareness of schools staffs regarding the disconnect between students’ own cultural knowledge and science content knowledge, and also between the “primary discourse in the home and community and secondary discourse in school” (p. 406).

Knowledgeable and innovative. All three principals in the González (2002) study were considered innovative and enhanced their knowledge about curriculum and instruction through the avid pursuit of research and professional literature. Other studies affirmed this finding, that campus leaders possessing a thorough understanding of the research and pedagogy, and who are prepared to advocate for the programs that best meet their students’ needs, are those most likely to be successful with ELL students (August & Hakuta, 1997; Genesee et al., 2006). The three principals in González’s (2002) research also shared their knowledge with their teachers, and at times, communicated to their staffs, the expectation that the practices gleaned from this information would be implemented in the classrooms. Regarding this collaborative

piece, other research has indicated discussions and ideas shared among the school staff should focus on critical questions such as, Who benefits from what goes on here? and What does this mean for school improvement? (Hunsaker, 1992). According to González (2002), these principals also possessed the background and technical knowledge in ELL instructional practices and had ample experience in ELL/bilingual classrooms. González (2002) explained:

All three [principals] see the education of Latinos as integral part of the school's program. Instead of leaving this responsibility solely in the hands of ESL [English as a Second Language] or bilingual education teachers, they take full responsibility in seeing that the programs are implemented and integrated into the academic program of the school (p. 24).

Sharing of a vision of high expectations. The Reyes (1999) study indicated that promoting a shared vision is one of an administrative leader's most important tasks. They stated, "It is essential that administrators, staff, teachers, parents, students, and the community share a common vision for success and have a detailed plan for achieving that success" (p. 33). Valverde's (1999) research also supports this finding and suggests that through constant communication of the school's vision to the staff, faculty, and community, a partnership may form in which all three stakeholders are motivated to support student achievement.

In Gamoran, Anderson, and Ashmann's (2003) study of the type of leadership that supports teachers to increase students' scientific and mathematical thinking skills, the authors found "... little evidence that articulating a vision for mathematics and

science teaching and learning was a major task for principals” (p. 111). It seems clear that a campus leader may foster the generic “all children can learn,” but rarely is there a vision promoted specific to science or mathematics. However, McKenzie, Skrla, Scheurich, Rice, and Hawes (2011) conducted a study on urban high schools experiencing academic success in math and science instruction. They stated, “The focus of the leadership for these high schools, then, was on continuous improvement of instruction for all students, minimization of distractions from this purpose, and persistent avoidance of ineffective practices” (p. 110). It seems that for most low performing schools, the instructional practices that support the belief that all children can learn are not well implemented to foster academic achievement across content areas. However, it is evident from that work of McKenzie et al. (2011) when these practices are effectively in place, they give rise to substantial student achievement,

Leadership styles. The administrators in both the Reyes (1999) and González (2002) studies were aware that teachers were indispensable to school effectiveness. Researchers in the Reyes (1999) study described a variety of common behaviors that supported this belief, such as modeling a positive attitude and commitment, being dedicated to their students, and being open about what they expected from their teachers (Wagstaff & Fusarelli, 1999). The campus leaders’ active engagement and dedication to their students inspired their teachers to also go the “extra mile.” In these schools, principals built an atmosphere of trust and respect for all stakeholders. Also, these leaders respected teachers’ individual styles and worked with them to increase student success. The Wagstaff & Fusarelli (1999) stated,

Administrators need to recognize that they don't have all the answers to improving education and must be willing to respect the judgment of the professional teaching staff. This includes learning to let go, get out of the way, and provide the means for staff to solve their own problems (p. 33).

Additionally, Wagstaff and Fusarelli (1999) indicated that campus leaders viewed one of their roles as someone who should secure resources for their teachers. These results were consistent with the research of Spillane, Diamond, Walker, Halverson and Jita (2001). Through the theoretical lens of distributive leadership, Spillane et al., (2001) examined how school leaders pull resources together to enhance science instruction; despite the fact that the other core subjects, such as math and the language arts, may be utilizing the bulk of resources. Distributed leadership occurs when the school leadership is spread or divided among formal and informal leaders in the school (Spillane et al., 2001). Spillane et al. (2001) clarified: "Our distributed perspective, however, goes beyond considering a division of labor for leadership functions to argue that the thinking and practice of leadership is stretched over school leaders and the material and symbolic artifacts in the environments" (p. 920). Therefore, according to the research, it is the identification of these resources and their activation to support leadership for science instruction that will lead to improvement in science instruction. Spillane et al. (2001) also proposed that there are three dimensions of resources for leadership: (a) physical resources including money and other material assets; (b) human resources including individual knowledge and skills; and (c) social capital or the relations among the participants that give rise to expectations of trust and collaboration.

However, Spillane et al. (2001) argue the mere possession of these resources is not sufficient to promote instructional change; rather it is the *activation* of resources to support leadership for science instruction that may distinguish one school from another. Specifically, Spillane et al. (2001) explored what strategies school leaders utilized to mobilize resources for science education leadership, and concluded:

The strategies of action engaged in by social actors in school contexts are important. Although schools may be embedded in contexts with similar configurations of support, accountability mechanisms, and external resources for science instruction, some schools are still able to parlay these resources into substantive efforts to lead change in science instruction. We argue that the skill with which these resources are identified and configured by school leaders is important (Spillane, et al., 2001, p. 937).

Professional development. Staff training and ongoing professional development are essential components of effective schools for ELL students (Supovitz & Turner, 2000). Research emphasizes the positive relationship between quality professional development and an increase in the use of inquiry based instructional practices in science instruction (August, Beck, Calderon, Francis, Lesaux, & Shanahan, 2008; Darling-Hammond, 1996; Supovitz & Turner, 2000). The intent of professional development is to provide teachers with tools and resources needed for quality instruction, so that learners may acquire a deep understanding (Buczynski & Hansen, 2010). Research from Rosenholz (1986) indicated that the effect of staff development has little impact on improvement in classroom practice if it is not focused on a common

vision for the campus. Similarly, Newman, Rutter, and Smith's (1989) results suggest a limited effect of professional development unless the professional development activities are deeply connected to school goals. Finally, Guskey (2002) argues that if professional development is to foster lasting change, the campus leader must seek change in practice before change in a teacher's attitude. Guskey's (2002) rationale was that once the teacher witnesses student achievement from the implementation of new learning, acceptance of new practices will follow.

These results are consistent with studies by Reyes (1999) and González (2002) of the high-performing schools, where continuous improvement was attributed to consistent high quality and meaningful professional development. In the Reyes (1999) study, Wagstaff and Fusarelli (1999) described the professional development at the high-achieving schools as taking a variety of forms such as visiting other campuses, staying current with the professional literature, and utilizing train-the-trainer models. In González's (2002) study of three successful elementary schools, both the administration and teachers engaged in ongoing professional development. Regarding one of the schools in the study, González (1991) stated, "The undergirding theme is that there is no sole expert, and the group must pool its knowledge to obtain the staff development they need and desire in their school" (p. 9). Additionally, it is worth noting that low quality professional development may promote classroom practices that continue to support deficit assumptions about the performance of traditionally underserved students (Scribner, 1995). This finding is particularly profound for educators concerned with issues of educational equity.

A synthesis of research authored by August and Hakuta (1997) on professional development for teachers of diverse students is consistent with findings on the connections between high quality professional development and effective teachers. August and Hakuta (1997) stated, “Researchers cite a need to recruit more teachers and provide high-quality development experiences to both preservice and inservice teachers serving these students, particularly given the continuing rapid increase in the number of students” (p. 252). Professional development is essential to achieving the dual goals of promoting high academic achievement while simultaneously pursuing educational equity for diverse student groups (Lee, et al, 2007). In fact, research has documented incidents where professional development could have made a difference in circumstances where teachers used strategies that appeared to be ineffective in the ELL classroom (Akerson & Hanuscin, 2007; Buczynski & Hansen, 2010). Therefore, the school leader should work to attain current and substantial knowledge about trends in effective professional development and should be engaged in ongoing professional development activities for herself and her teachers (González, 1998).

However, Knight and Wiseman (2005) indicated that even as teachers are considered the “... catalyst of for a student’s academic success” (p. 388), they posited that finding professional development for teachers of diverse populations is difficult, and because the instructional approaches for diverse groups involve specialized knowledge and skills, generic professional development for these teachers may be inappropriate and ineffective. Knight and Wiseman (2005) also cautioned that the results from

professional development studies regarding the value of generic professional development for use in diverse classrooms has little research to support or refute it.

Thus, more serious than the issue of the quality of professional development for science instruction of ELL students, may be the total lack of it. Lee et al. (2007) states, “In the case of science instruction, most elementary teachers are not adequately prepared to teach science effectively, lacking both science content knowledge and familiarity with inquiry based science instruction” (p. 1,270). This research examined the impact of professional development focused on helping teachers incorporate elements of students’ home language and culture into science instruction. Lee et al., (2007) examined an integrated approach where teachers participated in a professional develop event which gave them an opportunity to simultaneously enhance their teaching of science inquiry, develop their students’ English language skills, and incorporate their students’ home language and culture into science instruction. The results indicated that as teachers began their participation in the intervention, they rarely incorporated students’ home language or culture into science instruction. Additionally, Lee et al., (2007) found teachers’ beliefs and practices remained relatively stable and did not show significant change based on completion of the professional development activity. These researchers suggested that the limited effect of the professional development intervention was due to a variety of factors including the limited availability of culturally relevant curriculum and pressures the teachers were under to meet accountability standards.

In terms of professional development for science teachers, according to the National Science Foundation (NSF) (2006), in the 1990’s professional development in

many school districts consisted of a single workshop with little support or follow-up with the teacher thereafter. Teachers attended professional development programs for only a few hours over the course of a school year, but not enough to bring meaningful change in teaching behaviors (NSF, 2006). To be effective, staff development must be long-term, as short term professional development was found not to be effective as teachers tend to quickly revert to their original teaching practices (Barrow & Sawanakunanont, 1994; Beck, Czerniak, & Lumpe, 2000). Often, unsuccessful professional development is delivered through a traditional method of top-down instruction and is regarded as isolated from the realities of the classroom (Buczynski & Hansen, 2010). Some professional development programs may also fail to take into account teachers' existing knowledge, beliefs, and attitudes, or dismiss the mitigating factors that could lessen the impact of the professional development (Verloop, 2001). For example, Bucynski and Hansen (2010) conducted a qualitative case study to measure the impact of a four-year ongoing professional development program on students' science achievement. While teachers transferred their learning to increase their science content knowledge and inquiry skills in their classrooms, other teachers encountered a variety of obstacles such as language learning and classroom management issues. Bucynski and Hansen (2010) concluded that strategies to deal with obstacles need to be in place to maximize the full impact of any science professional development offered. With regards to how much professional development teachers should experience, Supovitz and Turner (2000) indicated that teachers experiencing less than forty hours per academic year often reported less positive experiences with the implementation of

inquiry and investigative practices than those teachers that attended *no* staff development. Furthermore, these researchers found that for any improvement to occur, teachers would need to receive more than eighty hours of professional development per academic year

Interestingly, Furtak and Alonzo (2009) suggested that a teacher may focus on students enjoying their experiences in science class, specifically because teachers fear a replication of their own negative experiences when they were learning science as students themselves. These researchers posited that if teachers are presented the opportunities to tackle real science content through professional development activities, they will develop enough confidence to provide similar kinds of learning experiences for their own students (Furtak & Alonzo, 2009). Additionally, the research of Johnson and Fargo (2010) suggested that if staff development focusing on science instruction is to have a cumulative and lasting impact on teaching, it must not only provide the instructor with hands on experiences in science, but this training must also be ongoing and allow teachers to regularly reflect and debrief with peers about what is occurring in their classrooms. Duschl, Schwingruber and Shouse (2006) made the following recommendation regarding effective professional development to support science instruction:

State and local school systems should ensure that all K-8 teachers experience sustained science-specific professional development in preparation and while in service. Professional development should be rooted in the science that teachers

teach and should include opportunities to learn about science, and about how to teach science (p. 7).

Yore, Anderson, and Shymansky's (2005) work described a teacher enhancement project where the goal was to support teachers' implementation of new science instructional strategies as part of a school district's reform of curriculum. These researchers posited that professional development must be aligned to teachers' unique backgrounds, priorities, demands, and cultures. Furthermore, they suggested that the activities of professional development must support the work of the teacher. That is specifically, it must be authentic and worthwhile. Hill, Rowan, and Ball (2005) have also suggested that professional development programs should focus on supporting teachers' content knowledge, as this was viewed by the authors to have the greatest impact on teacher quality. However, results from a survey of principals conducted by Torff and Sessions (2009) indicated that professional development should focus on pedagogical issues. These authors concluded:

Professional development initiatives focused on content knowledge apparently miss the target, by providing additional training where it is least needed while failing to address the components of pedagogical knowledge that principals regard as the main causes of ineffective teaching. These initiatives ought to be devoted at least part of the time to the pedagogical skills pressed into action when teachers interact with students – classroom management skills, ability to establish rapport with students, and lesson implementation skills (p. 142).

Participation in professional development programs may be beneficial. However, most professional development programs do not consider the variability that may occur in the implementation of these skills in the classrooms. These differences may influence what, how much, and how well students learn science (Enyedy, Goldberg, & Welsh, 2007). Moreover, this variability arises from what Gándara and Contreras (2010) posited is the single most valuable resource in any school: the teacher. Therefore it is necessary to examine the literature on an important role of school leadership: the recruitment and retaining of quality teachers for linguistically diverse students.

Recruiting and Retaining Teachers of ELL Students

Scribner (1999) stated, “Dynamic teachers who can transcend language and cultural barriers can make a difference in the lives of Hispanic students” (p. 3). However, well-prepared and experienced teachers are in short supply (Scribner, 1999). Often, effective campus leaders of schools with ELL students strive to recruit and keep talented and dedicated staff. To do so they may engage in practices such as hiring bilingual staff whose cultural backgrounds are similar to those of the students and who may serve as role models (August & Hakuta, 1997). Nonetheless, research indicated that it is difficult for school districts to fill these positions with an adequate number of highly qualified individuals (August & Hakuta, 1997; Gándara & Contreras, 2010). Therefore, NCLB’s (2001) requirement that schools staff all classrooms with “highly qualified teachers” constitutes a major challenge. This is especially true for schools in inner-city and poor rural areas, as many of these schools serve a linguistically diverse

population (Darling-Hammond, 2003). In an issue brief from the Education Center of the National Governors' Association Center for Best Practices, Berry and Hirsch (2005) stated, "The pressure to find highly qualified teachers is especially felt in what are commonly described as hard-to-staff schools" (p. 2). This statement is remarkably disturbing as these schools often educate children living in poverty and children of color. Therefore these students are far more likely to be taught by inexperienced, underprepared, and less-effective teachers (Clotfelter, Ladd, Vigdor, & Diaz, 2004; Darling-Hammond, 2000). That is, as Darling-Hammond (1998) has suggested, students living in poverty and students of color are the least likely to be in a classroom of a highly qualified teacher. Additionally, according to Berry and Hirsch (2005), if a district is able to recruit a teacher to work in a low-income community with children that require individualized attention, retaining that individual is another challenge. It is not unusual for that teacher to leave after a few years for another teaching position that may pay more and be less demanding (Berry & Hirsch, 2005; Gándara & Contreras, 2010). Ingersoll (2001) reported teacher turnover as 50 percent higher in high-poverty than in low-poverty schools. Gándara and Contreras (2010) propose several solutions to this problem such as recruitment of teachers from within the community, as they already possess the knowledge and sensitivity of the culture. They also suggest additional targeted incentives such as scholarships and signing bonuses. Berry (2004) suggested that recruiting and retraining highly qualified teachers for hard-to-staff schools should focus on teacher pay and working conditions, early outreach, paraprofessional pathways, and alternative routes for nontraditional recruits.

While these incentives may prove to be effective in recruiting and retaining teachers, research has also supported the assertion that the quality of the school leadership plays a critical role in the retention of quality teachers. An investigation by Barnett, Hopkins-Thompson, and Hoke (2002) from the Southeast Center for Teaching Quality has shown that quality teachers will gravitate to hard-to-staff schools with strong effective principals, and where they are able to work with likeminded, supportive colleagues. These authors also suggested that successful teachers in hard-to-staff schools must have sufficient knowledge and skills to help students learn in their school, and to do so, they expect teachers to serve as leaders and mentors. Finally, regarding the overall lack of qualified teachers for these schools, Ingersoll's (2001) work indicated that while theory has traditionally held school staffing shortages were primarily due to a small pool of qualified teachers, his analysis of the problem revealed that there were other factors that caused teacher turnover. The results of Ingersoll's (2001) study suggested that school staffing problems were due to excess demand resulting from a theoretical "revolving door" where large numbers of qualified teachers depart for reasons other than retirement. Ingersoll (2001) concluded that popular education initiatives, such as teacher recruitment programs, will not solve the staffing problems if they do not also address the organizational sources of low teacher retention.

Summary of Prior Research

In this literature review, I discussed the major scholars in the field and their contributions to the areas of science instruction, teaching ELL students, and the culturally responsive issues surrounding both areas of study. Then, through examination

of the research on high-performing schools largely attended by Hispanic students, I discussed leadership, and a chief concern of school leadership—recruiting and retaining quality teachers. In exploring literature on teachers' attitudes toward science instruction of ELL students, I found ample scholarship on special considerations regarding the education of ELL students and science instruction. Some of these studies focused on the role a teacher's content knowledge and pedagogical skill play in effective instructional practices including the implementation of inquiry (Furtak & Alonzo, 2009; Lee, 2005; Shulman, 1987). Other work emphasized the role of honoring student diversity through culturally relevant instruction (Aikenhead & Jegede, 1999; De la Cruz, 2001; Genesee et al., 2006). Additionally, research on effective campus leadership for ELL science teachers revealed several common themes in supporting and maintaining academic excellence (Reyes, Scribner, & Scribner, 1999). However, there was limited research on the role leadership can play in supporting science instruction for the ELL student. The lack of scholarship in this area emphasizes the need for more research to create a better understanding of this issue. Continued scholarship in this area will allow school leaders to proceed from a more informed perspective in terms of design and facilitation of quality science instruction.

CHAPTER III

METHODOLOGY

This study seeks to examine teachers' perceptions and reflections on science instruction for ELL students at Salas Elementary. This chapter describes the research methodology used in this study and discussions around the following areas: a) qualitative methodology, b) research design, c) study participants, d) data collection, e) data sources, f) data analysis, and g) trustworthiness.

Qualitative Methodology

The intent of qualitative research is to examine a social situation or interaction by allowing the researcher to enter the world of others and attempt to achieve an understanding of that world (Merriam, 1998; Patton, 1990). Creswell (2009) defines this type of research as "... a means for exploring and understanding the meaning individuals or groups ascribe to a social or human problem" (p. 4). Thus, the objectives of qualitative research are focused on interpreting the meaning of human experiences (Denzin & Lincoln, 2000).

Qualitative research involves the collection of data in the participant's setting, exploring data for themes, and interpreting the data to find meaning (Creswell, 2009). I chose qualitative methodology to guide this record of study, because I believe it provides a better understanding of teachers' perceptions of science instruction for ELL students. Furthermore, by using a qualitative approach school leaders who will likely read the results study may proceed from a more informed perspective in terms of guiding,

planning, and designing effective practices that resulting in higher academic achievement. In seeking to understand teachers' perceptions, three research questions were addressed:

- What do teachers understand about teaching science to elementary school ELL students?
- What do teachers understand about ELL student learning in relationship to science teaching?
- What are teachers' perceptions about the role of the school leadership in support of that teaching?
- What does the structure of teachers' lesson plans indicate in terms of their awareness of effective science instruction for the ELL student?
- What do the observations of instructional practices indicate in terms of teachers' awareness of effective science instruction for the ELL student?

Research Design

According to Creswell (2009), the selection of the research design depends on the type of research problem that will be examined. Creswell (2009) identifies three criteria for making such a decision, "... the research problem, the personal experiences of the researcher, and the audience(s) for whom the report will be written" (p. 21). The following discussion on the design of this research implements Creswell's framework and outlines my rationale for using a qualitative approach.

Match Between Problem and Approach

In order to explore the advantages and disadvantages of qualitative research, it is necessary to provide working definitions for both the qualitative and quantitative research paradigms. Denzin and Lincoln (2000) described the qualitative research paradigm as allowing for researchers to examine phenomena from a subjective perspective and look for meaning beyond numeric and statistical data. The methods used in this paradigm to obtain non-numerical data, various narratives, and in-depth descriptions call for the researcher to be immersed in the context of the phenomenon while searching for understanding (Marshall & Rossman, 2006). Alternatively, quantitative inquiry relies on scientific, empirical, and mathematical principles and methods using data that are considered observable and measurable facts. The researcher plays the role of an objective and distant observer detached and uninvolved with the objects in the research (Denzin & Lincoln, 2000). With this paradigm, the researcher seeks to find universal truths that can be applicable in similar contexts. The researcher in this paradigm is guided by questions of description, confirmation, causal explanation, and prediction (Lincoln & Guba, 1985). The following discussion further compares the advantages and disadvantages of both research approaches.

Comparison of qualitative and quantitative research approaches. In comparing qualitative and quantitative research, Denzin and Lincoln (2000) describe the focus of each type:

... [qualitative] researchers seek answers to questions that stress *how* social experience is created and given meaning. In contrast, quantitative studies

emphasize the measurement and analysis of causal relationships between variables, not processes. Proponents of such studies claim that their work is done from within a value free framework. (p. 10).

One of the disadvantages of qualitative research may lie with the issue of credibility in connection with the role of the researcher. In quantitative research, the researcher is an objective observer who neither participates in nor influences what is being studied, as opposed to qualitative research where there may be questions regarding the credibility and professionalism of the researcher (Merriam, 1991). However, Rossman and Rallis (2003) suggest that researchers using qualitative analysis do not disturb the research site any more than is necessary. An additional criticism of the qualitative paradigm, in terms of the role of the researcher, is that bias can enter into the design of the study and into the process of data collection, and, therefore, it cannot be assumed that the mere presence of the researcher is not altering or affecting the study (Cresswell, 2007). However, to validate the accuracy of results, qualitative research clarifies that a disclosure and discussion of bias may be brought into the study "... to create an honest and open narrative that will resonate with readers" (Creswell, 2007, p. 196). Additionally the participants or sources in the study may not all be equally credible, nor can it be assumed that the group under analysis is actually representative of the population (Merriam, 1991). In terms of qualitative research, Gall, Gall, and Borg (2007) state, "Qualitative research is more flexible with respect to sampling techniques than quantitative research. This flexibility reflects the emergent nature of qualitative

research design, which allows researchers to modify their research approach as data are collected” (p. 177).

The research sample in a qualitative study is purposive (Patton, 1990). The logic behind purposive sampling lies in selecting information-rich cases, with the objective of yielding insight and understanding of the phenomenon under investigation (Patton, 1990). While the random sampling found in quantitative studies controls for selection bias and enables generalization from the sample to a larger population, the qualitative researcher’s intent is not to generalize to another context or population, but to describe a particular context in depth (Gall, Gall, & Borg, 2007). Additionally, an advantage of a qualitative approach is that it allows the researcher to obtain a high level of detail about the participants, as well as becoming involved in the participant’s experiences (Rossman & Rallis, 2003). Specifically, it enquires into the meanings groups or an individual ascribe to a problem, and involves data gathering procedures in the field or the site where participants experience the issue (Creswell, 2007). Therefore, qualitative research is naturalistic because it studies a group in its natural setting (Gall, Gall, & Borg, 2007; Rossman & Rallis, 2003). Patton (1982) explains, “Naturalistic inquiry is thus contrasted to experimental research where the investigator attempts to completely control the condition of the study” (p. 4) (Patton, 1982).

Another basic assumption of the quantitative research paradigm is the notion of a single objective reality that can be observed, known, and measured (Merriam, 1991). Qualitative researchers, on the other hand, contend that multiple-constructed realities abound and that generalizations are neither desirable nor possible (Johnson &

Onwuegbuzie, 2004). Additionally, according to Kraus (2005), qualitative researchers believe in understanding a phenomenon by viewing it in its context and by becoming immersed into the culture or organization studied since there is no single unitary or objective reality.

The qualitative paradigm in education. Research guided by the qualitative paradigm is important to the field of education because of the reflection, action, and collaboration that define the type of knowledge produced (Merriam, 1991). As educational reform calls for theory and practice that leads toward the eradication of achievement gaps and behaviors that foster racism, deficit thinking, White privilege, social injustice, and educational inequities, the qualitative research paradigm provides the philosophical underpinning necessary to achieve these educational reform goals (Johnson & Onwuegbuzie, 2004; Merriam, 1991).

Gage (1989) suggested the need for educational researchers to find "... an honest and productive rapprochement between the paradigms" (p.10), based on the moral obligation of researchers in this field. Thus, if educational researchers and educational leaders intend to be agents of change by influencing policy, challenging the status quo, and improving the educational system in the interest of social justice and equity for all learners, they need to look at research from an ethical and moral point of view (Gage, 1989). Both qualitative and quantitative paradigms provide a means to successful investigation, but it is up to the researchers to search for the answers to the questions and to select the paradigm that best suits their investigative needs (Cresswell, 2002; Lincoln & Guba, 1985).

Rationale for the use of qualitative analysis. An advantage of qualitative research is that the researcher can learn about the problem, participants, and context by participating and/or being immersed in a research situation (Cresswell, 2002). I believe a qualitative approach was the best match for my study as it assisted me in the exploration of my participants' perceptions, as well as provided a basis of support for their further reflection on their practice. As the researcher, I sought to establish "... the meaning of the phenomenon from the views of the participants" (Cresswell, 2007, p. 21). Possessing an interest in learning about school improvement and in improving educational practices led to the posing of questions which are best examined through the lens of a qualitative research design (Merriam, 1998). Thus, a qualitative design was the best approach in answering the questions I had as a school leader regarding improving the practice of science instruction for ELL students.

Personal Experiences of the Researcher

One of the features of quantitative research is the use of prediction about the expected outcomes or direction of the study (Cresswell, 2002). Therefore, Creswell (2002) suggests that researchers experienced in statistics and technical writing would probably choose this mode of research. As for the individual selecting qualitative research, Creswell (2002) states, "For advocacy/participatory writers, there is undoubtedly a strong personal stimulus to pursue topics that are of personal interest – issues that relate to marginalized people and an interest in creating a better society for them and everyone" (p. 23). While a theory or a hypothesis is not established beforehand as in quantitative research, rather than relying on predictions, the naturalistic

inquiry method is employed in qualitative analysis (Cresswell, 2002). This permits the researcher to understand the story and experience that each participant brings to the study and allows the voice of each participant to be heard in order for the reader to recognize and connect with the thoughts and feelings of the participants (Lincoln & Guba, 1985).

Throughout my twenty-five year career in education, I have worked in elementary schools that are chiefly populated by students that are Hispanic and from low income families. Many of these students are classified as ELLs. As an assistant principal in one of these schools, I became interested in the instructional practices that occur on this type of campus. Specifically, I became interested in how these practices do or do not work to reduce the achievement gap between Hispanic students and White students that now exists in my school district. However, I was primarily interested in bringing a voice to the concerns and perceptions of the teachers of ELL students in the context of science instruction. This was the chief motivation for my selection of the use of the qualitative method. I anticipated that doing so would allow school leaders to proceed from a more informed perspective in terms of design and facilitation of quality science instruction for the ELL student.

Audience

Creswell (2007) suggests in the selection of the qualitative or quantitative approach, researchers should be cognizant of the backgrounds of their audience. Experiences of these audiences will shape this decision (Cresswell, 2007). While I was aware of the part my dissertation committee plays as an audience for this research, I was

also concerned about the school administrator who may read this work. For the campus leaders already overloaded with information, if this work is to have any impact, it seems that the more literary-style of qualitative writing would be more suitable and accessible for the school leader interested in teachers' perceptions of effective science instruction for the ELL student.

Context of the Study

The school that provided the context for this study is a suburban elementary school of approximately 600 students in a southeast Texas school district. Salas Elementary has experienced a dramatic increase in the diversity of its student population since it opened in 1962. According to AEIS reports published on the TEA website, the current student population is 89% Hispanic, 4% White, 5% African American, and 1% Asian. Additionally, the composition of the school is 68% limited English proficient, 82% at-risk⁴, and 88% of the students are eligible for free/reduced lunch. Overall, throughout the district, the percentage of Hispanic students has increased from 61% in 1994 to 89% in 2010, while attendance of White students has fallen from 26% in 1994 to 4% in 2010. These changes in the student population also reflect similar changes in schools throughout the state (TEA, 2010). Additionally, the AEIS reports reflected that forty-seven teachers work at Salas Elementary teaching pre-kindergarten through fifth grade. AEIS reports also show that for the academic year of 2009-2010, 52% of the faculty possessed one to five years of teaching experience.

Study Participants

When selecting participants, the researcher should be deliberate in nature (Patton, 1990). Therefore, the process used to choose specific settings, persons, or events that allow for an in-depth understanding of the participants' experience should be intentional (Patton, 1990). The use of the purposive sampling technique allowed me to select individuals (i.e., teachers) directly involved in the phenomena (i.e., teaching science to ELLs). According to Patton (1990), purposive sampling is a non-random way of selecting participants for the study. Patton (1990) suggested that participants should be selected in conjunction with the research question, because they may possess relevant experience to the issues under study.

After permission to gather data was granted by my dissertation committee, I sought formal permission to conduct this study through the Texas A&M University Institutional Review Board (IRB) and from EISD. Once permission was granted, fifteen teachers from Salas Elementary were asked to participate in the study. From the initial pool of fifteen teachers, twelve agreed to participate. These teachers were selected based on their expertise in the subject area of science which is relevant to this inquiry and for their practical experience in teaching science to ELL students.

Gaining entry and obtaining trust are critical to the validity and success of a qualitative study (Gall, Gall, & Borg, 2007). Therefore, I informed participants regarding the protection of their identities and the maintenance of confidentiality through the use of a coding system. This system was implemented to ensure security measures to protect participants' identity as well as the security of audiotapes, transcripts, and field

notes. Additionally, the purpose of the study and the participants' role in the research were clarified to each participant in an Informed Consent form. Each participant was provided with an Informed Consent form prior to the beginning of the study. As all interviews were audio taped and transcribed, included in the informed consent, the participants were advised that the audio tapes, as well as the transcriptions would be stored in a locked file cabinet while the dissertation process was underway (see Appendix E). Furthermore I informed participants regarding the protection of their identities and the maintenance of confidentiality through the use of a coding system. Additionally, as a former assistant principal at Salas Elementary, I also wanted participants to feel comfortable sharing information throughout this process. Therefore, the consent shared with the participants also contained information regarding the names of individuals in the schools district they could contact if they had any issues with this process.

Data Collection

As the researcher, I served as the primary instrument for data collection and data analysis (Merriam, 2002). However, the use of multiple methods of data collection and triangulation is critical in attempting to obtain an in-depth understanding of the topic under study (Denzin & Lincoln, 2000). Using multiple methods of data collection adds rigor, breadth, and depth to the study and provides corroborative evidence of the data obtained (**Denzin & Lincoln, 2000**). Therefore, this study employed a number of different data collection methods including, interviews, document analyses, and participant observations (Creswell, 2009). The data gathered was used to examine

various facets of science instruction in the four areas of curriculum, instructional methods, availability of instructional supports, and student achievement. The following discussion is focused on the three types of data collection methods that were used in this study.

Interviews

Data for this study was collected through the use of face to face, semi-structured open-ended interviews. The purpose of using interviews was to gain a more in-depth understanding of each teacher's perceptions regarding teaching science to ELL students. Therefore, during the interview, my goal was to focus on understanding these teachers' experiences. I interviewed each teacher privately one time for 30 to 45 minutes. All interviews took place in a private room at Salas Elementary after school hours. After explanation of the study, seven questions were posed to each teacher in each interview (see Appendix D).

Interviews were selected as the primary method of data collection for this study because I felt they would be the most useful method to elicit rich, thick descriptions (Boyatzis, 2007). I used the interviews to capture meaning, richness, and variety of the participants' perceptions, in their own words. Many scholars suggest that collecting data through individual, in-depth interviews is one of the best ways to capture a person's perspective of an event or experience (Creswell, 2007; Denzin & Lincoln, 2003; Marshall & Rossman, 2006). Patton (1990) concurs by stating, "Qualitative interviewing begins with the assumption that the perspective of others is meaningful, knowable, and able to be made explicit" (p. 278). My logic for using this data-collection

method was that it was a legitimate way to generate data through interacting with people (i.e., talking to and listening to them), thereby capturing the meaning of their experience in their own words (Denzin & Lincoln, 2000). Marshall and Rossman (2006) described the interviews that occur in the typical qualitative study as "... much more like conversations than formal events with predetermined response categories" (p. 142). The detailed transcriptions from the interviews allowed me to pause, review, and reexamine them to ensure accuracy of an account and to be less subjective (Denzin & Lincoln, 2000). Further, it gave me an opportunity to clarify statements and probe for additional information.

Participant Observations

According to Patton (1990), the purpose of observation data is to describe the setting that was observed, the activities that take place in that setting, the people who participate in the activities, and the meaningfulness of these activities to form a view of the participants' experience. Marshall and Rossman (2006) define participant observation as an approach to inquiry and a data-gathering. They describe it as "... the systematic noting and recording of events, behaviors, and artifacts (objects) in the social setting chosen for study" (p. 139). Furthermore, Marshall and Rossman (2006) describe this method as challenging, as it requires the researcher to assume an unassuming role while at the same time "... identifying the big picture while finely observing huge amounts of fast-moving and complex behavior" (p. 140). During participant observation, a researcher is also required to become immersed into the setting of the

study so they may experience reality as their participants do, thereby allowing the researcher to learn from his own experience (Patton, 1990; Marshall & Rossman, 2006).

In this study, I conducted one classroom instructional observation for each of the twelve of teachers. Conducting observations allowed me to look for instructional behaviors and patterns, as well as any pedagogical strategies employed that may have reflected teachers' attitudes and perceptions regarding science instruction and their ELL students. Data from the observations were recorded as field notes.

Field Notes

The use of field notes can also add to the validity and reliability of the research (Merriam, 1998). Merriam (1998) describes field notes as containing the verbal descriptions of the setting, activities, and direct quotes from these sessions. These elements are key factors in understanding the perception of the phenomena (Merriam, 1998). Denzin and Lincoln (2000) posit that all observation records contain explicit references to participants, interactions, and routines. In this study, field notes were taken from observations and as I reviewed teachers' lesson plans. Keeping field notes provided descriptive information that directly recorded what I specifically viewed and heard. Additionally, they gave me the opportunity to capture my personal reactions and reflect upon the information gathered.

Data Analysis

Interpretational analysis was utilized to examine the data closely in order to find patterns that could be used to describe and explain recurring themes (Gall, Gall, & Borg, 2007). Interviews were used to characterize the ways in which teachers describe their

teaching. Interviews were carefully reviewed to search for emerging themes that might have helped me understand the teaching practices in the Salas science classroom (Creswell, 2007).

I organized and prepared the data for analysis to obtain a general sense of the information and to reflect on its overall meaning. Raw information from the interviews was reduced and themes were analyzed and compared (Boyatzis, 1998). Open coding (Boyatzis, 1998) was used to identify and categorize the data. The coding process reflected the ways teachers described their role during instruction, and their expectations for students' learning, as well as expectations for themselves (Furtak & Alonzo, 2009). After open coding was complete, the constant comparative method was employed (Lincoln & Guba, 1985). Through the use of the constant comparative analysis, data was organized according to similarities and differences and provided a framework for comparison (Lincoln & Guba, 1985).

In qualitative research, trustworthiness addresses the issues of validity (the degree to which something measures what it purports to measure) and reliability (the consistency with which it measures it over time) (Marshall & Rossman, 2006). Lincoln and Guba (1985) use the terms *credibility*, *dependability*, *confirmability*, and *transferability* in seeking to establish the trustworthiness of a qualitative study, arguing that a qualitative study should be measured differently from a quantitative study. These are the ways I sought to control potential biases that could be present in this study.

Credibility

The assessment of credibility (or validity) is made through a determination as to whether the results of the study are accurate and credible from the perspective of the researcher, the participants, and the reader (Gall et al., 2007). Creswell (2007) defines validity as the accuracy of the account using one or more of the procedures for validation, such as member checking, triangulating sources of data, or using peer or external auditors of the accounts. Both methodological and interpretive validity are concerned not with seeking to verify conclusions, but rather to test the validity of conclusions reached (Creswell, 2007; Mason, 1998).

Assessing the match between the logic of the method to the kinds of research questions being asked is a hallmark feature of methodological validity (Creswell, 2009). This type of validity requires the researcher to consider the relationship between the pieces of the research design—the study’s purpose, research questions, and methods (Marshall & Rossman, 2006). In this study, to enhance methodological validity, data was triangulated from interviews, field notes, and observations. The information provided by these different resources was compared through triangulation to corroborate conclusions drawn from this study. A thick description (Boyatzis, 2007) was obtained from interview transcripts, observations, and detailed field and interview notes. Gathering data from these multiple sources and by multiple methods produced fuller and richer descriptions of the perceptions and reflections of the teachers.

Alternatively, interpretative validity involves examining both the validity of the data analysis and its interpretation (Creswell, 2007; Mason, 1998). Interpretive validity

assesses the quality and rigor of the researcher's interpretation and analysis of the data in relation to the research design (Mason, 1998). Thus, interpretive validity is a type of trustworthiness. One way to assess interpretive validity, or trustworthiness, is through member checking. Erlandson, Harris, Skipper, and Allen (1993) describe member checking as providing "... for credibility by allowing members of stakeholding groups to test categories, interpretations, and conclusions" (p. 142). Further these researchers state, "It is in this step that the members of the setting being studied have a chance to indicate whether the reconstructions of the inquirer are recognizable" (p. 142).

Therefore, to support interpretative validity and to ensure that my own biases did not influence how particular perceptions are portrayed by participants, I employed the use of member checks through meetings and informal conversations with the teacher participants. Member checking allowed me to verify and check for accuracy of my interpretation of the data (Creswell, 2007; Erlandson et al., 1993). This was completed in two ways. First, I asked teacher participants for clarification during the interviews and summarized major ideas in the field notes. The teachers also had the chance to review the transcription in order to provide them the opportunity to suggest changes and/or additional information.

An additional way that I ensured trustworthiness was through peer reviewing (or peer debriefing). Erlandson et al. (1993) describes the role of the peer review as helping to build credibility "... by allowing a peer who is professionally outside the context and who has some general understanding of the study to analyze materials, test working hypotheses and emerging designs, and listen to the researcher's idea and concerns" (p.

140). Peer reviews, conducted through conferring with fellow doctoral candidate, who assisted me in examining any assumptions I may have had and/or consider alternative ways of looking at the data.

Finally, I kept a researcher journal to record my thoughts regarding the study, as well as field notes as a means of cross checking and verifying the data gathered. These methods ensured that the reality of the participants was adequately reflected.

Dependability

Dependability (or reliability) may be defined as the extent that research results can be replicated (Creswell, 2003; Guba & Lincoln, 1998; Schwandt, 2001). While a qualitative study may not cover the number of subjects that a quantitative study may cover, Lincoln and Guba (1985) suggest the more important issue is whether or not, within the data collected, the results are consistent and dependable. Therefore, the goal may not be to eliminate inconsistencies, but to ensure that the researcher is cognizant of their occurrence (Cresswell, 2003).

The purpose of triangulation is to increase the dependability or reliability of the data and the data collection methods (Erlandson et al., 1993). Triangulation mines from the data what is seen, heard, and read, and validates the data gathered from other sources (Marshall & Rossman, 2006). For the purpose of triangulation I used multiple sources of data to achieve a broad understanding of teachers' perceptions of science instruction and ELL students. The use of a variety of sources increased the credibility of the study. Additionally, I asked a professional colleague to code several interviews, thereby

establishing inter-rater reliability. This process of checking the consistency between raters reduced the potential bias of a single researcher collecting and analyzing the data.

Confirmability

In quantitative research, the concept of confirmability refers to objectivity, where the results are viewed as coming directly from the study, rather than the biases and/or subjectivities of the researcher (Denzin & Lincoln, 2000). In terms of qualitative research, Lincoln and Guba (1985) define confirmability as the degree to which attributes of data produced by the researcher can be corroborated by others who will study these results. For the qualitative researcher to achieve confirmability, s/he must show how the data can be traced back to its origins through an audit trail (Lincoln and Guba, 1985). In regards to this method of ensuring trustworthiness, Erlandson et al. (1993) state, “The audit trail leads to dependability and confirmability by allowing an auditor to determine the trustworthiness of the study” (p. 148). This audit trail may include materials such as interview guides, notes, documents, journals, field notes, and transcripts (Lincoln & Guba, 1985). In regards to this method of ensuring trustworthiness, Erlandson et al. (1993) state, “The audit trail leads to dependability and confirmability by allowing an auditor to determine the trustworthiness of the study” (p. 148). This trail must evident the reflection of the researcher and may include materials such as raw data (interview guides, notes, documents), journals, field notes and transcripts (Lincoln & Guba, 1985). Schwandt and Halpern (as cited in Erlandson et al., 1993) propose a system for the audit trail that will support a thick description of the phenomenon under study. They suggest six types of files be used for the audit trail.

Three of which concern the phenomena being studied: *raw data files* which will contain all the information that supports the results of the study; *data reduction files* which may contain notes or other methods to reduce or summarize the large amount of data that accumulates in the study; *data construction files* are the notes and other methods of record keeping that keep track of themes that arise from the raw data and data reduction work. In connection to this study, the files connected to the phenomena to this study included such items as the raw transcripts of interviews, notes from the analysis of lesson plans and observations. These files also contained summaries of transcripts as well as excerpts from interview transcripts and notes analyzed for common themes. The other three represent the inquiry process: *process notes* which may contain notes regarding methodological issues; files about *intentions and motivations* will include the original inquiry proposal and personal notes that may address such issues as any biases, concerns, or other thought processes; and a file containing copies of *instruments, tools, and resources* which will serve to provide the reader with the information about the construction of this study; such as protocols, and tools to collect and analyze the data from this study. In terms of this study, these files contained such items as the series of emails from the Texas A&M University International Review Board regarding the appropriateness of conducting a study at a school where I was a supervisor of the teacher participants. These files also contain several drafts of my interview protocol along with copies of AEIS reports. About the purpose of the audit trail, Erlandson et al. (1993) state, “The key to the audit trail is reporting no “fact” without noting its source and making no assertions without supporting data” (p. 150).

Transferability

Lincoln and Guba (1985) define transferability as the ways in which the reader may determine whether and to what extent the particular context can transfer to another particular context. Patton (1990) defines transferability as "... speculations on the likely applicability of results to other situations under similar, but not identical conditions" (p. 489). Although I do not expect the results of this study to be generalizable to all other settings, it was anticipated that the lessons learned in the setting of this study might be useful for other contexts and settings. Nevertheless, as I have provided a rich, thick, and detailed description (Denzin & Lincoln, 2002), of the study design, another researcher may be able to frame a similar study in a similar context.

Summary

In this chapter, I have demonstrated the qualitative methodology used in this study. I also described the research design I implemented, as well as the rationale for my decisions. There was also a discussion regarding the context of the study and a description of the participants selected for this study. I also described how the data was collected, the interview protocol, and an explanation of how the data were analyzed and reported. Finally, I discussed how I established trustworthiness throughout this study.

Exploring the perceptions of elementary school teachers regarding science instruction and their ELL students is a multi-faceted and complex issue. My decision to incorporate qualitative methodology seemed to be the most appropriate for understanding these teachers' perceptions.

CHAPTER IV

RESULTS

The purpose of this study was to investigate Salas Elementary teachers' perceptions and reflections on science instruction for ELL students. It was my desire to synthesize the discoveries from this study and make available for school leadership the participants' reflections and their instructional practices in science instruction for the ELL learner. I believed that a better understanding of this phenomenon would allow school leaders to proceed from a more informed perspective in terms of design and facilitation of teacher support for effective science instruction for ELL learners. The research questions that steered this exploration were the following: What do teachers understand about teaching science to elementary school ELL students? What do teachers understand about ELL student learning in relationship to science teaching? What are teachers' perceptions about the role of the school leadership in support of that teaching? What does the structure of teachers' lesson plans indicate in terms of their awareness of effective science instruction for the ELL student? What do the observations of instructional practices indicate in terms of teachers' awareness of effective science instruction for the ELL student?

To address these research questions, in-depth interviews were conducted with selected teachers from Salas Elementary. Additionally, lesson plans were reviewed and classroom observations were conducted. All twelve interviews took place at the Salas Elementary School campus and the best time to conduct the interview was negotiated

with each participant. After conducting the interviews, I transcribed each one immediately after it was conducted. After completing the transcriptions, a follow-up visit was conducted with each participant to allow each teacher an opportunity to confirm my interpretation of his/her respective transcript. None of the participants opted to edit any of the contents of their interview transcripts. Additionally, participants provided me with their science lesson plans for the 2011-2012 school year, as well as permitting observations of their classrooms during science instruction.

This chapter presents the data from interviews, teacher lesson plans, and classroom observations. Analysis of the data generated three major themes: 1) instructional strategies, 2) assessments, and 3) the leadership role. For the science lesson plans, I examined the structure and components to identify how they supported quality science instruction in a classroom of linguistically diverse elementary school students. A review of the lesson plans with an explicit focus on instructional strategies generated two themes: 1) science objective construction and 2) instructional considerations to support the objective. Observations of science instruction allowed me to determine to what extent actual classroom practices reflected the contents discussed in interviews and described in lesson plans. Analysis of classroom observation notes generated two themes: 1) the work of the teacher, and 2) the work of the student. However, before the results are outlined and reviewed, it is important to describe the educational and professional background of the twelve teachers as well as additional information regarding Salas's history to give context to this study.

Participants

All twelve participants were certified to teach elementary school and all taught science to second through fifth grade ELL students at Salas Elementary. Table 1 below is a graphical representation of the participants' educational and professional background. Of this group, 10 of the 12 teachers interviewed were women (83%), while the remaining two were men (17%). This difference in gender is consistent with the gender divergence of EISD. The total years of teaching experience for the participants ranged from 4 to 35 years. The mean of the total years of teaching experience was 7.6 years. The total years of teaching at Salas ranged from two to five. The mean of the years of teaching experience at Salas was 4.2 years, well below the district's average of 12.1% (Texas Education Agency, 2012). Only two of the teacher participants (17%) received their certification as part of completing an education degree at a university. The remaining teachers (83%) received their credentials through a variety of alternative certification programs (ACP).

Table 1 Participants' Educational and Professional Background

Participant (Pseudonym)	Grade Taught	Total Years of Teaching	Total Years at Salas	Education Degree or ACP
Mark	3	7	5	ACP
Amy	2	5	5	ACP
Martha	5	10	5	ACP
Barbara	4	6	4	ACP
Diane	2	5	5	ACP
Carol	3	4	4	ACP
Paula	3	5	5	ACP
Mary	5	35	4	Education Degree
Rachel	2	8	2	ACP
Sharon	3	8	3	Education Degree
Sara	4	5	5	Education Degree
Robert	2	5	5	ACP

Background Information

None of the participants had taught at Salas for more than 5 years. While a description of Salas Elementary and its neighborhood was provided in the first chapter of this study, it is also necessary to provide a brief description of the school environment for the year before most of these teachers arrived to teach at this campus. This discussion is necessary in order to provide additional insight into the issues connected to the science teaching and learning. At the end of the 2006-2007 school year, the principal

of Salas Elementary was removed by the district administration due to, among other factors, a significant decline in the climate of the campus as measured by surveys administered by Excel ISD. However, this did not occur until 40% of the staff had made a decision to transfer from Salas to other campuses within the school district. This loss was so substantial that it resulted in the entire fourth grade team leaving. By the time the 2007-2008 school year began, the campus had hired 21 new teachers, most of whom had no teaching experience. While the effect of limited teaching experience on student achievement, as well as a negative campus climate, is beyond the scope of this study, I believe it may be worthy of consideration for future investigations of campuses where the majority of students are linguistically diverse.

A discussion of the major themes and subthemes generated through the interviews, lesson plans, and observations follow with some overlapping existing between subthemes, as they are not mutually exclusive. Additionally, the themes are interdependent with one another, so the lines of categorization may sometimes become blurred. Evidence of themes is categorized according to the source through which they were observed, either through interviews, lesson plans, or classroom observations.

Participant Interviews

Three themes were generated from the participant interviews. The first theme refers to instructional strategies implemented to teach science to the ELL student. This theme describes how the teacher participants provided the adequate instructional scaffolding to effectively deliver content to their ELL students in the science classroom. Within the instructional strategies theme, three subthemes emerged: a) strategies specific

to ELL instruction, b) culturally relevant instruction, and c) connected science instruction. Another theme focuses on the use of assessments and how accurate a picture they present of the ELL student's progress in science. From the theme of assessments, subthemes of cultural bias and language bias arose. The final theme refers to the leadership role and how administration can support effective science instruction for a linguistically diverse population. From the role of administration theme, the subthemes of resources and inadequate professional development emerged. The following is detailed discussion of the three themes and their subthemes.

Instructional Strategies

The first theme, instructional strategies, refers to the instructional tools teachers may implement to increase student achievement. Instructional strategies allow the teacher to plan and provide the adequate instructional scaffolding to effectively deliver content to students in the classroom. Magnusson et al. (1999) defines it as the teacher's understanding of how to assist students to comprehend specific subject matter and includes the recognition that learning can be organized and adapted to meet the diverse needs of all learners. In terms of forming science instruction for ELL learners, it is worth noting no two ELL students possess the same amount of grounding in their native language. Their level of experience in English, the history of their education, the socioeconomic level of their families, and literacy practices in their own homes all play a role in their readiness to learn in a language they may not be proficient in (Hill & Flynn, 2006). Therefore, in order to explore participants' perceptions of the teaching and

learning that occurs in their classroom in terms of scaffolding ELL learning, I posed the following questions to the participants:

- 1) *How do you differentiate science instruction for ELL students and non-ELL students?*
- 2) *Describe the instructional strategies you may implement during a typical science lesson.*
- 3) *As our students come with different English language skills, how do you differentiate your instructional practices in science to support differing linguistic needs?*
- 4) *Do you differentiate by race or ethnicity and if so, how do you implement culturally relevant instruction?*

Their responses generated the three subthemes: a) strategies specific to ELL instruction, b) culturally relevant instruction, and c) connected science instruction. The following is a detailed discussion of these subthemes.

Strategies specific to ELL instruction. Within the subtheme of strategies specific to ELL instruction, the use of several strategies was consistently discussed throughout the interviews. Ten of the twelve teachers described the importance of developing scientific vocabulary in their students so that they will be able to master complex scientific concepts. Mary described how she differentiates her vocabulary instruction for her students in her ELL classroom:

We break down words – important words for the skill, not every word they will encounter, and when there is a word that I say, “You’ll need to know and you’ll

need to remember this word.” I’ll say, “You’ll see it a lot.” You know, we’ll put stars in it when they’re writing in their journals, stuff like that, these are words you’ll need to know and to remember and then I’ll try to take it from simple to complex where we’re doing just the very core of that, that’s when I make my charts usually, that’s just the core of the concept so that’s always fresh in their mind and then we go to the more complex part of it.

In terms of the background her ELL students bring to the classroom, Diane expressed a concern about the complexity of vocabulary her students are exposed to in science instruction and assessments. She connected their struggle to lack of experiences children from “the other side of the freeway” come with. Diane described a benchmark assessment item that asked students what would melt in their hand. They were given several choices, one of which was paper. Even though, the concept of melting had not been directly taught, she was surprised that some student still chose paper as their answer. Diane commented:

The vocabulary is very – it’s a higher level of vocabulary. Our kids are not exposed to that high a level of vocabulary. It’s not a higher level. Our kids are not exposed to regular level, period. They are from zero (*puts her hands-on lap*) but then we have to make it here (*puts her hands-on her shoulders*), and science is like here (*puts her hands over her head*). So expose them to more vocabulary and have them experience everything.

In connection to the use of vocabulary strategies, seven participants referred to “Marzano strategies.” These teachers are referring to the work by Robert Marzano,

which contains a series of instructional strategies and best practices for the classroom (Marzano, Pickering, & Pollock, 2001). Many of these strategies are focused specifically on vocabulary. Paula described how she works with her students to build vocabulary skills:

We focus on the Marzano steps where we do the – sometimes we have to pull kids aside and come up with our own definition and not copy the definition from the book. We talk about the word and we also draw a picture and try to create a new sentence with the new word.

Seven of the teachers described implementing the strategy of paired students and group work to differentiate instruction. Two third grade teachers, Carol, a bilingual teacher, and Mark, a teacher of ELL students, combined classes to work with their students' varying needs. Carol described the use of these two collaborative strategies in her classroom:

I present vocabulary in English and Spanish and I have the students share with each other a lot. I share students with the ELL class and I'll take all the low kids in here and Mark takes the high kids for the English.

The other strategies discussed are also advocated as part of the dual language initiative, which is the mainstay of the school district's bilingual education program. This program was discussed in detail in the first chapter of this study. Several of these strategies were discussed throughout the interviews. The two strategies teachers referred to the most were pair-share and group work. These strategies are collaborative in nature and attempt to address the issue of having a class of students with varying linguistic

needs in a bilingual classroom and ELL classrooms. Additionally, they provide ELL students the opportunity to engage in increased levels of accuracy and correctness in conversation and understanding of English. Eight participants described implementing the pair-share strategy where one student who is stronger in English is paired with another student who is not as fluent. If a teacher wants to provide additional ELL support, she may ask students to work with their bilingual partner. In fact, the school district's dual language initiative requires bilingual classrooms to post this information in the classroom, describing this as "bilingual pairs."

Interestingly, even though the use of higher order questions appear consistently within lesson plans as part of an instructional strategy, only one teacher in this study, made a direct reference to the use of inquiry as an instructional tool. Paula described her use of questioning as follows:

For example, if we are doing a hands-on experiment, an investigation, they know that they are to come up with a conclusion to their investigation. Also, I use higher order questioning with them and have them explain, not give me a straight yes or no answer. I have them explain to me why did this happen, why did this not happen, so they feel like their answers are valued at school.

Culturally relevant instruction. The subtheme of culturally relevant instruction focuses on the instructional approaches and strategies that recognize and build on culturally different ways of learning, behaving, and using language in the classroom (González, 2002). In this type of classroom, students are encouraged to construct knowledge or make sense of new ideas to help them better comprehend the world around

them, rather than use low level skills such as memorizing facts (Villegas & Lucas, 2002). Every participant interviewed revealed their reflections to a varying extent on their role in making science relevant and meaningful to their ELL students. Strategies ranged from simply posting pictures in the classroom of scientists from different ethnic backgrounds, to having science books in the classroom library with pictures of individuals of diverse backgrounds, or to having active discussions of what it means to be a scientist. Mary described in her interview how she makes science meaningful in her classroom. She also explained how she establishes a scientific type of environment and communicates her expectations to her students:

We call ourselves scientists. We're scientists. We investigate. We explore.

They'll want me to give them the answer sometime and I'll say you're the scientist. Go back and use your research. We research, like when we read.

When we're reading out of the book, we call it research and we act like scientists when we do a lab, we write down things and record everything we see.

An observation of Mary's class engaged in a science experiment confirms her statements. Students arrived at the lab with their science journals. As the experiment on the water cycle was carried out, Mary would continually ask the students what their research was telling them and prompted them to enter this information into their notebooks. To provide additional ELL support, when students returned to their classroom, Mary instructed them to use their journals to "debrief" with their learning partners about what had occurred in the lab, encouraging them to use words like *hypotheses*, *results*, and *research*.

Carol described how she requires her students to put on goggles when they conduct experiments even though they may not need them. She also described words she uses to get her students to view themselves as scientists. This was evident when I observed her classroom. When her class was involved in an experiment on erosion, it was noted that she emphasized the vocabulary of a scientist as she asked questions such as “What are we investigating?” “Tell me about your hypothesis?” and “So, what’s your conclusion?”

In guiding her students to recognize their role as scientists, Rachel said she tells her students: “When you hear the word scientists, don’t immediately think it’s a person in a white lab coat. We’re scientists – we go out, we explore, we follow a method, we come up with hypotheses, we make predictions.”

Both Martha and Sara spoke about using books on science with pictures of people who look like their Hispanic students. Martha described finding biographies of successful Hispanics and noted that while it was difficult for her to find books on Hispanic scientists, she used the internet to provide that information. Sara described how she makes science relevant to her ELL students’ lives:

I try to get books that are more geared toward—with people that look like them or do things they might do or even having them think of themselves as investigators outside of school. I might ask them, “When was a time you had to investigate something on your own?”

As I conducted classroom observations, I looked for further indications of participants teachers’ actively integrating their students’ culture and cultural experiences

into science instruction. However, perhaps due to the brevity of these classroom visits, I did not witness extensive use of teachers connecting science instruction to students' cultural lives. Observations of culturally relevant instruction were limited to the above referenced four observations of teachers attempting to provide students with an opportunity to make science meaningful in the context of their culture.

Connected science instruction. The subtheme of connected science instruction refers to the classroom practice of enabling students to link new information with concepts the ELL student is familiar with (De la Cruz, 2001). Additionally, it has been suggested that it is most beneficial when English language skills are developed within the context of a core subject; such as science, to provide a meaningful context (Lee, 2005). According to De la Cruz (2001), it is critical that instruction occurs in a way that supports students in making connections between new information and with things they already know about. It is the teacher's charge to provide numerous and varied opportunities for students to become actively engaged in recognizing relationships between new information they are learning and ideas they already understand. In the interviews, I looked for evidence of participants' reflection on how they, as teachers, connected science instruction to their ELL students' experiences in attempt to activate prior knowledge. Rachel provided an example of how this teaching practice enriches and honors her students' knowledge:

I say, "Raise your hand if we go to your country to buy a kilo of tortillas." They immediately make that connection and find that over here we use pounds. I try to

use that background knowledge to make connections. We can use both and it makes us richer in our knowledge. We can use both.

Both Sara and Martha described their students' interest in science careers and how they attempted to integrate their students' interest throughout their science instruction. Martha shared the following about her students' interest in the medical field:

I tell them when they're doing investigations about a medical problem, that when they grow up, "You can find a way to solve this problem, and find a cure for this." Then we talk about jobs in the medical field and what kind of things you need to know.

Regarding strategies to make those connections, Mark described how he links science instruction to his students' environment:

I might play out a lot of scenarios so that they can see real life applications of whatever we're learning. We like to explore the campus, again with the soils since that's what we're doing this week. We went out to two different locations, and they actually dug up their own samples. They use a lot of science tools. I let them use the tools. It's so important to understand the tools, to understand the learning. I try to provide concrete experiences so when they take a test which is paper they can relate it back to that experience.

Assessments

With the presence of high-stakes testing and accountability and issues arising in connection to science instruction, teachers are given the responsibility of identifying

science concepts and, at the same time, developing best instructional practices (William, 2008). Additionally, NCLB (2001) presents additional challenges as it outlines the responsibilities of teachers to deliver a curriculum that will foster academic growth and development in an increasingly diverse student population. As teachers of Excel Independent School District, these participants are well aware of the predicament this places them in as teachers of ELL students. Salas Elementary is part of a school district that has mandated that benchmarks be administered periodically to assess whether students are performing at appropriate academic levels. One of the purposes of these benchmark assessments is to allow teachers to effectively plan and differentiate instruction to support students' varying needs. In the third, fourth, and fifth grades, it is expected by meeting those needs through focused and data driven instruction, their students will be prepared for the state assessments. In order to explore participants' perceptions of these benchmark assessments that occur in their classroom, I posed the following question: *Do you feel that benchmarks and standardized assessments are accurate reflections of what our ELL students can do? Why or why not?* The participant's response to this question generated two subthemes: a) cultural bias and b) language bias. The following is a detailed discussion of these results.

Cultural bias. Provisions of NCLB (2001) have strong implications for considerations of test bias. NCLB (2001) asserts that Limited English Proficient students, as members of targeted subgroups, must achieve at high standards. When I asked the participants about their feelings regarding science assessments, the most common response was that the tests were biased against their ELL students. The

teachers' concerns focused on the fairness of tests for their ELL students. Additionally, eleven participants expressed a concern about the lack of cultural relevance or sensitivity the benchmarks possessed. They expressed the sentiment that not only do those students encounter a language issue, but may lack the necessary social experiences to do well on these tests. These eleven participants expressed concerns regarding testing bias similar to Sara's concerns. She said:

I feel that the benchmarks are kind of developed for kids that are already strong in their language and proficient in the subject matter versus a student who is maybe learning English or struggling with the language. So, I don't necessarily feel that the content really reflects their experiences.

Both Barbara and Mark described these tests as "culturally inaccurate" for their students. Additionally, Mark described the responsibility a Title I school has to ensure that their students have the background experiences necessary to do well on the test. He also expressed this concern:

I think the benchmarks favor the kids who have had more opportunities, more life experiences. Some of the examples will bring up stuff my students have never done. In language arts, they might say what is snowboarding, and it might be an opportunity my students have never had. I think the wording of the questions is not always fair. It should be focused on the science information. Sometimes I think that the distractions or the examples don't always consider people of all nationalities, races or genders.

Two teachers described the bias in developmental terms. Rachel, a second grade teacher, suggested that her students have the content knowledge necessary to do well on the test, because of their ability to perform the tasks and experiments in the classroom. However, she felt that for especially young children, this knowledge is difficult to translate to a pencil/paper test.

Amy expressed a similar opinion pairing developmental issues with language issues:

Sometimes it's the way the tests are worded. Sometimes, it might be pressure. It might be the English acquisition -- where they are. I've seen kids who are very, very intelligent, but can't put it on paper. I don't think it reflects their English acquisition. Some get nervous, feel pressure. Sometimes they don't do well.

Language bias. Four teachers expressed the concern that the data derived from these assessments did not paint a true picture of students' ability, and therefore, the results had limited usefulness in planning future instruction. These participants expressed concerns regarding what they perceived as the poor quality of the translations of the tests and the appropriateness of the Spanish dialect used in the tests. These participants expressed the frustration of teaching a scientific concept using one dialect of Spanish, while the concept may be tested in another dialect. The teachers felt, because of this issue, the tests did not present a true picture of their students' scientific knowledge. Additionally, Robert described the process his grade level team goes through to ensure that his students receive the correct translation:

With students who speak Spanish from other countries [that are] not Mexico, that's hard to deal with, because sometimes we have that problem mostly with the assessments, because the people that are in charge of that are not aware of the differences. Sometimes, lately, [a colleague] asks me to check out when they translate something, just read it over, just let them know if we can make some changes, if we need to fix something.

One important piece of the One Way Dual Language Program mandated by Excel ISD is that students who attend bilingual education classes receive science instruction in Spanish up until fourth grade. In fifth grade, the bulk of science instruction occurs in English with a science “preview” in Spanish at the beginning of each lesson. Carol expressed frustration regarding the fact that these fifth grade students take their science assessment in English, as well as how the amount of testing that occurs affects her students:

Since they have to take the test in English, it is not quite accurate. I think that a lot of time, they are confused with the way the questions are asked. I can see that in the class they can tell me, they can explain it, but when they have to answer a question in a slightly different way, different word, it gives that question a level of difficulty that is too hard for them and I also think that sometimes the students are tired of being tested and they don't give the tests the importance that they should because they say, “We have to take another test again. Well, the real one, I'll try better.”

Leadership Role

To facilitate serious and long lasting change in schools chiefly populated by a linguistically diverse student body, it is critical that the leadership be the type that can synchronize all the elements and components of an educational program which results in academic success for all of its students (Goldenberg & Sullivan, 1994). In order to explore participants' perceptions of the role of administration in supporting quality science instruction for Salas's linguistically diverse population, I posed the following questions:

- *How can administration best support your instructional practice for ELL students in the classroom?*
- *What are the types of professional development connected to science instruction have you found to be most beneficial for being successful with your ELL students?*
- *What are the types of professional development connected to science instruction have you found to be least beneficial for being successful with your ELL students?*

From the role of administration theme, the subthemes of a) issues with resources and b) inadequate professional development emerged. The following is a description of the results connected to these subthemes.

Availability of resources. All participants expressed some concern regarding the science materials available to the teachers. Their concerns focused on either the organization of the materials, the lack of materials, or on how current these materials

were. It is worth noting that Salas Elementary, along with all the other elementary schools in Excel ISD, housed at least two school improvement specialists. One of these provided instructional support in language arts and social studies, while the other provided support in math and science instruction. Due to budget cuts, these positions were eliminated after the 2009-2010 school year. Therefore, the person responsible for coaching teachers in science instruction, maintaining the lab, and securing materials was no longer there. Additionally, in the summer of 2011, parts of the campus were renovated, and many materials that belonged in the science lab were packed and stored, and subsequently, some were never unpacked and prepared for use in classes.

Martha was concerned because the teachers were asked to cover science instruction, however materials were not available to perform the experiments or to demonstrate concepts. Additionally, Mary best expresses how the loss of the instructional position of school improvement specialist affected teachers' ability to access science materials as they needed them:

I think we have a lot of good materials here, but they're not organized to the point that they are usable. Particularly this year, when we had to pack up the lab and it is still not unpacked. [The school improvement specialist] would have had it all unpacked. There's no way to really do it.

I was curious about the accuracy of Mary's observations about the science lab. After I made a cursory visit to the campus science lab, I saw that indeed some materials were still in boxes, and while some were unpacked, they were in no discernible order.

Issues with professional development. Research indicate that elementary school teachers are not sufficiently prepared to teach core subjects, such as science, nor are they ready to meet the needs of a linguistically diverse student body (Kennedy, 1998; National Center for Education Statistics, 1999). When I posed the question focusing on administrative support, it would generally flow into a discussion of the types of professional development that was available to the participants. Their responses covered a variety of issues concerning staff support in the science instruction of elementary school students or staff development of ELL learners. Rarely, did a participant mention professional development that provided support for both issues of science instruction and the linguistically diverse classroom. The teachers interviewed mentioned a variety of concerns such as vertical teams, “hands-on” training for teachers, dual language, and literacy. Additionally, teachers shared that the trainings they were required to attend did not include any contextualized follow-up support. These traditional models also tended to provide a large amount of information in a brief period of time allowing little time for effective transfer of new skills. The teachers also shared the concern that training agendas were typically set by campus and/or district leadership with little consideration for teachers’ needs or instructional skill levels.

I was curious about the types of training the teachers did participate in. A review of professional development transcripts from the years 2009 to 2011 evidenced their participation in a vast array of activities to support their instruction. The following describes just some of these activities followed by a brief description.

- *Guiding Developing Readers: It Works for Fountas and Pinnell* focused on guided reading for young children through read aloud, shared reading and interactive writing.
- *Tribes Training* established how teachers can establish Tribes Learning Community in order to achieve a classroom that observes social norms and strives toward building collaborative relationships among its members.
- *Consume, Critique, Produce* supports writing instruction where teachers guide students through examining various genres of writing, analyzing their characteristics, and ultimately producing their own work.
- *Questioning Training* supports teachers' use of higher order questioning to support students' complex thinking skills and authentic engagement in their learning.
- *Mentor/Mentee Training* provides a structured opportunity for experienced teachers to provide guidance and support for new teachers.
- *Norms of a Healthy School Culture* was an ongoing set of meetings to establish a relationship and communication framework to guide and facilitate the interactions between the members of the Salas Elementary staff.
- *Roadmaps to Instructional Planning* were a series of grade level meetings that produce an overview of lessons for the upcoming nine week period.
- *Design and Delivering of Instruction Training* was a series of trainings to provide information and support for lesson planning and instructional strategies.

- *Balanced Literacy Training* provided strategies for planning effective instructional practices in literacy.
- *Math and Science Focus Group Meetings* occurred every two to three weeks for each grade level to review benchmark data and plan appropriately.
- *Differentiated Workstations* provided strategies for putting in place workstations that meet students' varying needs.

On a positive note, in response to the question regarding helpful professional development nine teachers mentioned the “science rollout” as the most helpful professional development opportunity. This is the school district’s professional development lead by the Excel ISD’s director of science instruction. It is held every nine weeks and focuses on each grade level. The expectation is that a representative from each grade level will attend and return to share this information. Sara, like many other participants, described this professional development in positive terms:

The rollouts are very beneficial, they’re all hands-on. [The science director] gives you a list of activities to teach with every subject. So if there’s a unit coming up on magnets, there’s five experiments you can do.

Mark found that staff development that was flexible and did not make assumptions that you had certain materials. He also made this comment regarding the amount of science staff development and the district’s science rollouts:

Finding relevant science professional development is tricky. I wish there were more opportunities. The rollouts have been helpful. I wish that they could happen more frequently, and at least earlier in the year. So when the topic comes

up in science we're ready to go. When they give them as we're supposed to be doing them, it's hard to implement them fully.

Robert also described the better science professional development opportunities as those where he was allowed to do "... hands-on activities with follow up activities." This was a common attribute of staff development that participants described as most beneficial for teaching science to their ELL students.

Two teachers mentioned the use of strategies they derived from Project GLAD training. GLAD is an acronym for Guided Language Acquisition Design. It is a model of professional development in the area of language acquisition and literacy. The strategies and model promote English language acquisition, academic achievement, and cross-cultural skills. It is comprised of "... an organizational structure to bring together all the elements of an integrated, research/standards-based unit" of study (Brechtel, 2001, p. 1). From this training, both Paula and Diane describe the importance of integrating literacy with science. Paula suggested, "Those reading skills are also needed in science, and lot of the times we forget that when the kids are getting the content and that's why I think it's important to teach vocabulary, with like the GLAD strategies."

Nevertheless, participants did express various concerns about professional development. For example, a large piece of professional development for bilingual classrooms in EISD focuses on the implementation of the dual language program. This program was described in Chapter II of this study. Teachers attend six to twelve hours of staff development focusing on how science instruction will occur in their classroom. District supervisors along with the trainers visit bilingual classrooms to ensure that

teachers are maintaining fidelity to the dual language program. Paula discussed the role of administration and the disconnect she senses regarding this program and the training she received:

Just having a clear message -- I'm referring to one way dual language. We get mixed messages from administration and from what the district wants. The training was not clear and a lot of times, I don't think administration knows the program enough to support us in that subject. They need to be more informed.

In terms of the disconnect perceived between administration and teachers, Sharon shared her frustration:

We are given so many things to do. We have all these meetings, lots of staff development, we have to sit through and I'd rather work with my kids, work in my classroom. And then they change their mind, or the district does something different. We keep meeting about the same things, and nothing gets done.

Finally, Robert expressed his concern about how the teacher trainings are conducted on the campus at Salas Elementary:

Sometimes, I don't like to share what I'm really thinking, because I see some ideas get shot down. I would like a place to get ideas from other teachers, but most of our meetings are run by the same one or two people.

Summary of Participant Interviews

A review of the interview transcripts indicates that these teachers do care deeply about their instructional practices in the classroom. Furthermore, they acknowledge and take seriously the special challenges that occur as teachers of students whose first

language is not English, and the even greater challenge of making a complex subject such as science meaningful to their students. However, the types of instruction occurring in the classroom varied..

The interviews of the participants generated three themes. The first theme was instructional strategies. The first subtheme strategies specific to ELL instruction focused on teachers' reflections in connection to how they scaffold science instruction to meet the needs of their linguistically diverse classrooms. Most of the teachers, ten of the twelve, discussed the importance of building scientific vocabulary to support mastery of scientific concepts. Teachers of bilingual classrooms also discussed the implementation of the One Way Dual Language Program in their classroom and how it supports English proficiency for their ELL students. The second subtheme focused on how teachers provide culturally relevant instruction. Teachers revealed varied strategies as to how they build on the cultural diversity in their classroom to make science instruction meaningful to their students. These strategies ranged from simply displaying posters of historically important Hispanic scientists to actually conversing with their students and engaging them in inquiry as if they were scientists. Only three participants mentioned this higher form of culturally relevant instruction, where the teacher treated her students as if they were scientists. The third subtheme focused on connecting science instruction so that students are able to connect new science learning to prior learning and experiences. Most of the participants indicated that they felt they attempted to activate prior knowledge when introducing new scientific concepts to students. However, there

was little evidence that there was an active integration of other core subjects in order to make science more meaningful to their ELL students.

The second theme that arose from a review of interview transcripts was assessment. The first subtheme generated was cultural bias where eleven of the teacher participants expressed the concern that the district's mandated testing and the state's standardized assessments were culturally biased against their ELL students, who may lack the social experiences to do well on the test. The second subtheme that arose was teachers' perceptions that these assessments also possessed a language bias. Four participants expressed the concern that because of the poor quality of translations it did not paint a true picture of their science learning.

The third theme that arose from an analysis of the interview transcripts was the role leadership plays in supporting science instruction in the ELL classroom. The first subtheme generated centered on the availability of resources. All participants expressed concern in terms of the lack of materials, how current the materials were, or the organization of the materials in the science lab. The second subtheme focused on the lack of professional development that supported quality science instruction in the ELL classroom. While the district and campus offer numerous staff development programs in order to support various mandates, none of the participants could recall staff development that supported science instruction in their ELL classroom. Only one participant mentioned the periodic science staff development that occurred every nine weeks to review the upcoming science curriculum.

The next section of this chapter will describe the results of my review of the participants' lesson plans. These plans were analyzed in hopes of creating a clearer understanding of a teacher's expectations and goals for student learning and achievement. Additionally, I was curious how these plans reflected the essence of the conversations I had with the participants regarding their teaching.

Lesson Plans

Lesson plans serve as a tool to assist teachers in systematically planning their instruction (Kitsantas & Baylor, 2007). I reviewed the participants' lesson plans which reflected instruction from the beginning of the 2011 school year through the end of the second nine week grading period, approximately the end of the fall semester. Analysis of science lesson plans generated two themes. The first theme generated was science objectives. This theme focused on the participants' construction of a learning objective in an attempt to align it with the Excel ISD's science curriculum and the state of Texas curriculum as outlined in the Texas Essential Knowledge and Skills. Two subthemes were generated: a) support for the ELL learner and b) consideration of the cognitive level of the learning goal. The second theme was the instructional considerations. This theme focused on the classroom activities that support the learning objective, and generated three subthemes: a) the use of inquiry, b) vocabulary support, and c) student engagement.

Science Objectives

A learning objective in a lesson plan describes what the student should be able to do and understand as a result of the teaching (Bloom et al., 1956). I examined science

objectives to determine performance expectations for the participants' ELL students in terms of the skills and knowledge they would attain. In a review of the objectives of the science lesson plans, two reoccurring subthemes emerged as a result of instructional considerations for their ELL students: a) support for the ELL learner, and b) consideration of the cognitive level of instruction.

Support for the ELL student. Students who do not possess the adequate oral and written English skills may struggle to master science learning goals in their classroom and their lack of proficiency puts them at a decided disadvantage in school (Echevarria, Powers, & Short, 2006). A review of the participants' lesson plans indicates their awareness of the need to accommodate their instruction to meet the needs of their linguistically diverse students and to enhance the development of academic language. This awareness is illustrated through the practice of teachers pairing a language objective to support language proficiency with core subjects. The English Language Proficiency Standards (ELPS) are a part of that language learning objective in an attempt to differentiate instruction for ELL students. These standards are the Texas Education Agency's answer to the federal government's Title III requirement that states develop a plan to "... develop high levels of academic attainment in English and meet the same challenging State academic content and student academic achievement standards as all children are expected to meet" (Sec. 3102(1)). Therefore, each state has the responsibility of developing their own ELPS that measure ELL students' English proficiency in the domains of listening, speaking, reading, writing, and comprehension (U. S. Department of Education, 2003).

It is the responsibility of Texas school districts to integrate the ELPS into instructional planning and practices into the classroom. Therefore, its use in planning instruction is mandated by Excel ISD in order to raise ELL students' proficiency in English through scaffolding their learning with instructional strategies that meet the needs of a linguistically diverse classroom. The ELPS were generally placed under the objective in the lesson plans. For example, in his lesson plan, Mark wrote as the objective: *The student will explore the gases and identify them in everyday life.* Directly under that he wrote one of the cognitively simpler ELPS: *Use prior knowledge and experiences to understand meanings in English.* As students are exposed to more complex ideas, ELPS also become more complex. A good example of this complexity comes from Mary's lesson plan. In her plan, Mary wrote as the objective: *The student will identify how the sun causes shadows on Earth.* Under the corresponding objective, she enters a more complex ELPS: *The student will speak using grade-level content area vocabulary in context to internalize new English words and build academic language proficiency.*

Consideration of the cognitive level. The higher the level of cognition at which a student is expected to perform, the more his learning experience will become meaningful and enhanced (Mayer, 2002). Studies indicate that meaningful learning can only occur if the teacher facilitates opportunities for the student to engage in high level cognitive processes, and ultimately achieve the outcome of being able to think and problem solve (Mayer, 2002; Whittington, 1995). Therefore, paired with strong content knowledge, teachers must consider the level of cognition required in mastery of the

science goal to support a deeper understanding of science (Duschl, Schweingruber, & Shouse, 2006). A review of the objectives outlined in the teachers' lesson plans reveals their awareness of the importance of including tasks that require and induce higher cognitive levels of learning. For example, the objective in Rachel's lesson plan stated: *The learner will compare structures that passes from parents to offspring that help them survive in certain environments.* Rachel, in planning this objective, expected a higher and more rigorous learning behavior from her students. Through analysis of this objective, the verb *compare* indicates that this task falls at the analysis level on the scale of the Bloom's taxonomy verbs (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956). Here, Rachel's method is more complex than if she had her students simply list the requirements of an animal to survive in a certain environment.

Instructional Considerations

Instructional considerations to support science learning goals were also examined through the teachers' lesson plans. The purpose was to determine what teachers had planned in terms of instructional strategies and classroom practices to scaffold ELL student learning of science concepts. A review of teachers' planning of instructional strategies generated three subthemes: a) the use of inquiry, b) vocabulary support, and c) student engagement.

The use of inquiry. Sandoval and Reiser (2004) described the use of inquiry in the classroom where there is the consistent posing of complex questions from both teacher and student. The purpose of this discourse is to generate data through observation, experimentation, analyzing data and drawing conclusions. In terms of ELL

scaffolding, this practice enhances the development of academic language to promote proficiency in English. Therefore, science process skills are acquired through the extensive use of inquiry, as students develop knowledge and understanding of scientific ideas (Sandoval & Reiser, 2004; Staver & Small, 1990). Bloom's taxonomy, for example, is an instructional tool to support higher levels of inquiry. Teachers pose questions that ask more of the student than to merely recall information. These questions serve to probe for higher levels of understanding. The taxonomy is hierarchical and cumulative in nature and is comprised of six levels: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom et al, 1956).

Excel ISD, in pursuit of instructional rigor, has set forth expectations that classroom instruction on all of its campuses will include questioning that falls within the higher levels of Bloom's taxonomy (Bloom et al., 1956). It is common practice for administration and staff at Salas, engaged in discussion about instruction, to ask each other, "What level of Bloom's is that?" A review of science lesson plans indicates that one of the methods of ensuring the use of a more rigorous line of questioning occurs through the use of focus questions. Focused questioning that falls within these higher levels are where students are asked to adapt, analyze or apply new learning and provides them with the opportunity to effectively study the "big ideas" and key concepts in science. The purpose of focus questioning is twofold: 1) to set the purpose and communicate learning goals at the beginning of science class, and 2) to achieve closure through assessing mastery of science questions at the conclusion of the lesson. For example, the objective in a third grade lesson plan requires students to conduct an

experiment using heat or thermal energy. The focus question and closing assessment question is *How can you keep something hot without having a constant heat on it?* A fifth grade lesson on the uses of mechanical energy poses this focus question: *How does mechanical energy help your life?* However, while these questions are explicitly listed as part of the science lesson plan, there is no indication within the plans as to how the teacher planned to effectively use these questions to build upon the classroom's use of inquiry to support students' ideas and new learning.

Vocabulary support. The teachers of ELL students should mindfully plan to scaffold student learning of the technical and specialist vocabulary that is necessary to master scientific concepts (Wellington & Osborne, 2001). In my examination of lesson plans, one method of vocabulary support occurred through focus and assessment questions. The questions in the lesson plans provided students the opportunity to be introduced and to engage in the use of new science through authentic contexts. Hadjioannou (2007) describes the discussions that are generated through these questions as a classroom based speech genre in which students have the opportunity to give voice to ideas and new learning. This engagement requires the learner to take part in “socially demanding speech genre” (p. 371) where he has the opportunity to offer ideas that can be questioned or challenged, and well as the opportunity to question his fellow classmates. For example, in a fourth grade lesson plan, the objective is for students to explain interactions with the ecosystem, and two focus questions are listed: *1) What is a habitat?* and *2) What are the interactions within a habitat?* Additionally, a lesson plan's learning objective was that students would show how work may be done with a pulley.

This plan served as evidence of providing students with opportunity to engage in the authentic use of new vocabulary through requiring them to draw a pulley, label the parts in their journal, and explain the function of each part.

One strategy consistently used in lesson planning to support vocabulary in authentic contexts was the use of the integration of literature. Most of the literature used was non-fiction books. Through the use of non-fiction, students were provided with the opportunity to use strategies to help them read with understanding, to locate and use information, to follow a process or argument and summarize, and to synthesize and adapt what they learn from the reading of the text (Wellington & Osborne, 2001). Additionally, integration of science content through the use of non-fiction is viewed as an important factor in promoting scientific literacy (Douville, Pugalee, & Wallace, 2003). For the ELL classes, the expectation is that as students read a wider range of non-fiction texts in English, this will increase their comprehension in terms of proficiency in both Spanish and English and in mastery of science content. For the bilingual classes, the expectation is that students will engage in texts in Spanish. In my review of science lesson plans it was clear that every plan contained at least one title of a non-fiction book to support the learning goal. For example, a third grade lesson plan's science objective was students would learn how to use weather tools to make predictions about upcoming weather. This teacher listed *Oh Say Can You Say What's the Weather Today?* as the text to support this objective. The goal served the purpose of not only introducing and reinforcing science concepts about weather, but also supporting authentic learning contexts for science vocabulary.

Student engagement. One method to secure student engagement is to make the learning relevant to the learner's interests (González, 2002). Culturally responsive instruction creates instructional situations that build on culturally different ways of learning in which students have the opportunity to bring their own experiences into the classroom as they acquire new learning (Villegas & Lucas, 2002). A review of lesson plans for second through fifth grades revealed little in teacher strategy to communicate the cultural relevance of science to their Hispanic students. The closest attempt occurred at the beginning of the school year where there is an objective referring to familiarizing ELL students with the tasks that scientists perform. A second grade lesson plan stated: *The student will explore what scientists do by creating a foldable AIMS [Activities Integrating in Math and Science] book.* Third, fourth, and fifth grade objectives were similar in nature requiring the student create a journal and discuss what a scientist does. An objective from the third grade lesson plan stated: *The student will create a science journal and observe and communicate about science.* It seems that it is left to the teacher to create learning contexts throughout the school year where their students can view themselves as scientists

Summary of Analysis of Lesson Plans

Analysis of lesson plans generated two themes: a) science objective construction and b) instructional considerations. In the analysis of the construction of the learning objective, the first subtheme that arose was support for the ELL learner. A review of the participants' lesson plans indicated an awareness of the need to accommodate science instruction to meet the needs of their ELL students through the practice of providing an

accompanying ELPS to support English language learning. Consideration of the cognitive level was the second subtheme. Six of the twelve lesson plans reviewed indicated teachers included in the construction of the science learning objective a task that required complex learning skills. The second theme generated was instructional considerations which generated three subthemes: a) use of inquiry, b) vocabulary support, and c) student engagement. Use of inquiry was evidenced through the use of focus questions and closure questions to assess to what extent students have attained mastery of the learning goals. The second subtheme, vocabulary support, arose after analysis of lesson plans indicated teachers created opportunities to enhance student proficiency in academic vocabulary. The teachers achieved this by securing student engagement through such strategies as specific focus questions and the integration of literature. Student engagement, the third subtheme, was evidenced through the planning of opportunities for students to actively participate in their own learning.

In a desire to see how actual classroom instructional practice aligned with the data from the interviews and the lesson plans, I, after receiving consent, made arrangements with the participants to observe their science instruction for periods of thirty to forty-five minutes. The following is a detailed description of the observations of science instruction at Salas Elementary and the themes and subthemes generated from those observations.

Classroom Observations

During my classroom visits, I observed not only the instruction of the teacher, but also the learning of the students. That is, rather than examine solely the instructional

behaviors of the participants, I also examined the type of learning behavior that was taking place. Analysis of my notes on classroom observations of science lessons revealed two themes. The first theme was the work of the teacher. This theme focused on teaching practices that support a linguistically diverse classroom. Two subthemes were generated: a) vocabulary and concept development, and b) limited use of inquiry. The second theme was learner centered instruction. This theme focused on the types of activities the students were engaged in during my visit to their classrooms during science instruction. Two subthemes were generated: a) active participation and b) rigor of tasks.

The Work of the Teacher

As I observed science instruction in classrooms of ELL students, my intent was to understand to what extent participants facilitated opportunities for their students to acquire content knowledge. This theme of instructional strategies generated two subthemes: a) vocabulary and concept development, and b) limited opportunities for inquiry.

Vocabulary and concept development. ELL students learn more vocabulary through active engagement in content (Hill & Flynn, 2006). In the following exchange, Barbara's ELL class was reading a worksheet containing a passage on plants and animals. After she gave them time to read the passage, she began her lesson.

Barbara: Talk at your table. What important facts did you find? See if you found the same important facts. [Students begin discussing in their small groups.] All right. Let's go back over here. Nina has something to say. Nina, what did you group discuss?

Student: Even though plants and animals are alike, they are still very different.

Barbara: Okay, so, even though plants and animals are alike, they are still very different. Hmm? Guess what that makes me think of doing? What's an awesome type of graphing organization thing we can do?

Students: Venn diagrams.

Barbara: Love it. So, Venn diagram time, why don't we go ahead and do this together. So, on your paper, in your journal, let's create a Venn diagram. This is only for paragraph two, because they're telling us about a whole bunch of different stuff, plants and animals. So, what are they talking about, plants and animals. So what are they talking about?

Students: Plants and animals.

Barbara: So, in paragraph two. Try to stay focused on paragraph two, only. Someone tell me – let's start off in the middle. What does the middle of my Venn diagram mean?

Students: What's the same. The same thing.

Barbara: The same. Thank you, Alex. So, what's the same about plants and animals?

Students: They're both living.

Barbara: They're both living. Thank you, Maria. Go ahead, fill these out guys. Both have cells. All right, can you – do you want to start telling me some

differences?

Students: Plants don't move.

Barbara: Uh? Plants don't move like animals, okay. No moving [enters into diagram]. No moving, as in yeah they move, but no moving as in they don't walk around. Okay, what else?

Students: Plants need carbon dioxide and animals need oxygen.

Barbara: Ooh, that's good. [Writes in the plant circle] Plants need carbon dioxide. [Writes in the animals circle] And animals need oxygen. Perfect, what else? Julia?

Students: Animals find food and plants make their own food.

Barbara: Perfect. Animals find food. [Writes in animal circle] Plants make their own food. There's one thing here, I can put in both. It's kind of right here in our face.

Students: They both need food.

Barbara: Okay, they both need food.

Student: They both breathe.

Barbara: Okay, they both breathe, right? But they breathe a different type of air, but they both breathe. What else, not even in paragraph two? What do you just kind of know about both?

Students: Uh, they both need energy.

Barbara: Right, what's that word about how they use energy?

Student: Photosynthesis

Barbara: Which one?

Student: Plants.

Barbara: Right, and both are living...

Students: [in unison] Living organisms.

Barbara's lesson illustrates the teacher scaffolding scientific vocabulary through the use of a graphic organizer. A Venn diagram is used to compare the similarities and differences of plants and animals. Barbara uses this tool to guide her students in analyzing the passage and engage in the more rigorous thinking skill of making comparisons between animals and plants, while engaging in the authentic use of academic vocabulary.

Limited use of inquiry. The following observation exemplifies an effective use of questioning to support an ELL's student critical thinking throughout a science lesson. When I observed Rachel's science lesson on the function of stems in plants, this practice was obvious through the consistent use of science vocabulary, as well as the posing of numerous cognitively higher order questions.

Rachel: ¿Qué tenemos que descubrir hoy en día? ¿Cuál fue el objetivo científico?
¿Qué queremos demostrar con este experimento? [What do we have to

discover today? What was the scientific objective? What did we want to demonstrate with this experiment?]

Students: Para estudiar sobre de los tallos. [To study about stems.]

Rachel: ¿Quién recuerda la función del tallo? ¿Qué hace una tallo? [Who remembers the function of the stem? What does a stem do?] (Rachel points to bottles of colored water with a celery stalk in each one.)

Students: Esto ayuda a la planta. [It helps the plant.]

Rachel: ¿Cómo ayuda a la planta? Describa cómo ayuda. [How does it help the plant? Describe how it helps.] (Students turn to each other and engage in a discussion about stems.)

Additionally, in Rachel's classroom, I observed the use of not only focus questions with scientific language, but the use of open ended questions to foster students' cognitive development as well as content area vocabulary. Nevertheless, the lesson that took place in Mark's ELL classroom mirrors the limited depth of inquiry that was common to most of the classrooms I observed.

Mark: What are the types of precipitation we know about?

Student: Rain.

Mark: That's the one we're most familiar with here. What else do we have?

Okay, go ahead.

Student: Rain, snow, sleet, and hail.

Mark: Rain, snow, sleet, and hail. Really, in Excel, we only get rain. We get snow about every ten years. We got it once.

Student: What about hail?

Mark: Well, let me show you this. [Mark played the video briefly illustrating the different types of precipitation. After all four were presented, he paused the video.] Well, let me just say sleet is slushier and it's the kind of weather that causes the cars to slip. Hail are more like balls, and if you get hit by hail, it hurts a little more, depending on the size of the ball. But with snow, if the snowflake falls on you, you don't worry about it. [Mark restarted the video on precipitation that further described the conditions for different kinds of precipitation. It ran for approximately 15 seconds.] Okay, I want you to pair/share with the person next to you. Here in Excel, we get a lot of rain. Why is it that we don't get snow, sleet, or hail? Share with your partner. [Students spoke to each other in response to his question.]

Mark: Juan [pseudonym], so, why do you think we get rain – probably not as much we as need? Why do you think we don't get snow, sleet or hail?

Student: The cold – it's not that cold.

Mark: So, you're saying the cold, the temperature plays a factor? What is it that impacts that? Everybody gets clouds. Why don't our clouds get snow? Okay, Ashley, Ashley [pseudonym] what's my question?

Student: It's about snow?

Mark: Yes, why don't we get snow, sleet, or hail?

Student: Because we're in Excel.

The focus of this lesson then shifted to how to look up weather data on the internet. While Mark provided more than adequate input, the instruction that students must have in order to master the learning goal, his questioning is limited to a relatively low cognitive level. Additionally, there were missed opportunities for Mark to scaffold instruction through the use of inquiry by engaging students in paired and group discussions about the different types of precipitation. Instead, he provided the information up front, thus removing the opportunity for students to make their own discoveries and thus have ownership of new learning.

Additionally, as I conducted classroom observations, I looked for indications of participants actively integrating their students' background experiences or making connections to prior learning into science instruction. Perhaps due to the brevity of these classroom visits, I did not witness extensive use of this instructional practice. Aside from the above mentioned participants, during my visits, I saw little evidence of teachers providing students with opportunities to make meaningful connections from the science they were learning to prior experiences.

The Work of the Student

A review of data on observations also generated the theme of the work of the student which focuses on students' learning behaviors during instruction. The focus of this theme shifts from the instructional behaviors of the teacher to the learning behaviors

of the students. I observed student engagement during my visits that communicated to the student accountability for his own learning, as well as engagement in more rigorous cognitive skills. This generated two subthemes: a) active participation and b) rigor of tasks.

Active participation. The practice of providing ELL students with the opportunity to actively participate in their own learning through collaboration was observed in six of the twelve classrooms during science instruction. If students were passive in their learning, for example receiving the majority of their instruction through teacher lecture during this classroom visit, I did not consider the students active participants. In terms of identifying the presence of this higher form of student engagement, it could range from the use of a pair and share strategy to actual student participation in a science experiment. Teachers communicated this expectation of student engagement in various ways; such as “turn to your learning buddy and . . .”, or “explain to your bilingual partner about . . .” For example in her ELL classroom, Martha made this request, “Turn to your shoulder partner and tell each other to name one tool we use to measure weather and explain what does it measure.” It was obvious through the smooth execution of this task and the presence of the quiet buzz of conversation, that this was an ordinary event in Martha’s science instruction. Additionally, I overheard students providing each other with language support in Spanish throughout their conversation, thus making them accountable for each other’s learning. For example, after Martha provided instruction for an upcoming activity, one student with a slightly puzzled look on her face, turned the student beside her and said “¿Qué dijo?” (What did

she say?). It was interesting to note that after this clarification, the remainder of their conversation took place in English.

Another example of actual classroom practice evidencing active participation occurred in Diane's bilingual classroom. On this visit, I observed that she not only provided opportunities for her students to actively participate in their learning, but students were able to make connections to the prior knowledge they were bringing to the classroom. As such they were enhancing their vocabulary through the authentic use of scientific words in Spanish. In the following exchange, as the Diane introduced the parts and functions of edible plants, she engaged her students in discussion tapping into their own personal experiences.

Diane: ¿Que es esto? [What is this?]

Students: Una zanahoria. [A carrot.]

Diane: ¿Que es esto? [What is this?]

Students: Un apio. [A stick of celery.]

Diane ¿Que es esto? [What is this?]

Students: Una cebolla [An onion.]

Diane: ¿Comemos apio? [Do we eat celery?]

Students Sí. (One student waved her hand in the air and Diane pointed to her.)

Student: Me gusta con crema de cacahuete. [I like it with peanut butter.]
(There was a murmur of agreement and several “yuks.” Voices quieted as Diane placed the carrot and onion on a table beside her, and then held up the celery for the class to view.)

Diane: Habla con tu vecino sobre las partes del apio que comemos.
¿Algunos de ustedes lo comen en su casa? ¿Como lo usa su mama cuando cocina? ¿Cuales son los nombres de esas partes?
[Talk to your neighbor about the parts of the celery you eat. Do any of you eat it at home? How does your mother use it when she cooks? What are the names of those parts?] (Students turned to each other and engaged in discussion of Diane’s question, until she gave a hand signal for attention.) ¿Quién me puede decir?
[Who can tell me?] (Several students raised their hands, until Diane called on a male student.)

Student: Son las hojas. [It’s the leaves.]

Diane: Sí. ¿Qué más? [Yes. What else?]

Student: La parte larga. [The long part.]

Diane ¿Cómo se le dice a la parte larga? [What do we call the long part?]

Student: El tallo. [The stem.]

Diane continued this process with the other two vegetables making connections with what the students were familiar with in their home life as well as adding her own personal experiences. Students' active participation was also evident through students speaking to their neighbor and sharing insights connected to this lesson throughout this observation. Finally, she connected this lesson to an opportunity to engage in literacy by having them enter their results in their science journals.

What follows illustrates the explicit vocabulary instruction in Carol's classroom focusing on the water cycle. In this lesson, Carol was projecting a web-based video lesson which explained different elements of the water cycle. The students were seated on the carpet at the front of the room gathered at her feet. As the video narrator described the water cycle, the word *evaporation* appeared. Carol stopped the video.

Carol: ¿Qué es esta palabra? [What is this word?]

Students: Evaporación. [Evaporation.]

Carol Ahora, hable con su vecino sobre lo que usted piensa que significa. [Now, talk to your neighbor about what you think it means.] (Students turned to partners and discussed possible definitions. After about fifteen seconds, Carol gave a hand signal for attention.) ¿Quién puede decirme lo que significa la evaporación? [Who can tell me what evaporation means?] (Several students raised their hands and Carol pointed to male student.)

Student: Es como el agua va [It's like the water goes....] (His voice trailed off.)

Carol: ¿Va adonde? [Goes where?] (She shrugged.)

Student: ¿En el cielo? [Into the sky?]

Carol: Eso es correcto. Se convierte en gotas y se eleva. [That's right. It turns into droplets and rises.]

This lesson proceeded in the same way, with Carol turning off the video as a new word was introduced and students participating in paired discussions of its possible meaning, with Carol clarifying after student discussion. Even though the questioning was of a cognitively low level, the teacher provided students with the opportunity to develop academic vocabulary through a form of active participation, specifically, a pair and share strategy.

Rigor of tasks. The second subtheme that was generated from observing classrooms was to determine the rigor of tasks students were engaged in. If the instructional aim is for students to think, reason, and problem solve scientifically, then student must be engaged in high-level rigorous scientific tasks (Erickson & Gutierrez, 2002). Table 2 below is a graphic illustration of the continuum of complexity of student engagement that occurred during my observations. I looked for the level of complexity through the tasks students participated in and were assigned to complete during science instruction. The levels of complexity varied from simply listening to the teacher to active engagement in a science activity. It is worth remembering that my visits were

thirty to forty-five minutes, and what was observed may be considered a snapshot of what normally occurs in the classroom. Nevertheless, in this series of classroom observations, the higher level of student engagement that involved hands-on activities such as experiments and active observations only occurred in four of the twelve visits. Students in Mary's and Amy's class participated in science experiments, while Martha guided her students in journaling in small group observations. Rachel guided her students in an active observation. I did observe most participants instructing their students to share in pair or group in response to questions posed by the teacher. Nevertheless, much classroom instruction involved minimal student engagement.

Table 2 Continuum of Complexity of Student Engagement

Participant	Listening To Lecture	Completing a Worksheet	Sharing in a Pair/Group	Engaged in a Hands-on Activity
Mark	X		X	
Amy		X		X
Martha			X	X
Barbara		X	X	
Diane	X		X	
Carol	X		X	
Paula	X		X	
Mary		X	X	X
Rachel	X		X	X
Sharon	X	X		
Sara	X	X	X	

Summary of Analysis of Classroom Observations

Analysis of observation notes revealed two themes: the work of the teacher and the work of the student. The first theme, work of the teacher, generated two subthemes: a) vocabulary and b) limited use of inquiry. The subtheme of vocabulary arose through the observation of the consistent use of classroom strategies to support students' proficiency in the use of the academic language of science. The second subtheme was generated through the observation of most classrooms where I witnessed only two teachers increasing the rigor of instruction through the use of higher order questioning

and engaging their ELL students in the process of inquiry as part of their science instruction. The second theme focused on the work of the student in terms of engagement and how their teachers hold them accountable for their learning. The first subtheme, active participation, was observed. This practice was observed in most classrooms taking a variety of forms such as pair and share where students were expected to show agreement or disagreement to statements made by teacher or student in the classroom. The second subtheme that arose from the classroom observations was the rigor of tasks. The focus was on the complexity of the tasks and the requirements of students to complete the activity. In only four out of twelve classrooms were students working on activities such as experiments and engaged in discussions of observations.

Summary

I interviewed twelve teachers using a protocol composed of seven open ended questions (see Appendix 4). These questions allowed me to gather rich data about the teachers' perceptions of their science instruction for their ELL students, as well as their perceptions about their teaching practices. Before presenting the results from the interviews, observations, and analysis of lesson plans, a brief description of these twelve teacher participants was presented in an attempt to assist the reader in understanding the participants, the instructional planning, and the classroom instruction which occurred during the observations. This chapter presented the data from participant interviews, lesson plans, and observations. Through the one-on-one interviews, participants shared their experiences and insights regarding the science instruction that occurred in their classrooms. The first theme that emerged from a review of the interview transcripts

were instructional strategies implemented in the classroom. Three subthemes emerged from this theme: a) strategies specific to ELL instruction, b) assessments, and c) connected science instruction. The second theme that emerged from a review of interview transcripts focused on the use of assessments and how accurate a picture they presented of the ELL student's progress in science instruction. The resulting subthemes were a) cultural bias and b) language bias. The third and final theme from analysis of the interview transcripts was the leadership role and the part it plays in supporting instruction in the classroom for linguistically diverse population. This theme generated two subthemes: a) resource issues and b) inadequate professional development. The structure and content of lesson plans were also examined to determine the role they play in science instruction for the ELL student. The review of lesson plans generated two themes: a) science objective construction and b) instruction considerations to support the ELL learner. The theme of science objective construction was explored to determine the role it played in focusing instruction. It generated two subthemes: a) support for the ELL student and b) the cognitive level of instruction. The second theme generated upon analysis of lesson plan focuses on the instructional considerations or what student work was planned to support science learning goals. This theme generated three themes: a) use of inquiry, b) vocabulary support, and c) student engagement. Finally, through observations of science classrooms that would present a clearer picture of instruction, two themes were generated: a) the work of the teacher, and b) the work of the student. From observing the work of the teacher, two subthemes were generated: a) vocabulary and concept development, and b) limited use of inquiry. From observing the work of the

student, two subthemes were also generated: a) active participation, and b) rigor of tasks.

To review, I constructed graphic representations for three major themes that arose throughout the data gathering process: a) instructional strategies, b) student engagement, and c) culturally relevant and connected science instruction. Figure 1, below, illustrates how each source of data evidenced (or did not evidence) issues connected to instructional strategies. For example, while the participants described the vocabulary strategies they implemented in their classroom, and this was evidenced through the focus questions listed in their lessons plans that supported authentic and real life use of scientific vocabulary. However, I actually observed the use of direct vocabulary instruction, where students were engaged in contrived activities during instruction. An analysis of interview transcripts also evidenced the use of dual language strategies as an instructional tool. Lesson plans listing the ELPS and observations did evidence the use of these strategies in the classroom. However, while lesson plans explicitly listed questions with higher cognitive intent, the mention of their use was limited to one participant and was rarely observed in the classroom visits.

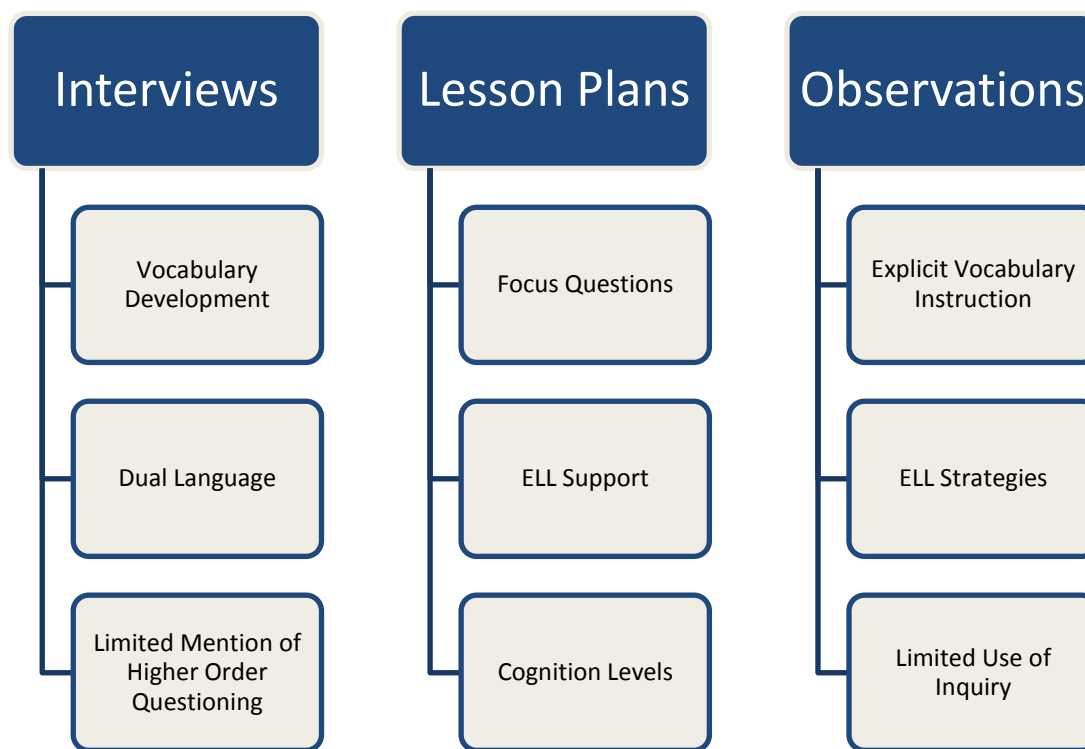


Figure 1 Relational Theme Chart for Instructional Strategies

Below in Figure 2, is a representation of student engagement as represented in interviews, lesson plans, and classroom observations. Several participants mentioned the use of classroom discussion to support student engagement. Additionally, focus questions were listed in lesson plans designed to initiate discussion and inquiry. Nevertheless, there was limited use of higher order questioning observed in the classroom during my visits. During interviews, participants frequently mentioned the use of hands-on activities to engage students' interests. While there were experiments and observational activities listed in lesson plans, only two teachers were observed leading their students in experiments in the classrooms. One teacher guided their students in an observational task.

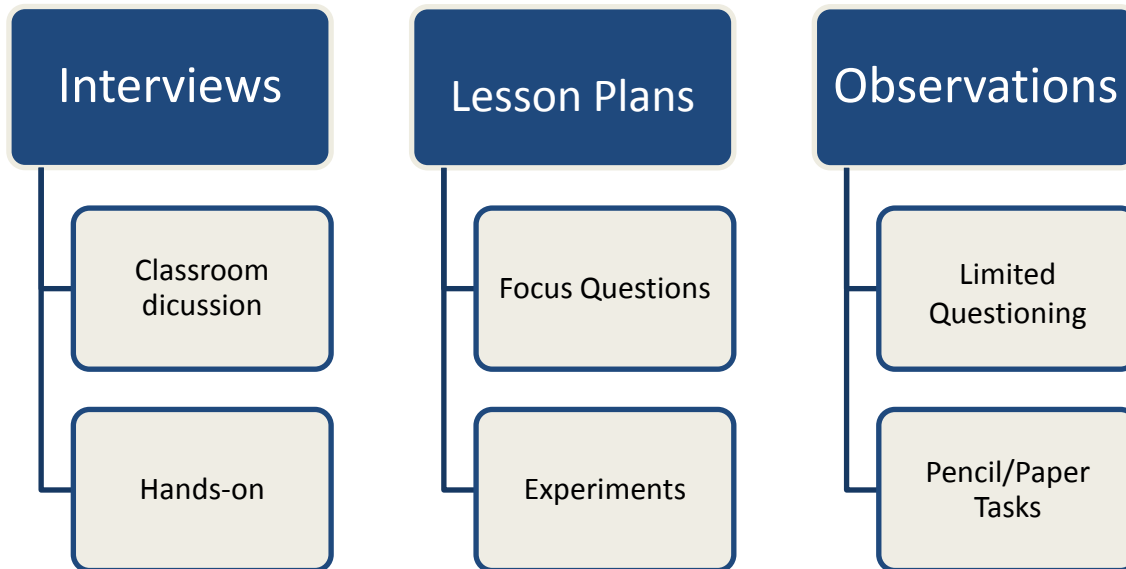


Figure 2 Relational Theme Chart for Student Engagement

Finally, Figure 3 illustrates how the issue of culturally relevant teaching and making connections was reflected in interviews, lesson plans, and observations. In the interviews the teachers mentioned a variety of strategies they employed to provide opportunities for their students to make meaning of complex science concepts, while also making science culturally relevant to their ELL students. However, there was very little evidence in lesson plans of teachers making a real effort to connect new science learning to students' personal experiences and interests. While the teachers spoke about encouraging students to view themselves as scientists, during the classroom visits, there was little evidence of that practice playing an active role in the classroom. Finally, while participants described strategies they used with their students to connect science to their lives and to other content areas, suggestions for connections were limited to naming non-fiction book titles teachers could use to support science concepts. Also, in terms of

classroom observations, I viewed only two participants actively making connections to students' lives in their science instruction.

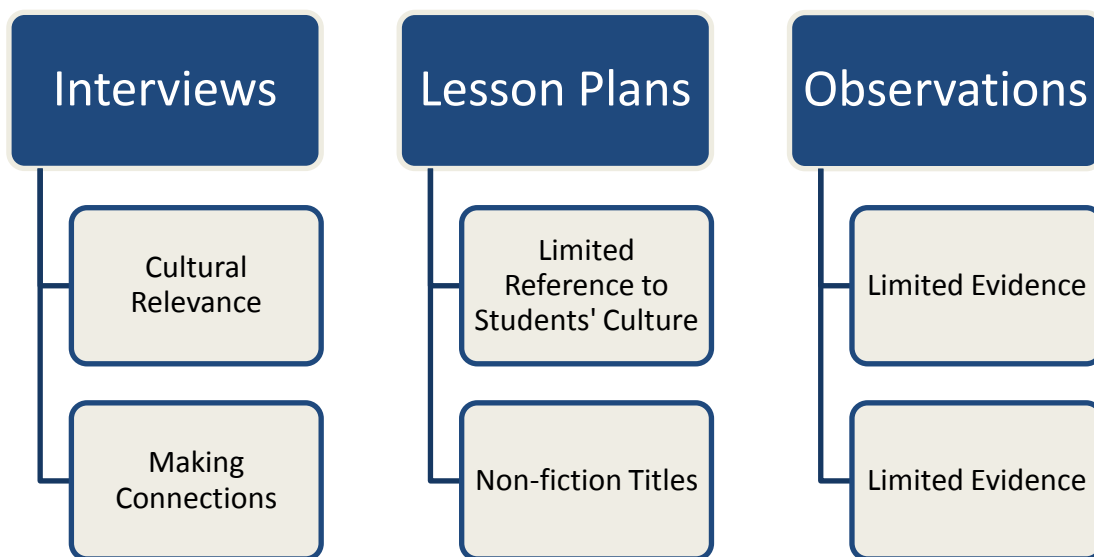


Figure 3 Relational Theme Chart for Cultural Relevant Instruction

In the fifth and final chapter, I will discuss the results and their meaning. Furthermore, this chapter will explore the question as to why despite numerous professional development opportunities, detailed lesson plans, and multiple opportunities to review data, ELL students still have not made substantial achievement in science as compared to other student groups. More importantly, the final chapter will examine why, despite efforts to support and improve teaching, classroom observations revealed minimal evidence of the focused instruction necessary to promote high student achievement in science. This examination will be accomplished through an exploration and connection to prior research and the literature reviewed in Chapter II. Implications

for school leadership as well as recommendations for future research will also be presented in Chapter V.

CHAPTER V

DISCUSSION, RECOMMENDATIONS, AND CONCLUSIONS

The final chapter of this study I discuss some possible reasons for the mismatch between interviews, lesson plans, and the classroom instruction I observed at Salas Elementary. I also discuss the relationship of the results of this study to the research literature. Finally, I conclude with recommendations for future research.

For this inquiry, I examined teachers' reflections and perceptions of science instruction for elementary ELL students through interviews. I also examined instructional structures through analysis of teachers' lesson plans. Additionally, I observed teacher and ELL student behaviors in the classroom during science instruction. Through this study I also sought to identify factors that limited the linguistically diverse student's academic success in science, as well as the factors resulting in the achievement gap that persists between ELL students and populations of higher achieving students. If educators can understand the reasons why such a gap exists in achievement, then perhaps policies and procedures related to instructional practices which focus on the ELL student and science instruction may be reexamined and modified to better meet student needs. By increasing their knowledge about successful ELL strategies, practitioners can assist in creating and developing the instructional practices to improve science education for students whose first language is not English.

The development of my study was guided by literature on the subjects of teaching science to ELL students, culturally responsive science teaching, and effective leadership

practices in successful schools with large populations of Hispanic students. By reviewing the scholarship in these fields, I was able to formulate research questions for the current study. My research questions were a) What do teachers understand about teaching science to elementary school ELL students? b) What do teachers understand about ELL student learning in relationship to science teaching? and c) What are teachers' perceptions about the role of the school leadership in support of their teaching? What does the structure of teachers' lesson plans indicate in terms of their awareness of effective science instruction for the ELL student? What do the observations of instructional practices indicate in terms of teachers' awareness of effective science instruction for the ELL student? In order to answer these questions, I conducted semi-structured interviews with 12 elementary school teachers from Salas Elementary in Excel ISD, a suburban school district in southeast Texas.

The qualitative interviews generated rich data in terms of teachers' perceptions and reflections connected to their science instruction, the strategies they implement to support ELL students' learning of scientific concepts, and the role that school leadership plays in supporting their science instruction. Through the interviews, I attempted to capture the voices of the participants as they provided detailed descriptions of their perceptions and practices when teaching science to their ELL students. This data also provided insight into teachers' perceptions of the role campus leadership plays in their instructional practices. Additionally, an examination of lesson plans revealed data about how lessons are structured to support ELL students' in science instruction. Analysis of lesson plans, allowed me to observe the planning of science lessons, as well as to assess

whether the components of instruction necessary to support ELL student learning were present. Finally, classroom observations generated rich data about teachers' instructional practices and students' learning behaviors that were actually occurring during science instruction. Actual observation of science lessons allowed me to assess how practice aligned with the participants' responses and their planned instruction.

The strongest fundamental themes and subthemes that arose throughout the data analyses were: a) instructional strategies, b) student engagement, and c) culturally relevant and connected science instruction. In connection to the use of instructional strategies, the first theme, the participants described the various strategies they implemented in their classroom. An analysis of interview transcripts also evidenced the use of these strategies as an instructional tool. Lesson plans contained the ELPS and observations revealed the use of these strategies in the classroom. However, while conversations with participants and lesson plans exhibited a general awareness of these strategies, the mention of their specific use was limited to one participant and actual implementation was rarely observed in the classroom visits.

The second theme, student engagement, was described by several of the participants in terms of classroom discussions and hands-on activities. Additionally, focus questions were listed in lesson plans designed to initiate discussion and inquiry, as well as planned experiments or observations. Nevertheless, I observed limited use of higher order questioning in the classroom during my classroom visits. Furthermore, during interviews, participants frequently mentioned the use of hands-on activities to engage students' interests, and although there were experiments and observational

activities listed in lesson plans, I observed limited use of hands-on activities in the participants' classrooms.

Finally, the third theme focused on culturally relevant teaching and making connections. Discussions throughout the transcripts mentioned a variety of strategies to provide opportunities for their students to make meaning of complex science concepts and to make it culturally relevant to their ELL students. Teachers' attempts to make their lessons culturally relevant ranged from the use of posters of Hispanic scientists to getting students to refer to themselves as scientists during activities. However, there was very little evidence in the lesson plans of making a real effort to connect new science learning to students' personal experiences and interests, and even though teachers spoke about encouraging students to view themselves as scientists. Moreover, during the classroom visits, there was little evidence of that practice playing an active role in the classroom. While participants described strategies they used with their students to connect science to their lives, again, as with the first two themes, my classroom observation revealed limited use of this instructional practice.

After I reviewed data collected for this study, I was intrigued that despite the teachers' participation in numerous professional development activities and composing detailed lesson plans based upon a district framework, the instruction I observed consisted of teachers providing their students with limited opportunities to engage in higher order thinking or to engage in rigorous tasks. Additionally, a review of several aspects of the data revealed issues concerning the connection between what is planned and discussed and what actually occurs. Even though there was professional

development focusing on some of these instructional issues, looking across my results, I found that practices were connected by the spotty and unfocused professional development the teacher participants participated in. What follows is a discussion and recommendations concerning the professional development the teachers participated in and its possible role in connection to the discrepancy which existed between the teachers' perceptions, and what actually occurred in their classrooms.

The Relationship of this Study to the Research Literature

Evidence of Misalignment

As I reflected on my data, I found several issues of concern. First, my conversations with the participants reflected an awareness of instructional issues that are connected to quality science instruction for their ELL students. They are also aware of the importance of providing hands-on opportunities for their students to explore science, and including teaching strategies that support academic vocabulary. Additionally, the lesson plans I reviewed indicated that teachers had reflected on the structure of the lesson they wanted to present to their ELL students. As discussed in Chapter IV, the lesson plans included such elements as focus questions, vocabulary support, and activities. Certainly these lesson plans could result in strong instructional practices in the science classroom. Nevertheless, my observations noted that in the majority of the classrooms, the teaching was of low level, tasks required of the ELL students were not complex, and the lessons lacked the rigor necessary to support complex learning skills needed for students to achieve in science. Therefore, I was curious as to why there existed a mismatch between interview responses and lesson plans compared to the

instruction I witnessed in the classroom. The following is a description of the reflection and process I engaged in to discover a possible rationale for this gap between awareness and practice.

Rationale for Gap between Awareness and Practice

As I reflected on the results of this study, I was curious as to why, with all the resources in terms of professional development and lesson plans provided by the district, the practices of eight of the twelve classrooms could not be described as highly effective. Additionally, I was aware through my research that studies had indicated the academic success of students is significantly influenced by teachers' access to quality professional development activities (Darling-Hammond, 2000; Guskey, 2002). These results seem to be indicative of a lack of sound professional development practices. Specifically, if the goals of professional development are to support effective teaching and improve learning for all students, my observations indicated that campus staff development had not met these goals due to evidence of low teacher efficacy observed in most of these classrooms.

After a review of the literature on quality professional development and its connection to effective instructional practices, it became clear that the current models of professional development offered to these participants were not reflective of best practices discussed in current research. The following is a discussion of the connection between research on quality professional development discussed in Chapter II of this study and the staff development practices that were occurring at Salas Elementary.

The Role of Quality Professional Development

According to the thesaurus of the Education Resources Information Center database (Houston, 2001), professional development is described as a process by which educators increase knowledge, skills, and abilities to meet professional goals. Fullan and Steigelbauer (1991) broaden the definition to include "... the sum total of formal and informal learning experiences throughout one's career from preservice teacher education to retirement" (p. 326). These goals build capacity within the teacher for the purpose of ensuring success for all students (Fullan & Steigelbauer, 1991). The review of the literature identifies several characteristics of professional development that lead to and sustain lasting school improvement in a linguistically diverse campus. I selected five characteristics of professional development that seemed the most relevant to teacher participants' science instruction for ELL students: a) focused professional development, b) job-embedded professional development, c) ongoing professional development, d) collaborative professional development (González, 2002; Knowles, 1973; McKenzie, Skrla, Scheurich, Rice, & Hawes, 2011), and e) teacher changing (Guskey, 2002). The following is a discussion of the literature on these components and the connections it had to the results of this study, as well as recommendations for the planning of quality professional development events.

Focused professional development. A review of teachers' professional development transcripts indicated that the participants had attended an average of 35 to 50 hours of professional development per year focusing on topics from guided reading to discipline strategies. Much of this professional development arises as preparation to

fulfill district mandates. Leadership at Salas rarely provided follow up to new learning.

As Amy remarked in our interview:

We go to trainings, and more trainings, but nothing really changes. Sometimes we'll hear more about what we learned, but ... (*pauses*). There is not a lot of follow up. Most of the time, I would rather work with my kids than to attend one more meeting.

This statement is representative of how most of the teachers perceived professional development. I also found it intriguing that these participants, as teachers on a campus which has difficulty providing quality science instruction for its ELL students, mentioned only one staff development event specifically focused on science instruction. Research indicates that professional development must be data-driven in order to sustain continuous improvement in students' academic achievement (Feischman & Safer, 2005). However, it must also provide opportunities for a participant to deepen content knowledge or broaden pedagogical skills. Rather than focus on continuous improvement in science instruction for its linguistically diverse student population, these staff development opportunities at Salas were not purposefully differentiated to meet teachers' individual needs in terms of science instruction for their ELL students. These practices do not reflect the research from McKenzie et al. (2011). In their study of successful urban high schools, the teachers attended a variety of professional development activities sponsored by the campus and district. Teachers' choices of trainings were based upon the needs of the district, campus, or individual teacher. The issue of individualizing staff development needs to meet the training needs of teachers

leads to a discussion of a second characteristic of quality professional development, job-embedded professional development.

Job-embedded professional development. Learning that occurs as educators engage in their instructional activities is described as job-embedded professional development (Knowles, 1973). It can be both formal and informal, and includes activities such as discussion with others, peer coaching, mentoring, study groups, and action research (Sparks, 1994). Job embedded staff development arises from the assumption that teachers, as adult learners, are motivated to learn new information that is important to them and to apply that new information immediately to their classroom practice (Knowles, 1973). The following is a discussion regarding job-embedded professional development and its place in teacher training on the Salas campus.

A review of professional development transcripts indicated that the various models of teacher training available to the participants from Salas Elementary did not include job-embedded training. Rather, the professional development trainings were generally traditional in nature, and allowed for little differentiation for the varying needs of a teacher; especially for a teacher trying to master the necessary instructional strategies to teach science to ELL students in elementary school. Additionally, as to Salas's general practice of offering one traditional model of professional development to its teachers, this did not reflect the current research regarding effective models of teacher support and training. Wagstaff and Fusarelli (1999) described professional development at the high-achieving schools they studied as taking a variety of forms; such as visiting

other campuses, staying current with the professional literature, and utilizing train-the-trainer models.

Research indicated that effective professional development must be tailored to meet the teachers' needs, years of service, and experiences (Hahs-Vaughn & Scherff, 2008; Kilgore, Griffin, Otis-Wilborn, & Winn, 2003). Researchers have expressed concern about the ineffective "one-size-fits-all" method commonly used for professional development, because it fails to take into account that teachers participating in professional development are just as diverse as the students they teach. Tomlinson (2000) stated, "It is unwise for educational leaders to ask schools and teachers to be vigorously sensitive to individual student differences while leaders function as though all schools or all teachers are alike" (p. 110). In terms of staff trainings, decisions made by district and campus leadership at Salas indicated they are not addressing the learning gaps of individual teachers in order to provide the instructional support for specific teacher needs. Current research does not support this practice. Therefore, school leaders at Salas need to respond to this diversity accordingly by differentiating staff development methods (Elmore, 2002; Hertbert & Brighton, 2005).

Ongoing professional development. If a new instructional practice is to remain vital and dynamic, it must have a system in place to ensure continued professional learning (Elmore, 2002). Therefore, an essential characteristic of quality professional development is that it must be ongoing. The benefit of this practice is that it helps teachers to form communities that explore their instructional practices as they are continually evolving (Boyle, While, & Boyle, 2004). The teacher's active engagement

arises through this knowledge allowing him/her to combine prior knowledge with new knowledge (Lutrick & Szabo, 2012). Most of the professional development opportunities available to the participants at Salas Elementary were isolated events limited to one-hour seminars or, at most, a one-day workshop. At the end of these events, the participants were expected to successfully implement the new strategy and sustain that implementation throughout the school year. This practice at Salas was not reflective of current research which indicates that the majority of participants who do take part in longer-term professional development make significant changes in their instructional practices (Boyle, While, & Boyle, 2004). However, as Mark responded to the interview question regarding effective professional development for science instruction:

They give us lots of handouts. Maybe somebody follows up with me. Like with guided reading, I might get someone checking on how I'm doing, but most of the time ... [*He shrugs his shoulders.*] Now, I just try to get one good idea of these trainings to use with my kids.

Such practices at Salas Elementary were not consistent with the current research which indicates continuous and ongoing training focused on one area of teaching is a chief characteristic of effective professional development. In order for any professional development to affect lasting change, ongoing training *and* accompanying follow up are needed to be major components of the program (Boyle et al., 2004; Johnson & Asera, 1999; McKenzie et al., 2011). A review of the literature on teacher training also maintained that those “drive-by workshops” fail to have lasting effects and may leave

teachers unprepared for the classroom (Darling-Hammond, 2000; Fullan, 1991). Staff development must not only be connected to the needs of teachers and students, it must avoid becoming an isolated event. Instead, it must be ongoing so it becomes part of the culture of the campus it serves.

Collaborative professional development. Collaboration is also an essential component in making professional development activities effective (Darling-Hammond & McLaughlin, 1995). Guskey (2002) discussed the importance of the social interactions that occur alongside learning in a teacher training event. Teachers need opportunities for collaboration while receiving on-going external support (Wideen, Mayer-Smith, & Moon, 1998). Based on the data from the interviews, teachers at Salas were seeking a learning community where not only the training was purposeful and focused, but where exchanges centering on instructional practices could occur in a non-threatening environment. After a review of transcripts, it became apparent that there were limited times that these participants could freely collaborate or debrief about new learning acquired through teacher training. For example, recall, Robert, who reflected in his interview that he wanted an opportunity to safely think aloud and he also wanted the same for his colleagues. Opportunities for teachers to engage in effective and purposeful discussion may likely lead to reflection and hopefully a change in instructional practice.

Ensuring that the four components of quality professional development are in place may not be sufficient to ensure lasting change in teacher practice. The final piece in exploring the characteristics of effective professional development is a consideration

of the sequence of the outcomes of teacher trainings: First, changes in attitudes, then, changes in classroom practices, and, finally, changes in learning outcomes.

Lasting change from professional development. If the goals of professional development are to change the classroom practice of teachers, change attitudes and beliefs, and change learning outcomes of students, consideration also needs to be given to the sequence of these outcomes (Guskey, 2002). The usual practice is to get teachers' acceptance and change in attitudes as they engage in the new training. For leadership, the rationale for this practice is to gain acceptance from the staff or "get them on board" (Joyce, McNair, Diaz, & McKibbin, 1976). This traditional model posits that teacher acceptance of new ideas must be in place before change takes place in classroom practice. Guskey (year) proposes an alternative model suggesting a different sequence of professional development outcomes. His research found that the necessary shifts in attitudes and beliefs occur *after* the implementation of the new professional development and when teachers see the new practices result in improvement for their students.

Guskey (year) writes:

The crucial point is that it is not the professional development *per se*, but the experience of successful implementation that changes teachers' attitudes and beliefs. They believe it works because they have seen it work, and that experience shapes their attitudes and beliefs. (p. 383)

Guskey's (2002) research supports the results of this study. Further research also indicates that experienced teachers rarely become committed to new instructional approaches until they have witnessed its success in their classroom (Bolster, 1983). This

may be indicative of why participants' actual classroom practice did not reflect their awareness of effective science instruction for their ELL student. At Salas Elementary, campus leadership may have attempted to secure teachers' commitments to new instructional practices by involving them in problem-solving and decision-making prior to implementation. This "over planning" may have led to limiting the effectiveness of strategies to support the ELL learner in the mastery of scientific concepts.

Summary

To review, Figure 4 presents the five characteristics of quality professional development necessary to affect continuous improvement. Quality teacher training must be focused. Training must be data-driven in order to sustain continuous improvement and provide opportunities for the teacher to deepen scientific knowledge along with instructional strategies to support the ELL student. Additionally, it must be ongoing and not viewed as an isolated event in order to promote active engagement of the participants and lasting change in their classrooms. Furthermore, quality professional development must be job-embedded or differentiated to meet the individual training needs of its teachers. Moreover, it should be collaborative in nature allowing participants a safe place to engage in conversations with both peers and leadership, and to share ideas and reflections in support of improving instructional practice. Finally, quality professional development should result in lasting and substantive changes in teacher practice in order to support high student achievement.



Figure 4 Graphic of Five Characteristics of Professional Development

Recommendations

The following recommendations serve as guidelines in forming decisions about quality professional development to support science instruction for ELL students. It is recommended that Salas Elementary leadership focus on four specific areas of growth in the delivery of professional development: a) continuous improvement, b) differentiation, c) continued learning, and d) lasting change. The following is detailed discussion of each focus area with accompanying recommendations.

Focus on Continuous Improvement

As part of a focus on continuous improvement in science instruction, the leadership of Salas Elementary should ensure that there is a plan in place for staff development that focuses on science instructional strategies which provide the optimum support for the ELL student. It is recommended that professional development

opportunities focus on science instruction and be linked to meaningful content and change efforts, rather than broad generic mandates (Darling-Hammond & McLaughlin, 1995). It is also recommended that a needs assessment or survey of instructional practices be administered seeking input from participants to sharpen the focus of teacher training.

In terms of supporting their ELL students in their science learning, there was absence of professional development specifically focusing on moving their students from basic interpersonal conversational skills (BICS) to cognitive academic language proficiency skills (CALPS). Cummins (1985) defines BICS as the conversational English ELL students develop through basic interpersonal skills. BICS is simply the ability to understand and speak informally with friends, teachers, and parents, and is not especially demanding (Hill & Flynn, 2006). BICS may be deceptive because even though the student might sound fluent to the teacher, their schoolwork and assessments may not reflect this fluency. ELL students must master the language of the classroom or CALPS. It is the language of scientific concepts – for example, the language of photosynthesis – and will support critical thinking skills and problem-solving skills to master scientific concepts. Therefore, moving students from BICS to CALPS should be a primary focus of professional development at Salas Elementary.

At Salas Elementary, a review of observation data indicated that teachers did not understand the different intellectual levels of English proficiency of their ELL students, as evidenced by the prevalence of low level cognitive questioning. When students answered these questions correctly, teachers may have assumed students possessed

CALPS, rather than BICS, as they were not aware of the specific academic needs of students at different levels of English language acquisition. At Salas, there is a need for specific and focused staff development opportunities related to working with all students. There is an additional need for teachers to develop an understanding of the differentiation of needs as students progress in their acquisition of English language.

Therefore, findings from this study indicate there is need for focused training on appropriate instructional strategies that support student progress in the stages of English learning proficiency to develop CALPS and support their mastery of complex science concepts. Such instructional strategies may include activating and building on students' prior knowledge in the content area and supporting English language learning in authentic contexts (Brinton, Snow, & Wesche, 1989). In terms of culturally responsive instruction, it may also be necessary to provide specific staff development to support teachers' awareness of the culture of the students in their classroom. Regardless of a teacher's ethnicity, they may not be aware of the appropriate instructional practices and decisions that best integrate the cultural characteristics or communication styles of their students (Knight & Wiseman, 2005).

Focus on Differentiation

Salas must acknowledge the vast variety of skill level and experience its teachers bring to science instruction. Just as its leadership expects teachers to differentiate instructional practices to meet students' differing needs, it is the charge of Salas leadership to also differentiate professional opportunities to meet teachers' varying needs. It is recommended that campus leadership provide a diverse menu of

opportunities from which teachers can learn new instructional strategies (Darling-Hammond & McLaughlin, 1995). Job-embedded professional development opportunities will best support teachers if they are linked to meaningful science content and change as well as honoring the different skill levels teachers already possess. Through structuring its professional development offerings to accommodate these differences, Salas will ensure that trainings are providing skills that meet individual needs. Additionally, such professional development should provide educators with skills that may be immediately applied in the classrooms.

In terms of differentiation of staff development to meet the varying needs of the teachers of ELL students, an analysis of the outcomes of classroom practice indicated that a lack of differentiation may be responsible for the current state of limited teacher efficacy at Salas Elementary. For example, classroom observations evidenced that teachers demonstrated a limited awareness of the stages of second language acquisition: 1) preproduction, 2) early production, 3) speech emergence, 4) intermediate fluency, and 5) advanced fluency (Krashen & Terrell, 1983). Students who clearly exhibited the characteristics that would place them in the speech emergence stage were asked simple questions that would optimally be posed to students in the early production phase. Therefore, teacher trainings should include focus on teachers who may lack the expertise to plan effectively for the level of language acquisition their students possess. Additionally, delivery of professional development should be facilitated by teacher leaders more often than campus leaders (Darling-Hammond & McLaughlin, 1995). Findings of this study revealed that there were teachers who evidenced expertise in

supporting their ELL students' achievement of CALPS in science. These "expert" presenters should be involved in leading other teachers and providing appropriate feedback and support through mentoring or modeling, thereby making new learning meaningful to its teacher audience. Additionally, in terms of culturally responsive instruction, it is recommended that levels of expertise necessary to make science concepts relevant and meaningful to a second language learner must also be considered in differentiation of professional development offerings.

Focus on Continued Learning

Salas Elementary must avoid the practice of the "one shot" professional development model, where there is little or no follow-up, and where there are no opportunities for teachers to reflect. If this campus is seeking continuous improvement in its science instruction for ELL learners, leadership must provide ongoing opportunities for teachers to explore and reflect on their science instruction, as well as to practice new learning. Such practice would communicate to teachers that their instructional practices will continually evolve, as they learn new skills both through formal and informal models of staff development. As teachers form communities that explore their instructional practices, they are continually reexamining them and changing them to meet their ELL students' needs (Darling-Hammond, 2000). Therefore, it is recommended that delivery of teacher training build on prior learning in a spiraling fashion, where as new skills are mastered, older skills are reviewed and connected to new learning. Additionally, teacher training should span over a minimum of one year,

including ongoing support during classroom implementation. In this way, ongoing learning may be considered the norm, that is, part of every school day.

At Salas, spotty and limited exposure to new trainings was not effective in maintaining new practices connected to issues regarding ELL instruction, for example, strategies to support student transition from BICS to CALPS. An examination of a teacher's professional development transcript evidenced the vast array of professional development activities a teacher was expected to participate in. Professional development that is presented in isolated episodes has resulted in most teachers reverting back to classroom practices that did not indicate recognition that students who were proficient in BICS were not necessarily proficient in CALPS. Therefore, professional development should focus on a series of strategies and classroom practices that support this transition. Such strategies and practices were notably absent in the instruction I observed. Productive and useful teacher training should focus on instructional strategies that support English language acquisition and include the use of nonlinguistic representations, graphic organizers, and note taking (Hill & Flynn, 2006). In terms of professional development to ensure culturally responsive science instruction, the focus should also include strategies to engage diverse groups of students in science activities and dialogue that supports meaningful learning (Upadhyay, 2009).

Focus on Collaboration

It is also recommended that leadership at Salas Elementary ensure that system supports are in place to provide teachers daily opportunities to collaborate with peers about their science instruction. The structure of professional development should work

to reduce the isolation, rather than perpetuate the experience of working alone (Darling-Hammond & McLaughlin, 1995). Darling-Hammond and McLaughlin (1995) also suggest that professional development take place in a non-threatening environment that allows for experimentation, risk-taking, team teaching, modeling, feedback, and mentoring. Teachers should also feel free to seek support in forming science instruction for their ELL student that supports their students' appropriate levels of English language acquisition.

From a review of the data generated from this inquiry, opportunities rarely occurred at Salas that allowed the teachers to consider the role of English language acquisition in forming effective instructional practices. While grade level teams were required to meet at designated times during the week, there was not time set aside specifically for teachers to safely reflect with their colleagues on the new strategies they were required to implement, much less the instructional practices that would support ELL learners in science instruction. For example, during her interview, Amy had expressed her frustration with attending professional development meetings, and then having no time to reflect or debrief with other teachers about how these trainings actually appeared in classroom practice. Therefore, as administration plans a professional program, it should include the critical element of allowing teachers time to provide feedback, reflect, and debrief. Additionally, if teachers are to provide culturally responsive instruction that builds on students' different ways of learning, they should have the time to reflect on the outcome of their instruction, as their students make sense of new ideas and construct new knowledge (Villegas & Lucas, 2002).

Focus on Lasting Change

Leadership at Salas Elementary should be aware that teacher acceptance and “buy-in” of new training should not be the primary focus when introducing new professional development. Leadership risks diluting new practices if they seek changes in teacher attitudes before actual implementation (Guskey, 2002). It is recommended that leadership seek lasting acceptance and buy-in in instructional practices after teachers have had the opportunity to witness significant ELL student achievement in science instruction. This recommendation speaks to one of the greatest challenges for leadership which is the restructuring of professional development within the campus (Darling-Hammond & McLaughlin, 1995). The expectation of supporting students’ CALPS as the critical element in mastering complex scientific concepts should be non-negotiable, as well teachers providing instruction that supports their ELL students’ appropriate levels of English language acquisition. Therefore, it is recommended that these expectations be clearly communicated to teachers. Consideration should also be given to appropriate changes in the time, scale, and space connected to teacher training. Leadership cannot expect lasting change in science instruction for a linguistically diverse student population if the structures presently in place to deliver professional development do not change themselves.

. In interviews with the teachers at Salas, some participants expressed concern that administration and teachers seemed to “over plan” when considering a new strategy. In the response to how administration could best support their science instruction for ELL students, Rachel said, “We talk about it, and talk about it [higher order

questioning]. It might get done. We might do it, but I see some misunderstandings, and some people might not even do it, because they get tired of talking about it.”

Discussions with most participants indicated that they felt the administration should limit attempts to get “buy in” from the teachers before setting forth specific expectations.

These expectations include instruction that reflects the use of strategies which actively support ELL students in English language acquisition as they master complex scientific concepts.

Conclusions

The existing achievement gap in science between ELL students and other populations at Salas Elementary is indicative of the problems the school’s leadership faces in meeting the needs of the majority of its students. Of course, Salas, by far, is not the only public school to deal with this issue. The scholarship in areas of science instruction, educating ELL students, and leadership of campuses with linguistically diverse students covers more than thirty years of research. However, little has changed, with the exception of the schools described in the studies of McKenzie et al. (2011) and González (2002). Additionally, the federal and state accountability mandates within No Child Left Behind (2001) have served to bring additional attention to this issue. Furthermore, these mandates have made it school leadership’s explicit responsibility to close this achievement gap. Research indicates that professional development is one of the best practices to accomplish this task (Boyle, While, & Boyle, 2004; Darling-Hammond & McLaughlin, 1995; Guskey, 2002; McKenzie et al., 2011).

Professional development of teachers is considered the most effective way to improve the teaching process and thereby improve student achievement (Eun, 2008; McKenzie et al., 2011). Instructional leadership, as it sets a vision for its teachers in terms of effective pedagogy, is becoming more responsible for not only determining topics of teacher trainings, but also for delivering these trainings. Therefore, instructional leadership, should be aware of the characteristics of quality professional development. However, more importantly, leadership should also be cognizant of the importance of having professional development which is focused on specific areas of instructional practice. Training must also meet varying teachers' needs and experience, as well implement instructional strategies that support and respect the adult learner. Campus leadership must also understand that fruitful professional development does not occur as part of an isolated event. These leaders should ensure structures are in place for continuous teaching training in order to support sustained change in instructional practices. As evidenced by the results of this study, traditional models of professional development will not effectively equip teachers with the knowledge and skills necessary to meet the instructional demands of an ELL classroom. The challenge for campus leadership is to not only provide these optimum conditions for professional growth, but as McKenzie et al. (2011) suggested in their work on high achieving urban high schools, to shield their teachers from all the unproductive practices that do not result in long lasting student achievement. As instructional leaders who provide the professional development, it is the leaders' charge to provide meaningful and relevant quality learning experiences with a goal of growth for both teachers and students.

ENDNOTES

¹ The full citation for the AEIS report is not provided in order to protect the anonymity of the participants in this study.

² I have used the term Hispanic, as opposed to Latino, since it is a government-endorsed term, and is used by formal institutions, such as schools.

³ The URL or website address of the school district is not provided in order to protect the anonymity of the participants in this study.

⁴ The ERIC Clearinghouse on Urban Education defines at risk children as those who are exposed to inadequate or inappropriate educational experiences in the family, school, or community (Natriello, McDill, & Pallas, 1990).

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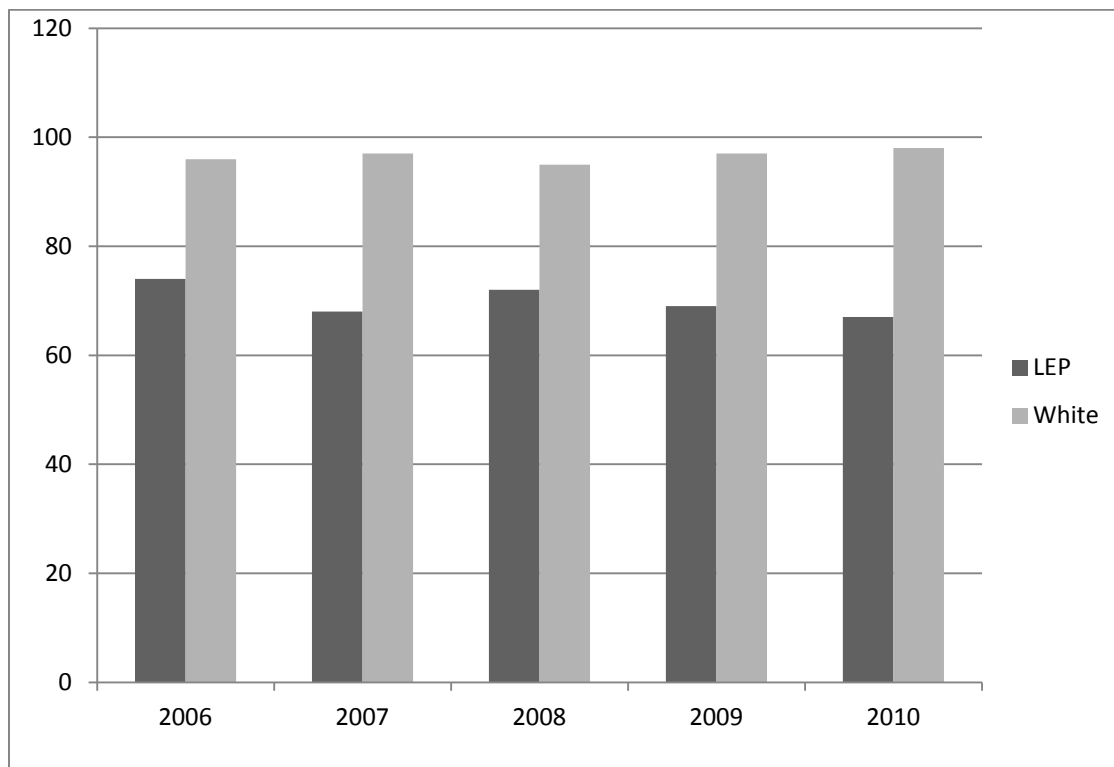
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APPENDIX A

EISD FIFTH GRADE SCIENCE TAKS SCORES



	2006	2007	2008	2009	2010
LEP Students	74%	68%	72%	69%	67%
White Students	96%	97%	95%	97%	98%

APPENDIX B

EDUPHORIA FORETHOUGHT LESSON PLANNER

Science, Grade 3

Learning Standards:

[Integrated] Day 4: TLW explore and discuss the benefits of different types of body coverings.[3.10A, 3.10B]

Content Objective: (Content, Cognitive Blooms Level, and Proving Behavior)

Language Objective:(ELPS & See ELL Resources)

Accommodations/Strategies:

Teaching & Learning Actions and Procedures:

(Materials and Resources, Procedure, Routines and/or Activities, Bridge to TAKS, Check for Understanding, Question Stems)

Content Objective: (Content, Cognitive Blooms Level, and Proving Behavior)

Language Objective:(ELPS & See ELL Resources)

Accommodations/Strategies:

Teaching & Learning Actions and Procedures:

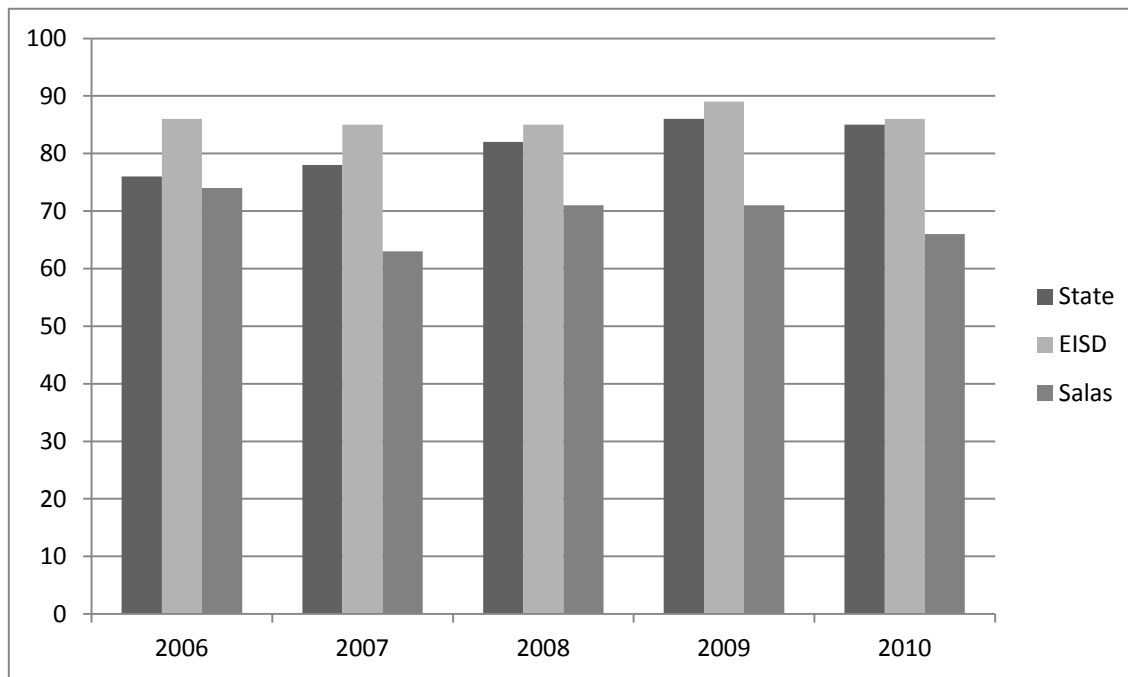
(Materials and Resources, Procedure, Routines and/or Activities, Bridge to TAKS, Check for Understanding, Question Stems)

Focus Questions	<ul style="list-style-type: none"> How do animals' body structures help them survive in a specific environment?
Warm Up	Warm Ups 7-8
Activities: Input Guided Practice Independent Practice	<p>Animal Adaptations</p> <p>Teacher does a think aloud on types of body covering in different environments, including fur, scales, and feathers.</p> <ul style="list-style-type: none"> What are the advantages of each? How does this physical property help you determine where the organism may live or survive? <p>Use a preprinted foldable or graphic organizer for students to fill out while jig-sawing out SF A66-A69:</p> <p>Land environment:</p> <ul style="list-style-type: none"> Feet: hooves, paws, claws <p>Water environments:</p> <ul style="list-style-type: none"> Fins & gills
Closure--Assessment	Migration Question (UESA pg 3-27) (attached below)
Vocabulary	Adaptations Dormancy Mimicry Camouflage Hibernation Migration Function Structure

Homework	Adaptation Questions (attached below)
Integrated Resources	http://www.beaconlearningcenter.com/WebLessons/CritterCraze/animals010.htm

APPENDIX C

FIFTH GRADE SCIENCE TAKS SCORE COMPARISON



	2006	2007	2008	2009	2010
State	76%	78%	82%	86%	85%
EISD	86%	85%	85%	89%	86%
Salas	74%	63%	71%	71%	66%

APPENDIX D**INTERVIEW PROTOCOL**

1. How do you differentiate science instruction for ELL students from African-American students or White students?
2. Describe the instructional strategies you may implement during a typical science lesson.
3. As our students come with different English language skills, how do you differentiate your instructional practices in science to support differing linguistic needs?
4. Do you differentiate your teaching by race or ethnicity and if so, how, do you implement culturally relevant instruction?
5. How can administration best support your instructional practice for ELL students in the science classroom?
6. What are the types of professional development connected to science instruction have you found to be most beneficial for being successful with your ELL students?
7. What are the types of professional development connected to science instruction have you found to be least beneficial for being successful with your ELL students?

APPENDIX E
INFORMATION SHEET

Title of Research Study

Problems with Science Teaching and Learning for English Language Learners in One Diverse Elementary School

Principal Investigator

Karen Rodriguez - doctoral student, Texas A & M University

Purpose of Study

The purpose of this form is to provide you, a teacher, (as a prospective research study participant) information that may affect your decision as to whether or not to participate in this research and to record the consent of those who agree to be involved in this study.

You have been asked to participate in a study that seeks to examine audio taped data reflecting elementary school teachers' perceptions and reflections on science instruction for ELL students and what can be done to close the achievement gap between these students and native English speakers. You were selected to be a possible participant because you are a teacher in an elementary school with a diverse student population.

What will I be asked to do?

If you agree to participate in this study, you will be asked to participate in an audio taped interview of 45 minutes to 60 minutes. Information obtained from this interview will be used in this study.

Your participation will be audio recorded and transcribed. It is not mandatory to have the interview audio taped; if you do not wish to have your interview audio taped, the researcher will take manual notes of your interview and answers.

What are the risks involved in this study?

The risks associated with this study are minimal and not greater than feeling uncomfortable as we discuss your experiences and perceptions of teaching science to ELL students.

What are the possible benefits of this study?

There is no direct benefit to the participants of this study. However, the findings from this study could contribute to the educational well-being of ELL students by narrowing the existing achievement gap between these students and their native English speaking peers. For faculty and staff, the findings in this study could assist in analyzing, planning, and implementing instructional practices that will foster equity and academic achievement for all students based on a better understanding of the needs of ELL students.

Do I have to participate?

No. Participation in this study is entirely voluntary. You may decide not to participate or to withdraw at any time without current or future relations with Texas A & M being affected.

Who will know about my participation in this research study?

This study is confidential. Confidentiality will be maintained through the use of a number coding system to identify participants. The records of this study will be kept private. No identifiers linking you to this study will be included in any sort of report that might be published. Information about you will be kept confidential to the extent permitted or required by law. Research records will be stored securely, and only Karen Rodriguez, the researcher, and her dissertation committee will have access to the records and the data.

If you choose to participate in this study, you will be audio recorded. Any audio recordings will be stored securely, and only Karen Rodriguez, the researcher, and her university faculty committee will have access to the recordings. Any recordings will be kept for one year and then erased or destroyed.

Whom do I contact with questions about the research?

If you have questions regarding this study, you may contact Karen Rodriguez at (713) 551-1079, or via e-mail at kmr412002@yahoo.com. If you feel you are being mistreated in any way because of your participation or choice not to participate, you should feel free to contact Patti Pace, District Executive Director for Elementary Administrative Services for Spring Branch ISD, (713) 251-2403 or via email at patricia.pace@springbranchisd.com.

Whom do I contact about my rights as a research participant?

This research study has been reviewed by the Human Subjects' Protection Program and/or the Institutional Review Board at Texas A & M University. For research-related problems or questions regarding your rights as a research participant, you can contact these offices at (979) 458-4067 or irb@tamu.edu.

Participation

Please be sure you have read the above information, asked questions and received answers to our satisfaction. If you would like to be in the study please sign in the spaces provided for participants.

Name and signature of person who explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

Signature and printed name of person who obtained consent

Date

You have been informed about this study's purpose, procedures, possible benefits and risks, and you have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time. Your signature on this page indicates that you understand what you are being asked to do, and you voluntarily agree to participate in this study. By signing this form, you are not waiving any of your legal rights.

I consent to the use of audio taping during my participation in this study.

Yes No

Printed Name of Participant

Signature of Participant

Date

Signature of Principal Investigator

Date