Assessment of Science Teachers' Vocabulary Strategies with English Language Learners and Self-Efficacy Levels

by

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Abstract

The purpose of this study was to examine science teachers' self-efficacy with teaching science and their self-efficacy level for teaching ELL students while also examining the types of vocabulary instructional strategies used in the classroom. The study consisted of an electronic on-line survey to measure self-efficacy levels of teaching science and self-efficacy levels of teach science to English Language Learners (ELL). The survey was disseminated to secondary science teachers in a southeastern region of the United States. Bandura's (1997) social cognitive theory provided a conceptual framework for examining the constructs of self-efficacy and outcome expectancy. He defined self-efficacy as a construct that is situation-specific.

Statistical analysis included calculating Cronbach alphas to measure internal consistency among items, one-way ANOVAs, a Pearson correlation, and frequencies of types of instructional strategies. One-way ANOVAs were calculated to determine if any statistical significance existed for gender, grade level taught, ethnicity, highest degree earned on self-efficacy levels. Only one variable had statistical significance on self-efficacy. Results for the study suggest that if teacher participants had a high self-efficacy of teaching science, they also had a high self-efficacy to teach ELL students. Implications from the research include offering professional development for working with ELL students and providing teacher candidate's opportunities and coursework to prepare for diverse classroom settings.

Acknowledgments

"So, whether you eat or drink, or whatever you do, do all to the glory of God." 1 Corinthians 10:31

I would like to first acknowledge and honor God. He has provided me with the strength, perseverance, and support through my family. I am indebted to husband, David Alan Crowe, for his patience and support throughout this milestone. He has provided support financially, mentally, and by being patient throughout many years. I am grateful for my children, Kirsten and Kameron, both of whom have sacrificed time for me to complete the dissertation. I am also indebted to my mother, father, sister, and brother, all of whom have helped provide motivation and teaching me how to set goals. I greatly appreciate everyone's support and sacrifices.

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I am grateful for all of the teachers who willingly took the time to complete my survey. I am also thankful for all of my co-workers, colleagues, and acquaintances who have helped by letting other teachers know about the survey.

Dedication

To my Lord and Savior, Jesus Christ

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Chapter 1

Introduction

Statement of the Problem

Many classrooms today in the United States are inclusive, and students have a diversity of needs. Thus, many teachers find it difficult to meet all the needs of students from culturally and linguistically diverse backgrounds, especially students whose home language is not English (Nabors & Edwards, 2011). English Language Learners (ELL) must not only learn science concepts but must also master the necessary science vocabulary (Nabors & Edwards, 2011).

Students who are ELL typically need five to seven years to be able to perform in the science classroom as well as the students whose home language is English (Collier, 1987). Yu Ren (2013) suggests that students need to learn 500 words in the general science curriculum, at least 1,200 words in biology, and over 1,000 words for earth science. This does not include the words they need to master in physics, chemistry, and all vocabulary words necessary to pass standardized tests.

A teacher's level of self-efficacy can have an impact on students in science (Hechter, 2011). For example, low self-efficacy can lead to students from elementary school to college lacking science content knowledge skills. Low self-efficacy among science teachers may manifest itself from ineffective pre-service teaching experiences. Enhancement of these pre-service teaching experiences can have lasting effects into the classroom (Hechter, 2011). Thus, if teachers have a low self-efficacy with teaching English Language Learners, then this can have an impact on these learners in science and their academic endeavors.

Research has suggested that pre-service teachers have lower self-efficacy levels and often feel unprepared from teacher education programs when teaching ELL students (Durgunoglu & Hughes, 2010). Durgunoglu and Hughes (2010) examined the self-efficacy levels of pre-service teachers with teaching ELL students (Durgunoglu & Hughes, 2010). The study included 62 pre-service teachers who were completing their student teaching (Durgunoglu & Hughes, 2010). The researchers examined their self-efficacy by administering a survey. The survey was designed to measure their perceived preparation and self-efficacy regarding ELL students (Durgunoglu & Hughes, 2010). The survey was also designed to measure attitudes toward ELL students in mainstream classrooms and attitudes toward parents (Durgunoglu & Hughes, 2010). The survey was then followed by conducting observations of pre-service teachers. Results of the study suggested that pre-service teachers articulated that they were unprepared to teach ELL students when entering the mainstream classroom (Durgunoglu & Hughes, 2010). Observations conducted indicated that the pre-service teachers often isolated these students and neglected them in the classroom (Durgunoglu and Hughes, 2010).

The purpose of this study was to examine secondary science teachers' self-efficacy with teaching science and their self-efficacy level for teaching ELL students. Teachers were from secondary science education classrooms. Bandura's (1977) social cognitive theory of self-efficacy was used to measure self-efficacy levels by administering a survey. Self-efficacy was defined as "an individual's perceptions about their ability to reach a certain goal within a specific domain (p. 200, Peters-Burton & Hiller, 2013)." Factors such as level of degree, years of teaching, etc. were also examined to determine if these have a correlation to levels of self-efficacy. The second part of the study examined the types of instructional methods that are used by science teachers when teaching ELL students through the use of a survey using Bialystok's

(1978) theoretical framework for second language acquisition. Second language acquisition can be defined as “the process of learning another language after the home language has been learned (Gass & Selinker, 2008 p.6).” A review of the literature was used to develop a survey to determine methods of instruction of science education teachers. Grade level of teachers included secondary grades, 6-12.

Eight variables were included in the study. These included gender, ethnicity, years of experience, degree level, teaching grade level, institution of initial certification, science course currently teaching by teacher, and areas of science certification. These were used to determine levels of self-efficacy of teaching science and ELL students. Lastly, an inventory of vocabulary strategies used by secondary science teachers was conducted. Then, an analysis was done to determine if there is a correlation between the type of instructional strategies used and self-efficacy levels.

The Problem for Science Education

Science educators must work to promote scientifically literate citizens. While educators are working with students to achieve this, they are also working to expand enrollment in science courses for ELL students. With these challenges science educators face, *No Child Left Behind* (2002) requires interventions for these students. It also holds science educators accountable for helping ELL students academically achieve, and these students are to be held to the same standards as their English-speaking counterparts (NCLB, 2002).

Latinos make up the largest ethnic group in the United States population (Suriel, 2014). Their population is expected to increase by 25% by the 2020 (Hussar & Bailey, 2011). Currently, 80 % of English Language Learners’ primary language is Spanish. While trying to promote scientific literacy with all students, science educators are faced with challenges when teaching

ELL Latino/as because of underperformance on standardized science examinations and low college enrollments. ELL Latino/as also are underrepresented in postsecondary science and science-related fields (Levine, Gonzalez, Cole, Fuhrman, & Floch, 2007; National Academy of Sciences [NAS], 2010; U.S. Department of Education & National Center for Education Statistics, 2007, 2012; as cited in Suriel, 2014).

Significance of the Study

There is currently a lack of research on understanding instructional variables and teaching with English Language Learners (Whitacre, Diaz, & Esquierdo, 2013). There has been a dramatic increase in the number of ELL students in the U.S. classroom over the years, and thus, there is a need for research in best practices for ELL students. By 2050, thirty-three percent of the U.S. population could be Latino, and thus, there is a need to meet the educational needs of ELL students (Mather & Foxen, 2010). The majority of teachers, however, have not been adequately trained to meet the needs of ELL students. In 2002, 41% of teachers reported teaching ELL students, but less than 13% reported receiving professional development to teach these students effectively (Arens et al., 2012; as cited in U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2002).

In addition to lack of professional development for teaching ELL, a teacher's self-efficacy can have an effect on their teaching abilities, particularly with ELL students. A teacher's self-efficacy has effects on interactions with students and their achievement (Stipek, 2012; as cited in Hoy, Hoy, & Davis, 2009). Self-efficacy has an effect on the amount of effort a teacher exerts. Teachers tend to have more focused instruction, have a willingness to try new instructional strategies, are more likely to build a rapport with students, and they focus more on student learning when they have a high level of self-efficacy. Thus, students with teachers with positive self-efficacy have more motivation, self-esteem, positive attitudes toward school, and have higher academic expectations. Teachers with a negative self-efficacy tend to experience burnout and may not use a variety of instructional practices (Stipek, 2012).

While literature exists with examination of levels of teachers' self-efficacy and the growing number of ELL students in classrooms, deficiencies in the literature exist in the relationship between levels of self-efficacy in teaching ELL students. Additionally, most research has been conducted with pre-service elementary teachers' self-efficacy, not veteran teachers or secondary teachers. Teachers' self-efficacy levels can be compared with their levels of self-efficacy with teaching ELL students. Factors such as years of experience teaching, level of degree, grade level, etc. can also be explored to determine if relationships exist to levels of self-efficacy. Deficiencies in the literature also exist as to what types of instructional practices teachers of ELL students are using.

This study will provide insight into strategies for addressing the academic needs of ELL students. This project will also facilitate educators, administrators, policy makers in education relative to strategies for promoting teacher professional development for teachers of ELL students.. There is currently a lack of research on understanding instructional variables and teaching with English Language Learners (Whitacre, Diaz, & Esquierdo, 2013). There has been a dramatic increase in the number of ELL students in the U.S. classroom over the years and there is a need for research in best practices for ELL students. By 2050, thirty-three percent of the U.S. population could be Latino, and thus, there is a need to meet the educational needs of ELL students (Mather & Foxen, 2010). However, the majority of teachers have not been adequately prepared to meet the academic needs of ELL students. In 2002, 41% of teachers reported teaching ELL students, but less than 13% reported receiving professional development to teach these students effectively (Arens et al., 2012; as cited in U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2002).

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This research will address the roles self-efficacy plays with teaching science and teaching science to ELL students from a quantitative perspective.

The following research questions were under investigation in the study:

(1) What are the self-efficacy levels of 6-12th grade science teachers when teaching science?

(2) Does the self-efficacy level of 6-12th grade science teachers relate to self-efficacy level of teaching ELL students?

(3) Is there a relationship between gender, ethnicity, years of experience, degree level, and grade level taught for 6-12th grade science teachers with self-efficacy of science and self-efficacy of teaching ELL students?

(4) What type of vocabulary instructional practices are 6-12th grade science teachers using when teaching students?

Background

Science can often be a subject that is intense with vocabulary. An analysis by Groves (1995) showed that one thousand to three thousand vocabulary terms are presented in each high school chemistry, physics, and earth science textbooks. Students often find that they are inundated with science vocabulary (Miller, Straits, Kucan, Trathen, & Dass, 2007).

Academic vocabulary is “a variety or a register of English used in professional books and characterized by specific linguistic features associated with academic disciplines” (Scarcella, 2003, p. 19). As students progress through school, their demands of knowledge of academic vocabulary increase. Much of the academic vocabulary is encountered through academic texts, not conversations. Many academic words have Greek and Latin roots that may not be evident to students. Some students have opportunities outside of the classroom to learn these while others do not (Corson, 1997).

Vocabulary is an essential component for students to comprehend various scientific concepts. Vocabulary in science is often used to define various scientific concepts and increase conceptual development of ideas in science. Students can often experience difficulty in content classes if they are having trouble acquiring the necessary vocabulary related to conceptual ideas (Young, 2005). Research by J. Miller (2009) suggests that many students identify vocabulary as being a major obstacle to learning, and science teachers tend to assume students know science content vocabulary rather than explain new science terminology. The author further suggests using a language-focused approach to support science vocabulary acquisition.

Definition of Terms. English as a Second Language (ESL)-an approach to teaching English to students for whom it is not a native language. The approach is systematic and comprehensive (Nieto, 2004).

English Language Learner- Individuals who meet the criteria as limited English proficient (LEP) (Uro & Barrio, 2013).

Limited English Proficient (LEP)

> The term limited English proficient, when used with respect to an individual, means an individual —
>
> (A) who is aged 3 through 21;
>
> (B) who is enrolled or preparing to enroll in an elementary school or secondary school;
>
> (C) (i) who was not born in the United States or whose native language is a language other than English;
>
> (ii) (I) who is a Native American or Alaska Native, or a native resident of the outlying areas; AND

(II) who comes from an environment where a language other than English has had a significant impact on the individual's level of English language proficiency; OR

(iii) who is migratory, whose native language is a language other than English, and who comes from an environment where a language other than English is dominant; AND

(D) whose difficulties in speaking, reading, writing, or understanding the English language may be sufficient to deny the individual —

(i) the ability to meet the State's proficient level of achievement on State assessments described in section 1111(b)(3);

(ii) the ability to successfully achieve in classrooms where the language of instruction is English; OR

unity to participate fully in society.

Source: No Child Left Behind Act, P.L. 107-20110, Title IX, Part A, Sec. 9101 (25) (Uro & Barrio, 2013, p. 17).

English Language Learners. Many classrooms today in the United States are inclusive, and students have a diversity of needs. Thus, many teachers find difficulty when trying to meet all the needs of students, including students with a home language that is not English. English

Language Learners must not only learn science concepts but must also master the necessary science vocabulary (Nabors & Edwards, 2011).

Students who are ELL typically need five to seven years to be able to perform in the science classroom as well as the students whose home language is English (Collier, 1987). Yu Ren (2013) suggests that students need to learn 500 words in the general science curriculum, at least 1,200 words in biology, and over 1,000 words for earth science. This does not include the words they need to master in physics, chemistry, and all vocabulary words necessary to pass standardized tests.

Strategies in Teaching ELL Students

When English Language Learners begin school in the United States, many are on grade-level just as their English speaking counterparts are (Yu Ren, 2013). They have learned the content, but the content is in their home language, and they have literacy skills in their language. Thus, an ELL students' prior learning is important when learning English and science (Cummins, 1979). Subsequently, activating a students' prior knowledge can be an effective strategy for helping students learn key vocabulary (Rupley & Slough, 2010). ELL students can use their scientific knowledge and literacy skills they have learned in their home language to translate these skills into English. For activating prior knowledge to be effective, it should include the learner's native language, native literacy skills, previous science learning, and native cultural knowledge and background (Yu Ren, 2013).

Suriel (2014) suggests the use of pictures and realia to build vocabulary with ELL students. This can be any visual tools such as pictures, illustrations, or other realia. She also suggests the promotion of writing and journaling for ELL students. This will help develop and support writing skills. Lastly, she suggests promotion of speaking for ELL students. This will help support and develop oral competency (Suriel, 2014).

Sheltered instruction is a method that can be used in the classroom to help students learn science content. Sheltered instruction is strategic, and it allows for subject matter to be more understandable to students. Through the instructional method, students are able to enhance English language development. Sheltered instruction enhances language acquisition through uses that are meaningful and through interaction (Echevarria, Vogt, & Short, 2007). Sheltered instruction has many overlaps with scientific inquiry, another instructional method. Like scientific inquiry, sheltered instruction (a) provides opportunities for application, (b) students learn by doing science, (c) provides meaningful and memorable experiences, (d) content is related to students' experiences, (e) allows for interactions through student groups, (f) allows for time and student management, and (g) content can be related to students' experiences (Bergman, 2011). Unlike science inquiry, sheltered instruction has content and language objectives and clear explanations of outcomes. Science inquiry often has content objectives and allows for open investigations of phenomena (Bergman, 2011).

Language Acquisition. Second language acquisition can be defined as "the process of learning another language after the home language has been learned (Gass & Selinker, 2008, p. 6)." Second language acquisition can also refer to a third or fourth language being learned. Language acquisition is different from learning in a foreign language environment because language acquisition requires for the learner to have considerable access to the language being learned (Gass & Selinker, 2008).

Second language acquisition entails how a person learns a new language system with limited exposure to the new language, what is learned and not learned of a second language, and why some second language learners do not attain the same degree of knowledge and proficiency in a second language compared to their home language. Language teachers and curriculum designers have become aware that for an individual to become proficient in a second language, rule memorization of the target language is not effective. Individuals need to express communicative needs (Gass & Selinker, 2008).

Language acquisition in the science classroom needs to allow for students to have opportunities for comprehensible input in English (Carrasquillo & Rodriguez, 2002; as cited in Krashen & Biber, 1988). These opportunities can be provided by teaching the content in a meaningful way to students in English and by using strategies that allow educators to check for understanding with ELL students. Additionally, opportunities for comprehensible input are created by teachers allowing for discovery learning, teaching for understanding, and teaching for concept and vocabulary development. These opportunities for comprehensible input will help ELL students to increase their understanding of science concepts while increasing their proficiency level in English (Short, 1991).

Vocabulary Instruction. Instructional design is pertinent to vocabulary instruction. Teachers should allow for students to make associations and accommodations to their experiences. They need opportunities to practice, apply, and discuss work knowledge in significant contexts. Educators' ultimate goals when teaching vocabulary is to have students increase, improve, and add to their existing conceptual knowledge. Educators also want to help students enhance their reading comprehension and understanding of texts they read (Rupley, Nichols, Mraz, & Blair, 2012).

Vocabulary words can be taught in a hierarchical fashion. Words can be tiered into three different tiers. Words that are considered to be the most basic would be included in the first tier.

Vocabulary words that occur frequently and occur across multiple language domains (reading, writing, speaking, and listening) are included in the second tier. Third tier words would include vocabulary words that are limited in frequency and limited to domains of specific content. Words that are encountered when reading authentic texts can be considered second tier words. These should be the focus of vocabulary instruction. These are the words that will have the greatest impact on expanding vocabulary knowledge (Rupley, Nichols, Mraz, & Blair, 2012).

Teachers can implement four principles with instruction of vocabulary for mastery (Wilcox & Morrison, 2013). These are the four E's of vocabulary instruction and include experience, environment, exposure, and engagement. A student's experience with a word is likely to have an impact on understanding a word's meaning. Teachers should try to connect what students' already know with the new knowledge of a words' meaning (Wilcox & Morrison, 2013). The environment principle deals with teaching vocabulary in context and not in isolation. Students often have difficulty comprehending vocabulary words if they are taught in isolation. Exposure is the fourth principle, and this occurs when students have multiple opportunities to encounter targeted vocabulary. Lastly, students need the last principle of engagement for successful mastery of vocabulary. Vocabulary can become redundant and boring for students if activities presented to them are not engaging. Students need meaningful experiences and engagement when learning new words (Wilcox & Morrison, 2013).

Science content entails learning and applying vocabulary words. Students should be able to use vocabulary learned in science to make informed decisions about scientific issues. Thus, science instruction should involve presentation of new and key vocabulary words, and lessons should contain presentation of these vocabulary words. Fewer than twelve words should be introduced per lesson (Fathman, Quinn, & Kessler, 1992). Students' knowledge of the science vocabulary words in their primary language can be very beneficial when identifying the definition of the word in English. The use of visual devices, real objects, and pictures can help facilitate learning of new science vocabulary in English. Other techniques that can be used to help ELL students master science vocabulary in the classroom include: (a) labeling lab materials that are to be used with stickers, (b) verbally describing to the students what they are doing in an activity, (c) use language that is appropriate for an ELL student's proficiency, (d) follow up with students by asking them to repeat what was done in the activity, and (e) have the students describe the activity in their own words (Carrasquillo & Rodriguez, 2002).

Science Teacher Self-Efficacy

A teacher's level of self-efficacy can have an impact on students in science. For example, Hechter (2011) suggests that low self-efficacy can lead to students from elementary school to college lacking science content knowledge skills. Low self-efficacy among science teachers may manifest itself from ineffective pre-service teaching experiences. Enhancement of these pre-service teaching experiences can have lasting effects into the classroom (Hechter, 2011).

Hecter (2011) suggests that a holistic approach can be used in teacher preparation programs to enhance self-efficacy of teachers. Postsecondary science courses can lead up to methods courses. The methods courses should be meaningful and provide positive experiences for the pre-service teachers. Regardless of the number of postsecondary science courses a pre-service teacher has taken, these positive experiences within them can help increase a teacher's self-efficacy. Unification of teaching philosophies between education departments and science departments can be developed so that pre-service teachers are taught with effective practices to maximize science learning and experiences. This can generate more confident teachers. If pre-service teachers are taught with effective practices, they are more likely to reciprocate these in the classroom.

Self-Efficacy and English Language Learners

Classrooms throughout the world are becoming more diverse with students that do not speak the predominant language of the country they reside in (Spotti, 2007). The number of ELL students in the United States has more than doubled, and ELL students represent approximately 8.4% of all students (Zehler, Fleischman, Hopstock, Stephenson, Pendzick, & Sapru, 2003). Approximately 56% of schools have students that are from homes where 3-50 different languages are spoken in the home. For some ELL students, their classroom teacher may be their one and only resource for learning a language that is not their home language. Thus, a teacher's self –efficacy with teaching ELL students can have an impact on classroom culture and student outcomes.

Curran (2003) suggests there is a trend toward linguistic diversity in U.S. classrooms. With this trend, many teachers are not adequately prepared to address the needs of these students. Moore (1999) additionally suggests that teachers come to teaching with their own preconceived beliefs about diversity. These beliefs and conceptualizations have an effect on what teacher's know. The environment will also have an effect on the classroom curriculum and implementation of the curriculum. Educational reform should include assessing what teacher's know and the environment they work in to help address the needs of diverse students.

Karabenick and Noda (2004) suggest that teachers, in general, have positive attitudes toward ELL students. There is, however, variability. For example, many teachers have less supportive beliefs, attitudes, and practices with ELL students. Teachers who are more supportive of ELL students are more likely to believe that a student's proficiency in their first language promotes school performance. They often do not believe this is a hindrance to learning a second language. ELLs should be tested in their home languages because lack of acquisition of a second language does not imply lack of comprehension. Teachers who are more supportive of ELL students tend to focus on mastery rather than performance. Thus, because of favorable attitudes and approaches to ELL students, they have a higher self-efficacy (Karabenick & Noda, 2004).

Bandura's (1997) theory of self-efficacy stresses the importance of an individual's perception of his or her abilities, therefore, a survey was helpful tool to assess teachers' perceptions of their abilities.

Limitations of the Study

There are several limitations to the study. One limitation of the study was the small sample size and focus of the sample population. The sample population only included secondary teachers who teach science in a southeastern state. Moreover, the participation was strictly voluntary. This could have contributed to the low response rate. In addition, only public school teachers in a Southeastern state. Another limitation is the use of self-report measures. Participants were able to respond based upon their own self assessments of their own capabilities and abilities. Consequently, the levels reported may not reflect the actual levels of practice but of their perceived confidence levels for teaching science and teaching science to ELL students. Participants' perceived capabilities may have led them to rate themselves in a favorable manner. This is known as social desirability (SDB). Social desirability can often distort data validity in survey research (Lee & Woodliffe, 2010). Participants may over-rate themselves in a way that is more favorable socially. Thus, respondents may not have answered questions truthfully, and they may have answered them in manners that make them appear more altruistic and more socially-oriented (Lee & Woodliffe, 2010).

Finally, the number of surveys completed may have impacted external validity. Only 15 participants answered all questions on the survey. The survey was disseminated in multiple ways, but many people would not respond. Sheehan (2006) suggests that response rates to surveys have declined over the years since 1986 when researchers began to use the Internet for distribution of surveys. The survey was disseminated through an in-service center, and there were no responses after dissemination to principals. The survey was also disseminated by accessing school principal email addresses from the State Department of Education website in the target districts for the study. The survey was sent to the principals to disseminate to science teachers, and a few responses were collected in this manner. The most effective method for survey dissemination was allowing other science teachers to know about the survey and asking them to share.

Role of the Researcher

This study sought to provide insight into the self-efficacy levels of teaching science and teaching science to English Language Learners. As a researcher, I found it important for me to clearly outline my background experience as a science teacher of ELL students. I began teaching twelve years ago in a southeastern state teaching gifted science education. During my first 4 years of teaching, I had very little experience with teaching English Language Learners. I then relocated to another state in the southeast where I taught general education. In this setting I have multiple English Language Learners each semester. I had a student my very first semester who did not speak any English. I struggled with my pedagogy because I did not know how to help the student learn the science content the student was required to learn. I had never received any professional development to teach an English Language Learner, and I struggled with knowing how to assess and to assess fairly. I reflected back upon my teacher education program, and I had never been taught any strategies to help students whose home language was not English. The school where I taught before did not provide professional development. Although, it is important to note that I have attended professional development since then to learn instructional strategies for teaching ELL students, but it is still an area I struggle with.

Theoretical Framework

In this study a constructivist epistemology was used. Constructivism is a "way of understanding and explaining how we know what we know (Crotty, 1998, p. 3). As a constructivist, I believe that there "is no objective truth waiting for us to discover it. Truth, or meaning, comes into existence in and out of our engagement with realities in our world. There is no meaning without mind. Meaning is not discovered, but constructed (Crotty, 1998, p. 8-9.)"

Constructivism is characterized by the following:

(a) Meanings are constructed by humans. These meanings are developed from interactions with the world.

(b) As humans engage with the world, they make sense of it based on historical and social perspectives. Thus, we are born into a world of meaning that is influenced by our culture.

(c) The generation of meaning by humans is social. It develops out of interactions with other humans in the community (Creswell, 2009).

Language Acquisition and Constructivism

The theoretical framework for second language acquisition followed Bialystok's (1978) framework. Bialystok (1978) identified four categories of learning strategies for second language learning. These include the use of inference, monitoring, formal practice, and functional practice. She defined learning strategies as a way to favorably utilize available information to improve the skills in a second language. Types of strategies depend on the type of knowledge required for a task. There are three types of knowledge. These include explicit linguistic knowledge, implicit linguistic knowledge, and general knowledge of the world (O'Malley, 1995).

Bialystok believed inferencing could be used with implicit language knowledge and knowledge of the world. Verbal drills would be an example of formal practicing. Formal practicing, monitoring, and functional practicing would give rise to explicit and implicit linguistic knowledge. Instructional strategies that are taught explicitly in a formal setting would additionally give rise to implicit language knowledge. This would result in students being able to comprehend and develop language (O'Malley, 1995).

Bialstyok's theoretical framework is different from Krashen's Monitor Model developed in 1982. Krashen's model does not allow for explicit linguistic knowledge to lead to implicit linguistic knowledge. Krashen's model includes two language processes, learning and acquisition. According to Krashen, acquisition occurs spontaneously and occurs subconsciously. The end result will be fluency. Learning, however, is when one recognizes the rules of a language from formal and informal practices of a new language. Thus, learning does not mean acquisition of a language is occurring (O'Malley, 1995).

McLaughlin, Rossman, and McLeod (1983) further expanded theories of second language acquisition by considering a cognitive component. With their theory, learners are active organizers of information. The learner, however, may have processing boundaries and abilities. Motivation does play a role in acquisition, but the learner's cognitive system is essential to processing. The degree of cognitive involvement is determined by interactions with the necessities of a task and the knowledge and mental processes used by the learner (O'Malley, 1995).

Thus, Bialstyok's conceptual framework allowed for a quantitative study with the use of a survey to determine types of instructional practices used by teachers who teach ELL students. Instructional practices laid within the framework because types of instructional practices are linked to tasks students must complete.

Self-efficacy Levels in Science Teaching

Constructs of self-efficacy in science teaching were applied by Enoch and Riggs (1990). They predicted that teachers who thought student learning was influenced by effective teaching were confident in their own teaching abilities. Thus, outcome expectancy was influenced by personal self-efficacy. Individuals with high self-efficacy would persist longer, allow increased academic focus, and utilize a variety of instructional strategies and practices. Lumpe, Haney, and Czerniak (2000) confirmed this. Teachers with a high sense of self-efficacy often implemented strategies in the science classroom that were inquiry-based. Teachers with low self-efficacy, however, often implemented a fact-based curriculum.

Bandura (1997) stated that self-efficacy can be developed through four modes. These modes include mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states. He argues that the greatest chance to build efficacy is through mastery experiences. This is because mastery experiences allow the most authentic evidence of whether an individual can succeed at a task. Successes and failures strongly affect a person's self-efficacy. Sustained effort, however, can help build efficacy as well when one encounters a task that they are unable to complete. Vicarious experiences help build efficacy because when an individual witnesses a peer's successful experience, he or she can visualize him or herself in the same situation. Thus, seeing others successful in a task can help a person see themselves being successful at the task as well. Lastly, self-efficacy can be promoted by others providing encouragement and support with one's ability to succeed at a task. Others can provide praise and positive reinforcement, and this can enhance one's self-efficacy (Bandura, 1997).

Summary

The increase of ELL students in classrooms and lack of literature for teaching English Language Learners, self-efficacy levels of teachers teaching students from linguistically diverse backgrounds is of importance. The self-efficacy level of a teacher can have an effect of student outcomes, particularly in science. (Hechter, 2011). Also due to deficiencies in the literature, the types of vocabulary strategies science teachers use to teach ELL students can be identified. Science vocabulary can be difficult for a student whose primary language is English, but it can be particularly difficult for students who are learning English.

The next chapter will review the literature and discuss research prior research on self-efficacy, self-efficacy of teaching ELL students, teaching science vocabulary, current vocabulary strategies for teaching science vocabulary, and pedagogical strategies for teaching ELL students.

Chapter II

Review of Related Literature

Descriptors of Self-Efficacy

A framework developed by Woolfolk Hoy and Davis (2006) linked teachers' sense of self-efficacy in relation of their subject matter, teaching strategies, classroom management, and relationship with students to student outcomes. Outcomes included student-self-efficacy, motivation, and achievement. Results from the framework suggest that teachers who have strong content knowledge, use student-centered instructional practices, are effective with classroom management, and build a rapport with students are more likely to have a stronger sense of self-efficacy. Instructional practices of these teachers often have higher goals and expectations as well as interest and engagement in the subject. There is a higher responsibility for student learning and creativity in teaching the subject. These teachers often participate in professional development to keep methods in content current and innovative. Classrooms of teachers with high self-efficacy include classrooms with student choices, teachers deliver feedback to students, and teachers have a caring rapport (Bolshakova, Johson, & Czerniak, 2011).

Bolshakova, Johnson, and Czerniak (2011) suggest that students' future science achievement and attainment of science-related careers is a result of self-efficacy of their teachers. The researchers conducted a qualitative study with three science teachers and fourteen students to examine how teachers' effectiveness impacted Hispanic students' science self-efficacy beliefs in a southwest middle school. Results from the study concluded that students had a higher sense of self-efficacy in science and an increase in science achievement. Bolshakova, Johnson, and Czemiak (2011) advocate for building awareness and support in teachers' self-efficacy and developing positive relationships between teachers and students when students are transitioning to middle school.

Tuck Bonner (2009) investigated science teachers' self-efficacy beliefs regarding students of diverse backgrounds. This included their self-efficacy beliefs in teaching all students regardless of racial, cultural, economical, and linguistically-diverse backgrounds of students. Tuck Bonner (2009) used the Bandura Teacher Efficacy Scale, Self-Efficacy Beliefs about Equitable Science Teaching and Learning (SEBEST), and Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST). Results from the study suggested that teachers reported having a high self-efficacy teaching all students except for ELL students (Tuck Bonner, 2009).

Self-efficacy can be divided into further two cognitive constructs. These include personal self-efficacy and outcome expectancy. How a teacher feels about how they can organize and execute courses of actions with potential situations would be a teacher's personal self-efficacy. Potential situations can be ambiguous, not predictable, and potentially stressful. Outcome expectancy is one's prediction about how a certain behavior will lead to a certain outcome. Teachers with low self-efficacy often have low aspirations, weak commitment to goals, focus on personal deficiencies, and abstain from challenging tasks. Those with high self-efficacy, however, set challenging goals, and they commit to them. If failures occur, these teachers often redefine their efforts. They tend to approach challenging tasks rather than avoid them (Bandura, 1977).

Enochs and Riggs (1990) examined personal self-efficacy and outcome expectancy in science teaching. They hypothesized that science teachers who had a positive self-efficacy also believed student learning was influenced by effective teaching. They had a high level of personal self-efficacy and would persist, provide academic focus in the classroom, and have a range of instructional strategies compared to a teacher with low self-efficacy (Enochs & Riggs, 1990). This prediction was confirmed by Lumpe, Hane, and Czerniak (2000). Their research suggested that teachers with high self-efficacy often used inquiry-based activities compared to teachers with low self-efficacy.

Research by Duran, Duran, Haney, and Beltyukova (2009) examined the impact of a professional development program called Active Science Teaching Encourages Reform (ASTER III) on teachers' self-efficacy and perceptions about inquiry-based science. Participants in the study included 26 K-3 teachers from public and private schools in northwest Ohio. Participants had already participated in ASTER I or II professional development projects. Quantitative and qualitative procedures were used in the study. Surveys were used to collect quantitative data. The Survey of Teacher Beliefs in Inquiry-Based Teaching (STBIBT) was used as well as the Science Teaching Efficacy Belief Instrument (STEBI-A)(Riggs & Enochs, 1990). Surveys were administered after the two week summer institute and then at the end of the project. Qualitative data were collected by having the participants submit anonymous written reflections at the end of the project. Participants were asked to describe their professional development experience in Project ASTER III. Teachers were able to explore inquiry-based science teaching through the professional development program. Exhibit-based hands-on and minds-on investigations were used at a science museum for the teachers to interact with the inquiry-based science. Throughout the study, the teachers were also able to develop a science curriculum aligned with museum exhibits and state and national standards (Duran, Duran, Haney, & Beltyukova, 2009).

Teacher beliefs were positively impacted by ASTER III professional development. Professional development opportunities, such as ASTER III, need to be provided on a continuous basis to reinforce teacher beliefs. Three themes emerged from qualitative data collected. These included impact on teacher understanding of inquiry, increased confidence with science teaching, and benefits of collaboration. Thus, teachers felt inquiry-based science teaching was beneficial in helping student achievement if it included engaging students in hands-on activities, increasing their excitement when learning science, and challenging them to communicate what they are learning. The teachers also stated that they felt they had the needed knowledge, skills, and abilities to be an effective science teacher. They were, however, more uncertain in their role as an effective science teacher in how to overcome barriers that impede student learning (Duran, Duran, Haney, & Beltyukova, 2009).

Self-efficacy and Teaching ELL Students

Some states have begun to mandate ELL endorsement courses for pre-service teachers (Jiminez-Silva, Olson, & Hernandez, 2011). This is to help ensure they are prepared to meet the needs of English Language Learners. The endorsement is designed to help these teachers feel more confident with teaching ELL students so that instructional practices are improved. Implementation and organization of endorsement questions is questionable as to how to effectively build teachers' confidence. Pedagogical practices that are engaging and build foundational knowledge through meaningful experiences will help foster confidence for pre-service teachers with meeting the needs of ELL students. Endorsement courses should not just try to cover the required content for the course (Jiminez-Silva, Olson, & Hernandez, 2011).

Pedagogy of Vocabulary Instruction

Coyne, McCoach, Loftus, Zipoli, Ruby, Crevecouer, and Kapp (2011) examined the effectiveness of direct and extended vocabulary instruction with kindergarten students. Extended vocabulary instruction is considered instruction that directs attention to target words and their corresponding definitions (Beck, McKeown, & Kucan, 2002). The study was conducted over an eighteen-week period, and it measured students' knowledge of target vocabulary words and the students' overall generalized language and literacy. Students were taught the definitions of fifty-four vocabulary words with interactive read alouds embedded in thirty-six half hours of instruction. Forty-four other students did not receive this treatment and were considered to be a control group. Data from the study suggested that students who received the instruction through read alouds outperformed the control group in regards to knowledge of target words.

Research by Mason and Krashen (2004) suggests that direct instruction is more effective than incidental vocabulary acquisition. If combined with incidental vocabulary instruction, acquisition is the most effective. The researchers set up two interventions groups, a "story-only" research group and a "story-plus study" group. Vocabulary growth was measured with participants who were first-year Japanese students at a female junior college in Japan. The "story-only" group spent fifteen minutes listening to a story while the "story-plus study" group spent approximately eighty-five minutes listening to the story and performing complementary activities. Researchers calculated the words per minute learned for each group, and data suggested that the students who were exposed to the "story-only" group learned vocabulary more efficiently. Results of the study also suggested that many traditional vocabulary exercises are not as efficient as listening to vocabulary words in stories. The "story-plus study" group learned more words overall, however,"story-only" group. The "story-plus study" group scores almost doubled on the post-test compared to the "story-only" group.

Students tend to learn vocabulary "incrementally" (Honig, 2012, p. 33). Students do not learn new vocabulary words instantly; they tend to gain knowledge of the word through repeated exposure. Students, however, must be able to use that word with exposure to gain knowledge of the word's meaning. Also, students' knowledge of a word is related to other words and contingent upon learning other words. For example, knowing the definition for words such as *snake* and *lizard* will influence a student's ability to learn the definition for the word *reptile* (Honig, 2012*)*. Students also learn vocabulary "multimodally" (Honig, 2012, p. 33). Thus, students need opportunities to gain experience with the vocabulary through the use of reading, writing, talking, and performing activities (Honig, 2012).

Young (2005) suggests several strategies for effectively teaching vocabulary in science. One example includes a semantic feature analysis. When performing a Semantic Feature Analysis, a column on the left should provide key vocabulary that will be used for analysis and key association. A row across the top would be used for analysis of similarities and differences. The teacher conducts whole guided practice with the class while students place a "+" next to items that are associated to the vocabulary and a place a "-" next to items that are not associated with the vocabulary word. After whole guided practice is conducted with the class, the teacher may then allow the students to continue analyzing their vocabulary in collaborative groups or individually.

Greenwood (2005) suggests various strategies for successful mastery of vocabulary in content areas by students. He encourages for students to be provided choices for vocabulary to be learned. Rote memorization is ineffective. Many students become frustrated with looking up definitions in dictionaries and can become confused as they try to look up words with the definitions. He argues that students need multiple exposures to vocabulary words presented in class, and students often do not retain definitions from minimal exposure to words presented in class. Students need practice in using context clues for developing their own definitions of vocabulary words. Lastly, time needs to be reserved by teachers to directly instruct vocabulary terms. Students need a balance between immersion and direct instruction.

Spencer and Guillaume (2006) suggest that students go through a learning cycle to learn new vocabulary. The authors acknowledge that acquisition of vocabulary is incremental and words can have multiple definitions. Students can only retain and gain so much knowledge from limited exposure to new words, and with words having multiple definitions, learning new vocabulary can be challenging. Knowledge of vocabulary is also multidimensional and the knowledge can be interrelated. Knowledge of vocabulary is multidimensional because one's full understanding of the word involves knowing the definition of the word, knowing how to pronounce the word, being able to use the word in a sentence, and knowing how it relates to other words.

Sun, Zhang, and Scardamalia (2010) assert that knowledge building is critical to vocabulary development. The authors define knowledge building as: "a social process through which people work collaboratively to create and improve ideas of value to their community. It is through this process that research groups produce increasingly powerful explanations about the world, and high-tech companies address challenging problems and develop new technological products (p. 148)." The pedagogy related to their definition of knowledge building is a different perspective than collaborative inquiry learning methods. Rather, knowledge building should be done as a community of learners. Students work together to generate problems that need to be solved, work together and provide ideas about problems, conduct experiments designed by themselves, examine as they conduct experiments, research, and cooperatively read new resources. This knowledge building helps enhance vocabulary development because it "engages an extended network of social processes driven by an authentic desire to understand the world, solve problems, and communicate ideas (p. 150).” Through knowledge-building communities, students locate and read large amounts of contextual information during the research phase of knowledge building. This allows students to have opportunities to have discourse with other students about information they have read and thus, build vocabulary knowledge.

Knowledge of words and their definitions does not happen all at once, but rather, it occurs over time. Knowledge of word usually evolves from a student recognizing a word, known as receptive knowledge, to being able to use the word when writing. When being able to use a word in writing, this stage of lexical knowledge is known as productive knowledge (Sun, Zhang, & Scardamalia, 2010; as cited in Laufer, 1998). The authors advocate the knowledge building communities in the classroom help the development of lexical knowledge across these two stages of word development (Sun, Zhang, & Scardamalia, 2010).

Vocabulary can be placed into three tiers. Basic or common words can be placed into tier one. These words include sight words, function words, and words that are used to name objects. Words that are used across the curriculum and words that have multiple meanings make up tier two, and tier three consists of vocabulary specific to a content area. The words in tier two are considered important for students to comprehend text, and tier three words are words that are used only in that content area, is technical, and students may have limited exposure to the words (Beck, McKeown, & Kucan, 2002).

Townsend (2009) examined the effectiveness of building academic vocabulary among English Language Learners (ELL) in an after-school setting. The intervention in the study was an after-school program called Language Learning Workshop, and the purpose was to determine if strategies used in it were effective with ELL students' learning content vocabulary words that were primarily abstract. Target vocabulary words were chosen from Coxheads (2000) Academic

Word List. The words from this list are general academic words and are not discipline-specific. The words, however, could be used throughout all academic disciplines. Strategies employed in the workshop included: (a) allowing students to have multiple exposures to target words in different contexts, (b) provide opportunities for students to process words, (c) allow personalization of words, and (d) provide visuals and practice of words. These strategies were implemented in the program in the form of games, such as with picture puzzlers, music puzzlers, and matching games. These games were followed up with follow-up activities, such as having students do skits to demonstrate knowledge of words and drawing the target words (Townsend, 2009).

Townsend's (2009) study had students that spoke another language other than English as their primary language. The after-school program consisted of twenty sessions that were 75 minutes long. Students were pre-tested on the target vocabulary words primary to the intervention. Results of the study suggested that students made significant gains in knowledge of the target vocabulary words from the workshop. Students who were considered at a more advanced level of English made the most significant increases in knowledge while beginning students showed the least amount of improvement (Townsend, 2009).

The use of vocabulary notebooks is another approach for instruction of vocabulary in science. The notebook is used as a personal dictionary where students are able to write down words they encounter. Students use the notebooks to keep track of the words' part of speech, definitions, other word forms, anonyms, and synonyms of words. Walters and Bozkurt (2009) conducted a study at Zonguldak Karaelmas University English Language Preparatory School, in Zonguldak, Turkey to study the effectiveness of vocabulary notebooks among students learning English. Notebooks were incorporated over a four week period. Eighty target words were chosen by the researchers from course books used by the students at the university. The words were chosen based upon frequency of words throughout the course books. Twenty words were introduced each week, and students were asked to record words along with definitions. Teachers provided information to students such as the part of speech, first-language translations, second language synonyms, antonyms, derivations, and collocations. Students were given a pretest and a posttest to measure acquisition of vocabulary that included target and non-target words. Interviews were also administered to measure students' attitudes about the notebooks. With the analysis of a one-way ANOVA, results suggested that students had a higher acquisition of vocabulary of target words with the use of vocabulary notebooks.

McCrostie (2007) examined the use of vocabulary notebooks and their effects on vocabulary acquisition of first year English majors at a Japanese University. The study focused on the source of vocabulary words participants' chose, parts of speech and frequency of words chosen by students, and why participants chose the words for their notebooks. Students were asked to document twenty words a week in their notebooks. Results showed that there was a wide range in the number of words chosen by students. This ranged from documenting a few words to 71. Eighty-two percent of the words participants chose to put into their notebooks were from the textbook or handout provided in class, and the majority of the words students chose were nouns. The most common reason provided by participants for why they recorded the words that they did in their notebook was because of the words' novelty. The second most common reason was their perception of how useful the word was. Very few students, two percent, reported writing the word in their notebook as the word being necessary for writing and speaking. Results also suggested that participants had difficulty recognizing high frequency words in the content. McCrostie (2007) argued that from the results, students need more guidance from teachers on scaffolding of notebooks since too many of them relied on the textbook as a source of the words, and they could not recognize high frequency words.

Explicit vs. Incidental Approach to Teaching Vocabulary. Spycher (2009) investigated the use of an intentional versus an implicit model of instruction for teaching vocabulary to kindergarten students in from lower-socioeconomic backgrounds in an urban California school. The purpose of the study was to compare the two models and measure vocabulary achievement among English Language Learners. The intentional model is similar to teaching vocabulary in isolation where the teacher uses explicit vocabulary instruction to teach vocabulary terms and definitions while implicit instruction did not have explicit vocabulary instruction. Thus, the vocabulary was integrated throughout the unit. The researcher used twenty vocabulary words to assess the intervention, instruction with explicit teaching of vocabulary. An Emergent Science Vocabulary Assessment, a picture test, was used to assess students' receptive vocabulary knowledge, and a Conceptual Interviews on Scientific Understanding, an interview, was used to assess expressive and conceptual knowledge. Findings from Spycher's (2009) study suggest that students who are taught with the explicit instruction have higher vocabulary achievement than students who are taught through the intentional model that was analyzed by conducting a two-way ANOVA and descriptive statistics.

Taboada and Rutherford (2011) examined an approach similar to teaching vocabulary as an isolated and integrated approach with English Language Learners. The authors, however, described these approaches as "explicit" and "incidental." Pedagogy with explicit instruction involved specifically targeting vocabulary words with instruction. Students are provided with opportunities to have exposure to the targeted vocabulary words. The exposures are "within rich language contexts where word awareness is created through the explicit focus on the target words (p. 118)." Incidental vocabulary instruction, however, maintains that students learn words from contexts. Reading-related experiences provide students with the necessary skills to increase their academic vocabulary and knowledge. Due to exposure of vocabulary through contexts, learning of academic vocabulary through incidental vocabulary instruction occurs in increments (Toboada & Rutherford, 2011).

The researchers examined the effectiveness of explicit and incidental approaches to instruction through two frameworks, contextualized vocabulary instruction (CVI) and Intensified Vocabulary Instruction (IVI), with English Language Learners. The same science academic words were used with each type of intervention. CVI had the component of implicit academic vocabulary instruction followed with incidental vocabulary instruction. The IVI framework consisted of instruction that contained explicit instruction of academic vocabulary, and target vocabulary words were taught in rich language contexts. Based upon formative assessments administered to students, results suggested the IVI framework increased students' academic vocabulary with target words three weeks after initiating the intervention. The CVI instructional approach, however, helped students' reading comprehension (Toboada & Rutherford, 2011).

Explicit instruction to vocabulary has begun to be phased out of teaching due to reading comprehension and decoding, but it is necessary and effective for students. It should not, however, rely on approaches that are passive, such as with traditional definition of context-based approaches. Instruction should allow students to be active in learning academic vocabulary. Explicit instruction can involve activating students' prior knowledge with academic vocabulary. Students can be taught morphemes and root words. This can be especially helpful because many words that students encounter throughout the day are low frequency words and are only found in that subject area. Also, definitions can vary from one subject to another depending upon the word (Taylor, Mraz, Richelman, & Wood, 2009).

Young (2005) also advocates for explicit instruction in science. Students must understand language used in science. A student's knowledge of language is a predictor of how well they will understand science textual information. Explicit vocabulary strategies that include inquiry-based methods and engaged word-meaning concept strategies enables students to develop their own connections among meanings of words and allows them to become confident in science content.

Didactic tension in the science classroom may result from explicit instruction of vocabulary and can be an obstacle for many ELL students. Didactic tension is "the tension that exists between the goal of teaching ELs how to talk science and the goal of teaching them how to do science (Bruna, Vann, & Escuderim, 2007, p. 37)." If explicit instruction is used and definitions of science vocabulary words are simplified, then the gain of knowledge in science will also be simplified, particularly with ELL students. The instruction may hinder students from having opportunities to talk and think like real scientists because of the oversimplification of terms (Bruna, Vann, & Escuderim, 2007).

Incidental vocabulary has been suggested to enhance vocabulary acquisition (Krashen, 1981). According to Smidt & Hegelheimer (2004), it can be defined as: ''learning without an intent to learn, or as the learning of one thing, for example vocabulary, when the student's primary objective is to do something else (Laufer & Hulstijn, 2001, p.10)." While some research suggests that intentional learning often yields better vocabulary acquisition, most vocabulary acquisition and learning is incidental. A study by Smidt and Hegelheimer (2004) suggests that incidental vocabulary instruction can enhance vocabulary acquisition, particularly with videos.

Their study consisted of presenting online videos of academic lectures to English as a Second Language (ESL) students.

Vidal (2011) examined the effectiveness of incidental learning on students' vocabulary acquisition with three different interventions, reading academic texts, watching lectures, or receiving no input and just completing necessary vocabulary measures. Frequency of target vocabulary words, type of word, type of elaboration, and predictability of word's definition from parts was also assessed and compared. The study indicated that students exposed to the reading of academic texts had greater gains in incidental vocabulary acquisition compared to the other two interventions. When performing pairwise comparisons, as students' proficiency increased, gains between the reading and listening conditions decreased. Students who received the reading intervention also had greater retention compared to the other two interventions one month after exposure to the intervention. This did not, however, occur with students who already had a high proficiency according to posttest scores.

Kweon and Kim (2008) performed research that suggests incidental vocabulary learning can take place, particularly from reading novel texts. Subjects of the study were given a pretest, and two posttests. The second posttest was used to determine if subjects retained their knowledge of vocabulary. Results of their study suggested that nouns were a little better retained than adjectives or verbs after reading three novel texts. Word gain was as high as 40 percent, and subjects retained knowledge acquired from posttest one to posttest two. Knowledge of some nouns was lost between the first posttest and the second posttest, but the authors suggest that this may be due to the low frequency of the words. Results from the study also suggested that the more frequent target vocabulary words are in subjects' reading, the higher the acquisition and retention of the words.

The effectiveness of explicit vocabulary instruction was compared with implicit by Sonbul and Schmitt (2010). The study compared the learning of vocabulary under a read-only intervention versus an intervention that also had a component where word definitions were communicated. The read-only intervention was considered incidental instruction while the intervention that communicated word definitions was considered explicit instruction. Form recall, meaning recall, and meaning recognition were assessed in terms of subjects' vocabulary knowledge. The reading-only intervention (incidental) was found to be less effective than when explicit instruction was combined with incidental instruction. Explicit instruction combined with incidental instruction was the most effective intervention in the study. Direct instruction of vocabulary was the most effective for form recall, which the authors considered to be the deepest form of vocabulary knowledge.

Direct instruction of vocabulary can be characterized as teachers incorporating relevant vocabulary before, during, and after reading stages of instruction. For example, in the before reading stage of instruction, the teacher may pronounce the target word, pre-teach word, and provide concrete examples of word. The teacher may define the word in context, help locate context clues, and use graphic organizers during the reading stage of instruction. Word walls, graphic organizers, helping students incorporate new words into writing assignments, and reinforcing new words through assignments are strategies used in the third stage of instruction when incorporating direct instruction (Sibold, 2011).

Connected Instruction versus Direct Instruction. Connected knowledge instruction in science consists of students acquiring knowledge through interactions that may be historical, cultural, and social that they participate in. Some of the interactions may occur in the home and school. Thus, students construct knowledge from their experiences. When teachers make connections to students' experiences, students found the knowledge they gained in science to be more useful, there is often an increase in parental participation, and recall knowledge better later on (Hammond, 2001). When Upadhyay and DeFranco (2008) examined vocabulary gain and retention among third grade students, research from their study indicated that students gained less science knowledge in the short-term compared to direct instruction. The students that received connected instruction retained the knowledge they gained better than the ones who received direct instruction.

Sibold (2011) describes direct instruction as being an effective practice, particularly with English Language Learners (ELL). Students may learn new vocabulary words from texts that they read, but some students, like ELL students, need specific and definite instructions to learn new definitions. With direct instruction, teachers can still incorporate a constructivist approach and build upon students' prior knowledge. Students can be allowed to make connections to new vocabulary words through pictures, objects, and photographs. Word walls, graphic organizers, and imagery can be used in direct instruction for effective vocabulary acquisition.

Coyne, McCoach, Loftus, Zipoli, Ruby, Crevecouer, and Kapp (2011) examined the effectiveness of direct and extended vocabulary instruction with kindergarten students. Extended vocabulary instruction is considered instruction that directs attention to target words and their corresponding definitions (Beck, McKeown, & Kucan, 2002). The study was conducted over an eighteen week period, and it measured students' knowledge of target vocabulary words and the students' overall generalized language and literacy. Students were taught the definitions of fifty-four vocabulary words with interactive read alouds embedded in thirty-six half hours of instruction. Forty-four other students did not receive this treatment and were considered to be a control group. Data from the study suggested that students who received the instruction through read alouds outperformed the control group in regards to knowledge of target words.

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The use of direct instruction of vocabulary, particularly among English Language Learners (ELL) can be effective according to some research. Research by Wallace (2011) advocates for breadth and depth in vocabulary instruction. Breadth of vocabulary deals with the number of words a student knows. Depth, however, is: "all word characteristics such as phonemic, graphemic, morphemic, syntactic, semantic, collocational and phraseological properties" (Wallace, 2011, p. 190). The author advocates teaching cognates when vocabulary is in a second language, teaching the meaning of words, and review and reinforcement of vocabulary is important as well in instruction.

Horn and Feng (2012) examined the effectiveness of direct vocabulary instruction on reading comprehension in a seventh grade classroom to determine its effectiveness in a literacy program. The study utilized a quasi-experimental design. One group of students was assigned to vocabulary acquisition strategies that were included before, during, and after reading. Pre-reading strategies included activating prior knowledge and focusing on a small number of target vocabulary words. Strategies used when reading included encouraging the students to use context clues and using graphic organizers. After reading strategies included encouraging the students to use the vocabulary they learned in their contexts. Another group of students did not receive any target vocabulary words or vocabulary acquisition strategies throughout their reading. Pretests and posttests were administered to both groups of students.

Results of the study suggested that there was no statistical significance between the two groups (Horn & Feng, 2012). Thus, direct instruction of vocabulary did not help the students in regards to reading comprehension. Horn and Feng (2012) acknowledge that the results do not corroborate other research on the effectiveness of direct instruction. The results did suggest, however, that there was an increase in pretest to posttest with the students who received direct instruction compared to the control group. Their scores increased 17.83 points, and their mean score was lower on the pretest compared to the control group. The authors suggest that the study should be conducted longitudinally, and there may be an effect if carried on for a longer amount of time.

Shin (2004) argues against direct instruction of vocabulary. The author suggests that books are the solution to vocabulary development among students. The author argues that a student in the fifth grade will read approximately 600,000 words in magazines, newspapers, books, and other texts outside of school. This would require students to just read fifteen minutes a day in school to cover this number of words throughout the course of the school year. Ultimately, a fifth grade student probably actually reads about one million or more words a year. With a five percent chance of learning a word, an average reader can learn a thousand new words a year. The author continues to argue that if the readings are not overly difficult, this number of words learned can increase to two thousand (Anderson, Wilson, & Fielding, 1988). Up to three hundred words can be taught throughout the course of a school year using direct instruction. This number of words learned is considerably lower than the number of words that can be learned from independent reading (Shin, 2004; as cited in Nagy & Herman, 1987).

Responsive Teaching and Explicit Instruction. Soo-Young and Diamond (2012) investigated the effectiveness of learning science vocabulary and concepts through the use of responsive teaching and explicit instruction with responsive teaching with one hundred five pre-school children on a unit about buoyancy. Responsive teaching involves using "child initiated and child-directed constructivist perspective in which teachers provide materials and opportunities for exploration and experimentation, but without explicitly and systematically teaching science concepts (p. 295)." Responsive teaching with explicit instruction involves using strategies in conjunction with responsive teaching that specifically introduce concepts and vocabulary words, directly asking higher-order questions, and conducting experiments. Participants were divided to one of three interventions: responsive instruction, responsive instruction with explicit instruction, or a control group who received neither. The researchers assessed prior knowledge of vocabulary related to and after the intervention. Data from the study suggest that students learn science concepts and vocabulary better with responsive teaching or responsive teaching combined with explicit instruction compared to those who did not. The students who received responsive teaching combined with explicit instruction, however, learned more science concepts and vocabulary compared to the students who just received responsive teaching and those who were in the control group.

Collaborative Strategic Reading. Shook, Hazelkorn, and Lozano (2011) implemented an intervention called Collaborative Strategic Reading (CSR) in an inclusive ninth grade biology class to assess its effectiveness with students' learning of science vocabulary. In CSR, students work cooperatively and are assigned a role. Roles include: leader, clunk expert, announcer, encourager, reporter, and timekeeper. The leader is responsible for telling the group what they are expected to read regarding the topic of choice by the teacher. He or she is also responsible for notifying the teacher if need be, gathers materials, keeps group members on task, and reports the students that are not meeting their expectations with roles. If students are having difficulty with or word or concept in the text given, the clunk expert is responsible for reminding the group of steps to take to figure them out. The announcer is responsible for holding vocabulary note cards and for calling on group members to share ideas or to read. This student is also responsible for ensuring all group members participate. Positive feedback to the group is provided by the encourager. This student also reports how many words each student gets correct. The reporter is responsible for reporting what words the group knows and the words the group is having difficulty with. Statements made by the encourager are written down and main ideas are reported to the class by this individual. Lastly, a timekeeper is available to set the timer for each portion of the CSR and lets the group know when it is time to move on. This role can be played by the teacher, and roles can be combined if needed (Shook, Hazelkorn, & Lozano, 2011).

CSR is carried out in multiple steps that include students using four strategies. These strategies include:

1. Preview (Shook, Hazelkorn, & Lozano, 2011, p. 46),
2. Clink and clunk (Shook, Hazelkorn, & Lozano, 2011, p. 46),
3. Get the gist (Shook, Hazelkorn, & Lozano, 2011, p. 46), and
4. Wrap up and review (Shook, Hazelkorn, & Lozano, 2011, p. 46)

In the preview step, students brainstorm and discuss what they know about the topic. Students will also predict what they will learn from their reading. The *click* strategy is them implemented while students are reading the text provided to them. The *click* strategy involves students referring to parts of the text that they understand, and then they use the *clunk* strategy to discuss parts of the text that does not make sense to them. The *get the gist* strategy is used in the third step of the activity to identify and summarize the most important information from the text. The *wrap up and review* strategy is used last. Students discuss everything they have learned from the text and pose any lingering questions that they still have (Shook, Hazelkorn, & Lozano, 2011).

Shook, Hazelkorn, and Lozano (2011) implemented the CSR strategy into a ninth grade inclusive biology class. Vocabulary quizzes were implemented to assess students' knowledge of vocabulary words related to current units. Prior to implementing the CSR intervention, baseline quiz scores over a three week period were seventy-five for the entire class. After five weeks of implementing the CSR strategy, the average score on the vocabulary quizzes were 93.85. Students with disabilities' average score after implementation was 93.57. Students without disabilities increased their quiz scores by thirteen points while students with disabilities increased their quiz scores by thirty-four points. There was a significant difference in quiz scores for both groups according to Wilk's Lambda. There was also an increase in scores on the end of course test for the class.

Putnam and Kingsley (2009) examined the effectiveness of students' gain of knowledge of science vocabulary using podcasts to middle and upper class students. Prior to a unit related to atoms, students were given a pretest on twenty-two target vocabulary words related to the unit. Vocabulary words were introduced each week and discussions about textbook-related definitions were conducted by the teacher. Students were required to read passages from their textbooks that included the vocabulary and class definitions. Instruction also included having students create vocabulary cards that included the words, definitions, and sentences related to the words. Demonstrations and experiments were conducted throughout the unit to reinforce the vocabulary. Throughout the unit, however, students were exposed weekly to podcasts related to the science content and vocabulary that were created by the researchers. Assessment of vocabulary was conducted each week through the use of posing science-related questions that required the use of the week's vocabulary words. The researchers acknowledged gains and acquisition of target vocabulary words by students.

Spencer and Guillaume (2006) advocate the use of a learning cycle to enhance achievement in science. Steps in the learning cycle include: engage, explore, develop, and apply. In the engage phase, the teacher activates prior knowledge about a topic of interest and relationships about what they know regarding the topic. Then, first-hand knowledge about the topic is provided to students and exploration of the topic is carried out in the explore stage. This stage can be provided through hands-on experiences. The development stage of the learning cycle involves allowing students to make connections and relationships among terms. Finally, in the apply stage of the learning cycle, students are provided with opportunities apply their knowledge of target vocabulary words in authentic, real-world contexts. Students are further provided with opportunities reaffirm and practice their knowledge of their new terms.

Glen and Dotger (2009) performed a qualitative study with teachers who taught upper elementary students to determine how these teachers used science vocabulary in their lessons. The researchers suggested that the teachers tended to use a labeling system for science phenomena and interpret science concepts. Science as a labeling system can have the following characteristics: (a) uses specific words to label objects, (b) fixed specific definitions for specific science vocabulary words, (c) learning more means learning more words and appropriate definitions, (d) texts are the preferred source for definitions, and (e) how the definition was constructed or labeled is not explained(Glen & Dotger, 2009). An interpretive approach to teaching science vocabulary has the following characteristics: (a) personal definitions are built based upon prior knowledge and experiences, (b) language available at the time is used to construct knowledge, (c) analogies are often used, (d) teachers and students share the accountability with science terms' explanation and understanding of vocabulary, and (e) learning about science involves understanding how scientists' constructed the knowledge they know from previous scientists' contributions (Glen & Dotger, 2009). Thus, in a labeling system, words' definitions are never discussed on how the definition came to be. The vocabulary and definition is assumed to be universal. Data from the study suggested that the teachers used a labeling system more often than an interpretive system. Students were not provided with opportunities to learn how words' definitions and scientific knowledge were constructed by scientists (Glen & Dotger, 2009).

Slough and Rupley (2010) advocate for reformation of many science instruction programs so that they consist of learning progressions, scaffolding, and offering a variety of reading. Their vision of science reformed programs would allow students to have opportunities to conduct hands-on activities, enhance their vocabulary knowledge and comprehension of science concepts, and have opportunities to read paired narrative and science texts. The authors argue that as students transition from third to fourth grade, they are moving from a learning to read stage of curriculum to a reading to learn stage of curriculum. Science texts are often inundated with vocabulary, and to fully comprehend when reading, students must understand 90-95% of the content they read. With the amount of dense vocabulary in science texts, students find the literature in science to be overwhelming (Biemiller, 2003).

The effectiveness of photographs has been examined as a tool for gains in scientific vocabulary knowledge. Jones (2010) used photographs in science lessons and reported positive gains in student knowledge. For example, when showing students a picture the researcher took with a snake in it, he was able to introduce vocabulary words such as reptile, predator, prey, and camouflage. Discussions were held with students to introduce these words and build their knowledge. The researcher reported that students were sparked by the photographs and their curiosity was heightened. Students who were often shy appeared to be more confident when speaking with the presentation of pictures and discussion of science vocabulary. The majority of the students the researcher taught were ELL students, and allowing these students to share and build upon prior knowledge about the photographs was important to the effectiveness of the lessons. Students were also allowed to work collaboratively in groups to write as many science vocabulary words they learned from lessons. Each cooperative group was allowed to share their list of vocabulary words with the class.

The photographs from the lesson were also used to assess learning from the lessons. For instance, after lessons, the researcher could present a picture of a snake and ask the students to explain what they knew about reptiles. Students were also assessed by having them sort cards with photographs or words according to certain characteristics or group. The researcher suggested for a more formal assessment, students could be asked to print or locate pictures, such as with the stages of a life cycle (Jones, 2010).

Gonzalez, Pollard-Durodola, Simmons, Taylor, Davis, Kim, and Simmons (2011) examined the effectiveness of integrating science and social studies vocabulary into shared book with reading with low socioeconomic preschool students. The preschool students were randomly assigned to one of two interventions. One group was assigned to Words of Oral Reading and Language Development (WORLD), and one group was assigned to what is considered typical shared reading practice. The WORLD intervention involved the use of interactive read-alouds using science and social studies content. The curriculum of WORLD is designed around thematic units, and students are exposed to narrative and informational texts (Gonzalez, 2005). The children were assessed and assigned to three levels of vocabulary achievement. Teachers who implemented the WORLD intervention worked with small groups of five to six students. The intervention was held over an eighteen week period with lessons lasting twenty minutes five times a week. Significant gains were found among the preschool students with the WORLD intervention for receptive and expressive vocabulary for science. The WORLD intervention had an overall main effect irrespective of what entry level of vocabulary of a student. The results of the study also suggested that age had an effect on results. Younger students performed better on the posttest compared to older students.

Graphic organizers are considered an effective strategy in academic content areas for vocabulary development. Graphic organizers are tools of instruction that allow the teacher and students to make relationships between word, facts, and concepts visually and spatially (Gajria

Jitendra, Sood, & Sacks, 2007). The purpose of graphic organizers is to promote meaningful learning. Graphic organizers should help allow abstract concepts to become more concrete, and hopefully, students should retain the material they learn from graphic organizers. Graphic organizers also allow students to make connections of their prior knowledge with new information (Dexter, Hughes, 2011).

Graphic organizers can be classified into categories, and these categories include cognitive mapping, semantic mapping, semantic feature analysis, syntactic/semantic feature analysis, and visual displays. Cognitive mapping allows students to connect major ideas explicitly through the use of lines and arrows to demonstrate their relationships. The lines and arrows are used to show the relationships spatially. Keywords are often used, and long complex sentences are often not used. Cognitive mapping can, however, be used with challenging texts to make the information simpler (Dexter & Hughes, 2011).

Semantic mapping is heuristic, and it is often used to help students recognize important information from lecture and texts. It is different from cognitive mapping because it allows the students and the teacher to create a visual display. Concepts are often listed for the students, and the teacher and the students work collaboratively to make predictions about the relationships from the key words. An ideal semantic map often has an oval that contains a main idea or concept at the top or middle of a page. This is called a superordinate concept, and the categories and other concepts related to the superordinate are placed in ovals surrounding or underneath it. The connections are connected by drawing a line to demonstrate the relationship (Dexter & Hughes, 2011).

Semantic feature analysis is similar to semantic mapping, but unrelated concepts can be inferred directly from the chart. A matrix is built with vocabulary representing coordinate concepts at the top of the matrix. Subordinate concepts are placed on the side. Again, students and teachers make predictions about the relationships between the coordinate concepts and subordinate concepts (Dexter & Hughes, 2011). Syntactic/Semantic Feature Analysis is the same as semantic feature analysis, but sentences are written based upon the matrix. These sentences are called cloze sentences, and they contain blank spaces that represent new vocabulary words. Students use their knowledge of vocabulary words, concepts, and their relationships to fill in the blanks (Dexter & Hughes, 2011).

Visual displays present concepts, information, and vocabulary in a computational manner. The relationships are made clear by their position on the display. The information can be presented comparatively, hierarchically, sequentially, spatially, or temporally. Respective examples of these include a Venn Diagram, taxonomy, flow chart, decision tree, and a timeline (Dexter & Hughes, 2011).

Science Vocabulary

For vocabulary development with students they need opportunities that are structured and allowing them to use the words in authentic and engaging ways (David, 2010). Students should have varied experience with target vocabulary, and vocabulary should be taught explicitly with a limited number of words (Graves, 2006). Additionally, vocabulary programs should allow for students to have multiple exposures to targeted vocabulary words. These exposures should have meaningful context and involve students in the processing of definitions of the words (Stahl & Fairbanks, 1986).

Jackson & Ash (2012) suggest that students have a deeper understanding of content and better vocabulary skills when they are provided opportunities to have inquiry-based instruction and multisensory explorations. These opportunities should allow for students to have repeated exposure to vocabulary words and definitions. Multisensory word walls also allow students to see, hear, touch, manipulate, and discuss content vocabulary. Vocabulary knowledge is deepened because these walls allow for semantic links between targeted science vocabulary and concepts. Thus, science vocabulary instruction is effective when words are taught in context, when words are taught in innovative ways, and students have multiple exposures and opportunities with words.

The use of vocabulary notebooks is another approach for instruction of vocabulary in science. The notebook is used as a personal dictionary where students are able to write down words they encounter. Students use the notebooks to keep track of the words' part of speech, definitions, other word forms, antonyms, and synonyms of words. Walters and Bozkurt (2009) conducted a study at Zonguldak Karaelmas University English Language Preparatory School, in Zonguldak, Turkey to study the effectiveness of vocabulary notebooks among students learning English. Notebooks were incorporated over a four week period. Eighty target words were chosen by the researchers from course books used by the students at the university. The words were chosen based upon frequency of words throughout the course books. Twenty words were introduced each week, and students were asked to record words along with definitions. Teachers provided information to students such as the part of speech, first-language translations, second language synonyms, antonyms, derivations, and collocations. Students were given a pretest and a posttest to measure acquisition of vocabulary that included target and non-target words. Interviews were also administered to measure students' attitudes about the notebooks. With the analysis of a one-way ANOVA, results suggested that students had a higher acquisition of vocabulary of target words with the use of vocabulary notebooks.

Connected knowledge instruction in science consists of students acquiring knowledge through interactions that may be historical, cultural, and social that they participate in. Some of the interactions may occur in the home and school. Thus, students construct knowledge from their experiences. When teachers make connections to students' experiences, students found the knowledge they gained in science to be more useful, there is often an increase in parental participation, and they often recall knowledge better later on (Hammond, 2001). When Upadhyay and DeFranco (2008) examined vocabulary gain and retention among third grade students, research from their study indicated that students gained less science knowledge in the short-term with direct instruction. The students that received connected instruction retained the knowledge they gained better than the ones who received direct instruction.

Vocabulary Strategies for English Language Learners in the Classroom. Brower (2013) conducted an action research study in a mainstream, split-grade classroom with twenty-six students in Ontario, Canada. Six of the students received special education services and two were English Language Learners. This research study examined the quality of experiments for junior students and best strategies to teach math and science vocabulary. Students were given test booklets that contained a science question and were instructed to read the passage given to them, and use a chart, diagram, equation, table, and list. Students were also instructed to use complete sentences when writing and use words from the passage in their own words. Teaching was conducted in cycles. Each passage was then analyzed and placed into a set of unit ideas. The set of unit ideas were categorized into percentages of how much recall the students were able to master with their answers. A top level category consisted of students mastering the summary of the science report. Students who mastered 80% of recall were considered high level. Mastery of recall within the 60-70% range of recall was considered mid-level for a student. If students mastered 60% of recall, then they were considered to be low-level of mastery (Broer, 2013).

Metacognitive awareness of text forms and languages were then analyzed by having the students name the text form and science vocabulary of the passage. Data from a large scale assessment called the EQAO was used for students in 5th grade in 2011 and 6th grade students in 2012 (Broer, 2013). Results suggested that the largest number of students were able to do informational reading, writing, and math sections on the EQAO test. No student was in the lowest percentage category for a set of unit ideas by the second teaching cycle. The majority of students were able to score in the middle to high percentage categories for science recall by the second teaching cycle. Skills in numeracy, reading, and writing improved as well (Broer, 2012). The author suggested that the use of graphic organizers, technology, and direct of instruction of science content and vocabulary help enhance the confidence of 5th and 6th grade students.

Didactic tension in the science classroom may result from explicit instruction of vocabulary and can be an obstacle for many ELL students (Bruna, Vann, & Escuderim, 2007). Didactic tension is “the tension that exists between the goal of teaching ELLs how to talk science and the goal of teaching them how to do science (Bruna et al, 2007, p. 37).” If explicit instruction is used and definitions of science vocabulary words are simplified, then the gain of knowledge in science will also be simplified, particularly with ELL students. The instruction may hinder students from having opportunities to talk and think like real scientists because of the oversimplification of terms (Bruna et. al, 2007).

Hansen (2006) suggests that ELL students need certain strategies pinpointed within the learning cycle when learning science concepts and science vocabulary. The four stages of the learning cycle include engage, explore, develop, and apply (Hansen, 2006). In the engagement step, teachers provide opportunities to get the students interested in the topic to be learned. For engagement to be successful, ELL students must be able to understand the teacher. Strategies that can be used in engagement include Specially Designed Academic Instruction in English (SDAIE), language buddies, and pre-assessment. SDAIE includes strategies that help ELL students understand the teacher, such as speaking more slowly, clearly, using gestures, facial features, and using student-centered activities (Hansen, 2006). Teachers should avoid idiomatic content. Language buddies include allowing an ELL student to pair up with students who are more fluent in English and speak their home language. For pre-assessment, ELLs can pair up with their language buddies to draw pictures, charts, words, phrases, etc. of the pre-knowledge (Hansen, 2006). During the explore phase of the learning cycle, ELL students can be allowed to work in cooperative groups and use multiple avenues of communication. Students can be allowed to draw pictures instead of using words. They may be allowed to use short sentences or phrases in their science journals (Hansen, 2006).

When in the phase of development, teachers directly teach new vocabulary and concepts. During this time, they can help ELL students master the language skills they need while they use methods that help them in the learning cycle. Key concepts and vocabulary can be previewed during this time. ELL students can be pulled for separate instruction during this time to help alleviate anxiety and prevent English-speaking students from dominating conversations. Cognates can be discussed with ELL students during this small group time as well. Guided Language Acquisition Design (GLAD) strategies can also be used during this time. This includes chunking information, using grids to compare information, and using technology (Hansen, 2006). The last stage of the learning cycle is apply, and during this time teachers help the students connect the science information they have learned to new situations and the real world. Facilitation of student understanding can be done by allowing students to share experiences and talk within pairs. Alternative assessments can also be used as well since ELL students often tend to find traditional tests to be difficult (Hansen, 2006).

The use of these strategies throughout the four stages of learning can help ELL students demonstrate expertise in science content and vocabulary. These strategies can help alleviate anxiety and promote participation from ELL students (Hansen, 2006). ELL students have a deeper understanding of science concepts and a better understanding of science-related vocabulary when they have opportunities for inquiry-based activities, multisensory activities, use visual clues, and use definitions in context (Husty & Jackson, 2008). A visual clue for ELL students is an interactive word wall. Many times students will have exposure to an unorganized list of words on a wall, but a word wall should be a visual scaffold. Word walls can be created to be like semantic maps. Semantic maps are graphic organizers that allow students to see how ideas or concepts link together. Thus, they demonstrate relationships among concepts (Jackson, Tripp, & Cox, 2011). An interactive word wall provides visual aids for students. The visual aids help illustrate definitions of words and conceptually organize words. This organization of vocabulary words helps students understand the words conceptually. An interactive word wall will also have a vocabulary label, but it may or may not have definitions (Jackson, Tripp, & Cox, 2011).

Early research on vocabulary instruction with English as a Second Language (ESL) students, incidental versus intentional learning had been explored by researchers, particularly with focus on incidental learning. (ESL is used here because this was the language used within the article). In regards to incidental learning, early research suggested to provide opportunities for students to have target vocabulary words for tasks. An example of this would include having students reading texts with only the target vocabulary words (Read, 2004).

However, as research has progressed studies have suggested that target vocabulary words were better retained by students when their meanings were correctly inferred by students than if they were explained by their synonyms (Hulstijn, 1992). Nam (2010) suggests that classroom vocabulary instruction supports the four domains of language, reading, writing, speaking, and listening, but it also mediates between English as a Second Language (ESL) students and content-area classes. This is because ESL students often find lack of vocabulary knowledge as an obstacle to learning. Nam (2010) suggests strategies for effective instruction with ESL students. These include pictorial vocabulary teaching, fill-task, post-reading composition task, and reading and retelling task. Pictorial vocabulary involves students using pictures of vocabulary words and having written annotations. Fill-in tasks are similar to fill-in the blank tasks. This form of instruction may not be beneficial to ESL students are beginning or intermediate learners of a second language. Fill-in tasks can also have students design sentences that are connected to provide a summary of read text. Post-reading composition task may include writing a letter with target vocabulary words. Students reading text and then having to retell the text to another student would be an example of a reading and retelling task.

Sheltered instruction is a language-support method for ELL students. The first step for a teacher to employ with sheltered instruction is to identify what skills and concepts students are to be learned in science. In addition to this step, the teacher should decide what language activities will be used to help ELL students meet objectives. Secondly, the teacher should brainstorm of ways to include students' prior knowledge and experiences into lessons. Teaching and learning experiences should then be defined for any lesson. In this step, the teacher will think of ways to group students to maximize instruction through interactions, decide what instructional strategies will be used to help with understanding, and decide on ways to effectively enhance vocabulary knowledge for understanding. Lastly with sheltered instruction, the teacher will decide how to best assess ELL students on content objectives (Pray & Monhardt, 2009).

Pray and Monhardt (2009) suggest using integrated approaches to teaching science and language skills to ELL students. This allows for students to learn science content while being engaged in meaningful activities to learn science and English. This allows for students to have opportunities that allow for students to have meaningful communication, develop meaningful questions, have meaningful interaction with materials, and be able to express their understanding in a meaningful way, thus, "making meaning (Pray & Monhardt, 2009, p. 34)."

Sibold (2011) describes direct instruction as being an effective practice, particularly with English Language Learners (ELL). Students may learn new vocabulary words from texts that they read, but some students, like ELL students, need specific and definite instructions to learn new definitions. With direct instruction, teachers can still incorporate a constructivist approach and build upon students' prior knowledge. Students can be allowed to make connections to new vocabulary words through pictures, objects, and photographs. Word walls, graphic organizers, and imagery can be used in direct instruction for effective vocabulary acquisition.

Taboada and Rutherford (2011) examined an approach similar to teaching vocabulary as an isolated and integrated approach with English Language Learners. The authors, however, described these approaches as "explicit" and "incidental." Pedagogy with explicit instruction involved specifically targeting vocabulary words with instruction. Students are provided with opportunities to have exposure to the targeted vocabulary words. The exposures are "within rich language contexts where word awareness is created through the explicit focus on the target words (p. 118)." Incidental vocabulary instruction, however, maintains that students learn words from contexts. Reading-related experiences provide students with the necessary skills to increase their academic vocabulary and knowledge. Due to exposure of vocabulary through contexts, learning of academic vocabulary through incidental vocabulary instruction occurs in increments (Toboada & Rutherford, 2011).

Academic vocabulary is "a variety or a register of English used in professional books and characterized by specific linguistic features associated with academic disciplines (Scarcella, 2003, p. 19)." As students progress through school, their demands of knowledge of academic vocabulary increase. Much of the academic vocabulary is encountered through academic texts, not conversations. Many academic words have Greek and Latin roots that may not be evident to students. Some students have opportunities outside of the classroom to learn these while others do not (Corson, 1997).

Students struggle with science vocabulary as early as the elementary years. Textbooks used are often inundated with technical vocabulary and abstract concepts (Yager, 1983). The vocabulary in the textbooks poses challenges for students, but students must still learn read content textbooks to be successful academically (Bryce, 2011).

Children's vocabulary rapidly expands between the age of zero and five. There is a disparity, however, among students of lower socioeconomic backgrounds and ethnicities (Gonzalez et. al, 2011; Farkas & Baron, 2004). For example, by age three, children from working class and professional class families had up to three times larger vocabularies compared to children from welfare class families (Hart & Risley, 1995). This is because these children often do not have the opportunities to develop their vocabulary knowledge. They may have limited access to books and less opportunities to participate in literacy activities with their parents (Duncan & Brooks Gunn, 2000).

As classroom become more culturally and linguistically diverse, there is a growing number of English Language Learners in current classrooms. Thus, the knowledge and skills to be an effective teacher is changing to meet these students' needs as they acquire a new language and learn new vocabulary (Bruna, Vann, & Escudaro, 2007). By grade three, gaps in knowledge in vocabulary in all academic areas are evident, particularly among disadvantaged children. Educators cannot assume that these children will fill in these gaps of knowledge once they learn to read because by the time these students reach the third grade, they are unable to catch up. Children by this time may need more direction, and direct instructional practices may help these students catch up and acquire necessary vocabulary (Biemiller, 2003).

Large numbers of middle school students often struggle to read and comprehend many academic textbooks, including science textbooks. Some classes may have as many as 75-80% of the students that have difficulty with reading their textbook. These students may have difficulty with reading or may have difficulty with reading comprehension that is expected for their grade level. The difficulty with reading and reading comprehension in science has an effect on academic achievement. Even though achievement in science has risen slightly in the U.S., the U.S. is still behind other developed nations (Carnine, L. & Carnine D., 2004).

Academic vocabulary, including science, is a challenge for many urban middle school students in regards to reading comprehension. Gaps in reading performance are often associated with gaps in vocabulary knowledge. Often times the students are lacking direct instruction in vocabulary to help support them when they are reading expository texts (Kelley, Lesaux, Kieffer, & Faller, 2010).

Science in particular has inundated with vocabulary, and thus, teachers tend to design their lessons around the vocabulary. This is partially due to the lexically dense nature of science vocabulary in science texts (Deboer, 2000). Additionally, the number of science terms in science textbooks increases as grade level increases (Doeber, 2000). Teachers acknowledge that increasing students' vocabulary has an impact on students' comprehending texts. Also, having a strong background in science vocabulary helps students understand what the discipline of science is about. For example, students are allowed to "assess the values, ideas, and activities of science" (Glen & Dotger, 2009, p. 71) because the building of knowledge in science and is contingent upon the necessary vocabulary skills to interpret the language. Also, students' knowledge of vocabulary helps teachers know if they have taught the necessary course requirements and if students are ready to proceed to the next grade level (Glen & Dotger, 2009).

Woolfolk Hoy and Davis (2006) linked teachers' sense of self-efficacy in relation of their subject matter, teaching strategies, classroom management, and relationship with students to student outcomes. Vocabulary in science can be particularly difficult for these students due to limited exposure to the words except for in the content area. Words that may be common, such as "parent", often have different meanings in science. Many students know the word "parent" to mean a mother, father, or guardian. In science, however, it is the beginning of a chemical reaction. The mismatch of definitions can make the content more difficult for these students (Rupley & Slough, 2010).

ELL Students and Representation in Special Education

ELL students have often been misidentified as needing special education services, and historically, they have been overrepresented in special education classes (Maxwell & Shah, 2012). Along with this problem, litigation and civil lawsuits have come about in recent years about not identifying ELL students who legitimately need special education services or not providing these services in a timely manner for students who need them. The U.S. Department of Education (2003) conducted a study and determined that over identification of ELL students with disabilities occurred more often in districts with very few ELL students, and under identification occurred in districts that had a very large number of ELL students (Maxwell & Shah, 2012). Maxwell & Shah (2012) suggest that data exists to suggest the underrepresentation of ELL students receiving special education services may be more of a problem nationally. For example, in 2009-2010, English Language Learners represented 9.7 percent of the student body population in public schools. ELL students, however, represented 8.3 percent of students receiving services under the Disabilities Education Act. Educators often report that it is difficult to validly identify whether an ELL student is struggling from language or if a disability exists (Maxwell & Shah, 2012).

Zetlin, Beltran, Salcido, Gonzalez, and Reyes (2011) suggest that teachers can misidentify ELL students as needing special education services because they may have low expectations of ELL students, lack of instructional skills to teach ELL students, and the use of ineffective curricula. The curriculum is often not motivational and does not tie into what students already know. Teachers often lack knowledge and training to differentiate between identifying language delays and language disabilities (Zetlin, Beltran, Salcido, Gonzalez, & Reyes, 2011).

Macswan and Rolstad (2006) suggest that English Language Learner assessment policies and poor language assessments contribute to the disproportionate of numbers of ELL students in special education. For example, states often assess ELL students' primary language at initial enrollment. ELL students who are identified as being limited in both languages are often referred and identified for special education services. Two common assessments involved with identifying these students include the Language Assessments Scale-Oral (LAS-O) Espanol and the Idea Proficiency Test I-Oral (IPT) Spanish. The authors advocate for changes in instructional and assessment strategies (Macswan & Rolstad, 2006).

Summary

This chapter summarized definitions and research related to self-efficacy, English Language Learners, vocabulary strategies with general education students and ELL students, and overrepresentation of ELL students in special education services. The next chapter will summarize methods and statistical analyses used in the study.

Chapter III

Methodology

Research Design

A survey was used to collect data. A survey allowed for collection of information from a large set of people with confidence (Dillman, Smyth, & Christian, 2009). Quantitative research was conducted because I was testing objective theories by examining the relationship among the variables. A constructivist worldview was also used. Additionally, numbered data was used within the surveys so that it could be analyzed using statistical procedures.

Research Questions

The following research questions were under investigation in the study to determine self-efficacy levels of teachers using Bandura's self-efficacy theory (1977):

(1) What are the self-efficacy levels of 6-12th grade science teachers when teaching science?

(2) Does the self-efficacy level of 6-12th grade science teachers relate to self- efficacy level of teaching ELL students?

(3) Is there a relationship between gender, ethnicity, years of experience, degree level, and grade level taught with self-efficacy of science and self-efficacy of teaching ELL students by 6-12th grade science teachers?

(4) What type of vocabulary instructional practices are 6-12th grade science teachers using when teaching students?

Data Collection

Surveys were disseminated to science teachers throughout a southeastern state after receiving permission from school systems and principals to administer the surveys. Superintendents were able to forward the survey through an information letter to potential participants. An invitation email was sent to superintendents or designee throughout the southeastern state requesting permission for science teachers to complete the survey. The email was also sent to a local teacher in-service center to recruit teachers. The in-service center disseminated the survey. The superintendents or designees were asked to forward the email to respective teachers within their school district. The invitation email contained an information letter with a link from Survey Monkey or Qualtrics. If superintendents could not be contacted for any reason, the email requesting participation in the study was sent to the in-service center to distribute to potential participants. After the in-service center tried twice to disseminate the survey, no participants responded. Potential participants were current science teachers for the 2014-2015 and 2015-2016 academic school years. Potential participants had at least 15 days to respond to the survey, but most had more time depending on when the survey was sent to them. The survey was open from January 2015 to December 2015 for any participants to respond once they were contacted.

A second email was sent to superintendents or designees that had not responded in the first week after the surveys have been sent to potential participants. This email was to serve as a reminder and encourage participation of responding to the surveys. An Institutional Review Board (IRB) modification was completed and approved in the middle of the study to help with recruiting of participants. Potential participants had the opportunity to enter their email address at the end of the survey for a chance to win a ten dollar gift card. For every ten surveys completed, their email address was entered into a random generator for a chance to win the gift card.

A quantitative approach allowed for testing of theories, such as Bandura's self-efficacy theory (1977), deductively, building protections against bias, controlled for alternate explanations, and the ability to generalize and replicate the findings of the study (Creswell, 2009). This approach also allowed for examination of the relationships among the variables. The variables were able to be numbered and analyzed using statistical procedures. A survey was used because it allowed for numeric descriptions of trends and participants' opinions of their self-efficacy levels (Creswell, 2009).

Instrument. The survey was adapted from Enochs', and Riggs' (1990) survey in Further Development of Elementary Science Teaching Efficacy Belief Instrument: A Pre-service Elementary Scale. The survey used as a model was considered to have validity by a confirmatory factor analysis. The survey was considered reliable by Enoch and Riggs (1990). The survey in this study had three parts, a demographic section, a section to measure self-efficacy levels, and a section for participants to report frequencies of vocabulary strategies that they use. It had a total of 14 questions, but some questions were further broken down into statements, particularly the sections about self-efficacy levels and frequencies of vocabulary strategies used. The first portion included demographic questions and factors related to teaching, and the second portion will determine measures of self-efficacy. Participants were able to choose from a drop down menu their gender, grade level taught, years of teaching experience, ethnicity, and degree level. A fill-in question was included in this section where participants were asked to fill in what institution they received their initial teaching certification. The last part of this portion of the survey ended with two questions that are Likert-type in form to determine participants' level of pre-service experience with ELL students and their self-efficacy levels developed from their teacher education program. The second part of the survey had sections that included statements for which participants marked their level of self-efficacy teaching science and a section to mark their level of self-efficacy teaching science to ELL students. The last part of the survey asked participants to tell how often they use various types of instructional strategies.

There are a growing number of English Language Learner's in the American classroom. This has caused an increase in the demand for teachers who are able to effectively meet the needs of these learners in the classroom (Hill & Flynn, 2004; as cited in Arens et. al, 2012). Additionally, the U.S. Department of Education (2002) reports that the majority of teachers have not received training in specific ELL strategies that will help ensure their success in the classroom (Arens et al., 2012). Karimi (2011) suggests that professional development can have an effect on a teacher's level of self-efficacy, particularly with teaching English as a foreign language.

The purpose of this study was to examine secondary science teachers' self-efficacy in teaching their current science class and self-efficacy of teaching ELL students in rural science education classrooms. Bandura's (1977) social cognitive theory of self-efficacy was used to measure self-efficacy through the use of a survey. The survey was conducted in a southeastern state. Results can promote for more professional development for teachers of ELL students to increase self-efficacy levels if they are lacking. This study will help support and promote more of the necessary professional development for ELL and science.

Measures. A survey was administered electronically through Survey Monkey and Qualtrics to science teachers teaching in public schools throughout science education classrooms in a state located the southeast region of the United States. Survey Monkey is a website that allows for creation of surveys that can be sent electronically to participants (Survey Monkey, retrieved February 22, 2016). Survey Monkey allows for real-time results, text analysis, SPSS integration, custom reporting, and filter and cross-tabbing. Based on length, Survey Monkey does have a monthly charge. Because of a formatting problem with one of the questions in Survey Monkey and the cost, the survey was switched over to Qualtrics. In Qualtrics, the design and the dissemination of the survey would not be any cost to me. Thus, some respondents responded in Survey Monkey and some responded in Qualitrics. Qualtrics is similar to Survey Monkey in that it is an online tool to create and distribute surveys (Qualtrics, Provo, UT, retrieved February 22, 2016). After collecting all data, the researcher retrieved the answers from Survey Monkey and answered them into Qualtrics in order to have all of the data in one place.

The survey was divided into two parts. The first part of the survey was designed and implemented to determine levels of self-efficacy among science teachers and their self-efficacy of teaching ELL students. The second part of the survey was used to determine what types of vocabulary instructional strategies are used among the teachers when teaching ELL students and determine if there is a relationship. A review of the literature was used in development of the questions. The survey was confidential, and thus, teachers did not have to report their names. Some participants were able, however, to enter their email address at the end of the survey for a chance to win a gift card. Participants that took the survey near the end of the study had the opportunity to enter their email address for the gift card after an Institutional Review Board modification. All surveys were emailed to potential participants from their local superintendant, principal, or a local education in-service center to school systems to administer the survey provided they provide permission. Most questions were structured and closed-ended. Surveys were not mailed to enhance confidentiality of surveys.

Response Scales. Bandura's (2006) suggestions for scales to measure self-efficacy were used for the second portion of the first survey. Bandura (2006) suggests that when respondents are presented with scales about their self-efficacy beliefs, they should be presented with scales that present items that portray different levels of task demands. The respondents were able to rate the strength of their belief in ability to perform a specific task. Respondents could represent the level of their strength of efficacy on a 100-point scale. The scale was subdivided into 9-unit intervals from 0 ("Cannot do") through intermediate levels of belief, 50 ("Moderately certain can do"), to complete assertion of belief of efficacy, 100 ('Highly certain can do"). Originally, a 10-unit interval was intended, but the survey was missing one range. A simple scale could have also been used with intervals ranging from 0 to 10 (Bandura, 2006).

Response scales with only a few steps were suggested by Bandura (2006) to enhance sensitivity and reliability. This is because participants responding in an instrument tend to avoid extreme positions. Thus, a scale with only a few steps may cause shrinkage of one or two points. Additionally, including too few of steps causes differentiated information to be lost. People who use the same response category may differ in middle steps if they are included. In addition, a scale with a 0-100 response format is a stronger predictor of performance than a scale on a five point interval (Bandura, 2006).

The efficacy scale was unipolar. Furthermore, the scale ranged from 0 to a maximum strength of 100. Negative numbers were not included in the scale. This is because respondents could have judged a complete incapability with a score of 0 to have no lower gradations. Additionally, bipolar scales that do contain negative numbers do not make sense (Bandura, 2006).

Initial instructions were developed to enhance the state of mind of participants when rating their strength of belief about their perceived personal abilities. The response scale was developed so that participants were asked to evaluate their current capabilities of teaching science and ELL students as of the present, not their future capabilities or their previous capabilities. Participants could have inevitably predicted themselves to be highly effective in the future. Thus, the survey was designed so that participants were responding to how efficacious they are able to perform an activity regularly over designated periods of time.

The second part of the survey administered was used to determine types of vocabulary strategies used by teachers and if correlations exist with their levels of self-efficacy. Development of this part of the survey was completed by reviewing the literature of effective vocabulary strategies. A Likert-type scale was used to determine how often teachers use strategies. For example, "Very Often, Often, Sometimes," and "Never" was used to determine how often a particular vocabulary strategy is used. The last question on the survey was open-ended, and participants were asked to write in any vocabulary strategies they use in the classroom that was not included in the survey.

Participants

Participants of this study included secondary science teachers throughout the southeastern United States of America in the 2014-2015 and 2015-2016 academic school years. This included teachers that teach in grades six through twelve. Various courses taught by secondary science teachers included earth science, life science, physical science, biology, chemistry, physics, and other similar courses. Range of years taught by teachers included less than one year of teaching experience to over twenty-five years of experience. All teachers taught in public schools in a southeastern state. In the 2012-2013 school year, 543 middle schools, 225 junior highs, 508 senior high schools, and 64 career/technical centers were considered secondary public schools. A school with multiple grade levels, however, could have been represented more than once in the grade level categories listed. The breakdown totals may be reported slightly higher than the actual numbers according to the state's department of education website. The actual number of science teachers in the southeastern state could not be obtained (ASDE, 2012).

Teachers must have met the following criteria to participate in the study:

(a) Teach in a public school in the southeastern portion of the United States.

(b) Must be currently teaching a science course in grades 6-12.

(c) Have up to 25 years of teaching experience

(d) Have access to a computer to answer the survey online

Twenty-five participants started the survey, but only 15 completely answered all of the answers. Twenty-one participants answered at least the demographic portion of the survey. The following demographics and statistics were collected from the sample:

Table 1

Gender, Grade Level Taught, and Highest Degree Obtained Results

Gender	
Male	5
Female	10
Grade Level Taught	
6-8th	4
9-12th	11

Highest Degree Obtained	
Bachelor’s Degree	4
Master’s Degree	8
Education Specialist	3

Table 1 above shows some demographics for the survey. After dissemination of the survey, 25 people attempted responses. Ten partially responded to the entire survey with only 15 people completing the entire survey. Twenty-one participants answered most of the questions. Beginning demographics included 5 male respondents and 10 were female. Four taught in grades 6-8th and 11 taught in grades 9-12th. Highest degree levels obtained by teachers were also collected. Four reported a bachelor’s degree as their highest degree earned, 8 had a Master’s degree, and 3 had an Education Specialist.

Table 2

Ethnicity, Science Course Currently Teaching and Years of Teaching Experience

Ethnicity	
White	12
African American	1
Other	3
Science Course Currently Teaching	
Physical Science	5
Chemistry	6
Physics	3

Anatomy	1
Biology	3
Forensics	2
Environmental Science	4
Life Science	2
Zoology	1
Year of Teaching Experience	
0-5	2
6-10	4
11-15	4
16-20	0
21-25	1
+26	4

The table above provides more demographic information about the participants. Twelve were White, 1 was African American, and 3 reported as “Other.” Two reported have 0-5 years of teaching experience, 4 had 6-10 years, 4 had 11-15, one had 21-25, and 4 had more than 26 years of teaching experience. Five teachers reported that they currently teach physical science, 6 taught chemistry, 3 taught physics, 1 taught anatomy, 3 taught biology, 2 taught forensics, 4 taught environmental science, 2 taught life science, and 2 taught zoology.

Variables

I. Independent Variable

These were factors related to teaching. These included gender of teacher, ethnicity, years of experience teaching, highest degree level earned (bachelor's, master's, education specialist, or doctoral), grade level taught, institution of original certification, current science course being taught by teacher, and area(s) of certification.

II. Dependent Variables

A. The first dependent variable is self-efficacy of science teachers teaching science. Self-efficacy is an individual's perceptions about their ability to reach a certain goal (Bandura, 1997). Self-efficacy can also be broken down further into two cognitive constructs, personal self-efficacy and outcome expectancy. Personal self-efficacy is how well a person can organize and execute courses of actions to deal with difficult situations. Outcome expectancy is defined as one's belief about their behaviors and their expected results. Individuals with a high self-efficacy in both areas tend to set goals to conquer and work through difficult situations. Those with low self-efficacy in these areas, however, shy away from difficult tasks (Bandura, 1997).

B. The second dependent variable is self-efficacy of science teachers teaching English Language Learners.

C. Frequencies of types of vocabulary strategies used in the classroom was the third dependent variable. The review of literature was used to determine the frequency of vocabulary strategies used in the classroom using a Likert-type of scale.

> Frequency of vocabulary strategies that were surveyed included explicit instruction, incidental instruction, use of graphic organizers, concept mapping, semantic mapping, word walls, scientific inquiry, project-based learning, flashcards, word walls, and reading strategies.

Bandura (1997; 2006) states that self-efficacy is one's beliefs about their capabilities to produce given achievements. Different levels of efficacy exist in different areas for people and their levels to which they develop with their pursuits. Bandura (2006) suggests that there is no all-purpose measure of perceived self-efficacy. Ambiguity often exists with self-efficacy scales because of what is being measured or the level of the task. Self-efficacy scales should be customized to a particular area of functioning that is the object of interest.

Self-efficacy beliefs are often multifaceted. Social cognitive theory of self-efficacy by Bandura (1997; 2006) identifies several circumstances that can co-vary among distinct areas of performance. Different specialties of activity are directed by similar sub-skills. There are often times some relation between the domains of perceived efficacy. Competent performance is partly led by higher-order self-regulatory skills. These skills may be general for identifying task demands, developing and evaluating different courses of action, setting realistic goals to guide oneself, and developing motivations to keep engagement in activities that may cause stress and obtrusive thoughts. General self-management strategies developed in one activity may apply to other activities with a co-variation in perceived efficacy among the activities.

Co-development is another characteristic associated with self-efficacy. Even if different areas of one's self-efficacy are not sub-served by frequent sub-skills, the same perceived efficacy can happen if unalike areas are developed at the same time. Additionally, mastery experiences can give powerful evidence of one's ability to make changes of one's efficacy beliefs. These mastery experiences that are often personal achievements can change one's beliefs about their efficacy.

Data Analysis

A one-way analysis of variance (ANOVA) was conducted with independent variables (gender, ethnicity, years of experience, grade level currently teaching, level of educational degree) listed on the survey to determine if factors correlate as to levels of self-efficacy. Eta square for effect size was calculated by dividing Sum of Squares Between Groups by Total Sum of Squares.

Normality was an assumption when the one-way ANOVAs are used. An analysis of variance should be robust to any violations of normality assumptions (Mertler & Vannatta, 2010). Any moderate deviations from normality should not have affected the interpretation of the results (Mertler & Vannatta, 2010). Homogeneity of variance was a second assumption with the one-way ANOVA (Mertler & Vannatta, 2010). A third assumption for the one-way ANOVAs was assumption of independence. The observations within the sample were randomly sampled, and they should be independent of one another. This assumption is critical, and violation of this assumption invalidates the study (Mertler & Vannatta, 2010).

A Pearson Correlation was conducted to determine if there was a correlation between self-efficacy levels of teaching science and self-efficacy levels of teaching English Language Learners. A Cronbach's alpha was calculated to measure internal consistency. Lastly, frequencies were calculated from the second survey to determine what types of vocabulary instructional strategies were being used in the classroom when teaching all students and English Language Learning students.

Summary

This chapter focused on data collection methods used in the study, participants, instrumentation, validity, and reliability and data analysis. The next chapter will report the results obtained from calculations of one-way ANOVAs, Cronbach alphas, a Pearson correlation, and frequencies of vocabulary strategies used in the classroom.

Chapter IV

Data Reporting and Analysis

Research Question 1

What are the self-efficacy levels of 6-12th grade science teachers when teaching science?

Responses were rated on a 9 point scale, 1= "0-10 Cannot Do", 5= "51-60 Moderately Certain Can Do, and 9= "91-100 Highly Certain I Can Do." Any questions that were not worded positively toward self-efficacy were reverse-coded. Internal consistency was then measured for the participants by calculating a Cronbach's coefficient of reliability. When the reliability was run, 15 cases were considered valid. The Cronbach's alpha calculated .964. The mean for item statistics of the survey was 6.930 with a range of 4.533. Variance was 1.451.

Items were averaged across to report overall self-efficacy level for teaching science and teaching science to ELL students. The overall self-efficacy level for teaching science was 6.929 with a standard deviation of 1.770. The overall self-efficacy level for teaching science to ELL students was 5.9976 with a standard deviation of 1.751.

Table 3

Descriptive Statistics for Self-efficacy Levels of Teaching Science

Question Regarding Self-Efficacy Level of Teaching Science	N	Minimum	Maximum	Mean	SD
When a student needs help in science, I can exert extra effort as a teacher.	15	1	9	7.53	2.326
I can find better ways to teach science.	15	1	9	7.40	1.957
When I try very hard, I can teach science as well as	15	1	9	7.73	2.219

other subjects.					
When the science grades of students improve, it is because I have found a more effective teaching approach.	15	1	9	6.67	1.877
I can teach science concepts very effectively.	15	1	9	7.60	1.957
I can overcome students' inadequacies in science by effective teaching.	15	1	9	7.13	2.031
I can effectively monitor science experiments.	15	1	9	7.53	2.167
Low achievement in science cannot be attributed to my teaching effectiveness.	15	1	9	6.00	2.299
If a student who is generally low-achieving in science progresses, it is likely due to that I can give extra attention to the student.	15	1	9	6.20	1.821
I understand science concepts well enough to teach them to my students.	15	1	9	8.40	2.063
When I increase effort with my teaching, there is often little change in some students' science achievement.	15	1	9	6.20	2.077
I can have a positive impact on a student's achievement.	15	1	9	7.93	2.120
If a parent comments that their child is	15	1	9	7.07	2.086

showing more interest in science, it is likely because I can perform my duties as their teacher.					
I often cannot explain to students why science experiments do not work.	15	1	9	4.80	3.121
I can usually answer students' question about the content I teach.	15	1	9	8.13	2.031
I do not have the necessary skills to teach science.	15	1	9	3.87	3.523
When a student has difficulty understanding a science concept, I can help the student understand it better.	15	1	9	7.87	2.066
I can constantly seek ways to improve teaching strategies in my class.	15	1	9	7.93	1.981
I cannot get students motivated in science.	15	1	9	5.67	2.769

Table 3 above provides descriptive statistics and Cronbach alphas calculated. A Conbach's alpha was also calculated for self-efficacy levels of teaching English Language Learners. Responses were rated on a 9 point scale, 1= "0-10 Cannot Do", 5= "51-60 Moderately Certain Can Do, and 9= "91-100 Highly Certain I Can Do." Any questions that were not worded positively toward self-efficacy were reverse-coded. A value of .977 was calculated for the Cronbach's alpha. A Cronbach's alpha based on standardized items was .979. There were 15 valid cases. The mean from the summary item statistics was 5.995 with a range of 2.200.

Variance was .547.

Table 4

Descriptive Statistics for Self-efficacy Levels of Teaching ELL students

Question Regarding Self-Efficacy Level of Teaching ELL	N	Minimum	Maximum	Mean	SD
When an English-Language Learner (ELL) student performs better in science, it is because I can more attention to this student.	15	1	9	6.67	2.059
I can find better ways to teach science to my ELL students.	15	1	9	6.60	2.063
When I try very hard, I can effectively teach science to my ELL students.	15	1	9	6.73	2.052
When the science grade of an ELL student does not improve, I can find a more effective approach to teach the student.	15	1	9	6.53	2.031
I can effectively teach science concepts to ELL students.	15	1	9	6.60	2.063
If ELL students are underachieving in science, I can improve my teaching strategies.	15	1	9	6.53	2.100
I can effectively teach science to ELL students.	15	1	9	6.53	2.232
I can overcome an ELL student’s inadequacies in science by effective	15	1	9	6.33	2.350

teaching.					
I cannot effectively monitor science experiments with ELL students.	15	1	9	4.80	2.859
Low achievement in science with an ELL student cannot be attributed to my teaching effectiveness.	15	1	9	5.93	2.086
If a student who is generally low-achieving in science progresses, it is likely due to that I cannot give attention to the student.	15	1	8	4.80	2.366
I understand science concepts well enough to teach them to my ELL students.	15	1	9	6.60	2.414
When I increase effort with my teaching, I cannot have an impact on ELL students' science achievement.	15	1	8	4.73	1.981
I can have a positive impact on an ELL student's science achievement.	15	1	9	6.60	2.197
An ELL student's achievement is because I can effectively teach.	15	1	8	5.80	1.859
If a parent comments that their ELL child is showing more interest in science, it is likely because I can perform my duties as a teacher.	15	1	8	5.93	1.944
I often cannot explain to ELL students why science experiments do not work.	15	1	8	4.73	2.520
I can usually answer ELL students'	15	1	9	6.53	2.356

questions about the content I teach.					
I cannot learn the necessary skills to teach science to an ELL student.	15	1	8	4.53	2.588
When an ELL student has difficulty understanding a science concept, I can help the student understand it better.	15	1	9	6.27	2.120
I can constantly seek ways to improve teaching strategies for ELL students in my class.	15	1	9	6.47	2.134
I cannot get ELL students motivated in science.	15	1	8	4.87	2.232
I can get more professional development to help meet the needs of my ELL students.	15	1	8	6.27	1.870
I can get more professional development to help meet the needs of my ELL students.	15	1	8	6.13	1.807
I often seek ways to effectively teach ELL students.	15	1	8	6.13	2.031
I can communicate with my ELL students.	15	1	9	6.20	2.513

Table 4 above provides descriptive statistics of self-efficacy levels of teaching ELL students science. None of the averages for the responses in regards to self-efficacy level where extremely high nor low. The average self-efficacy level for teaching science to ELL students was 5.9976.

Research Question 2

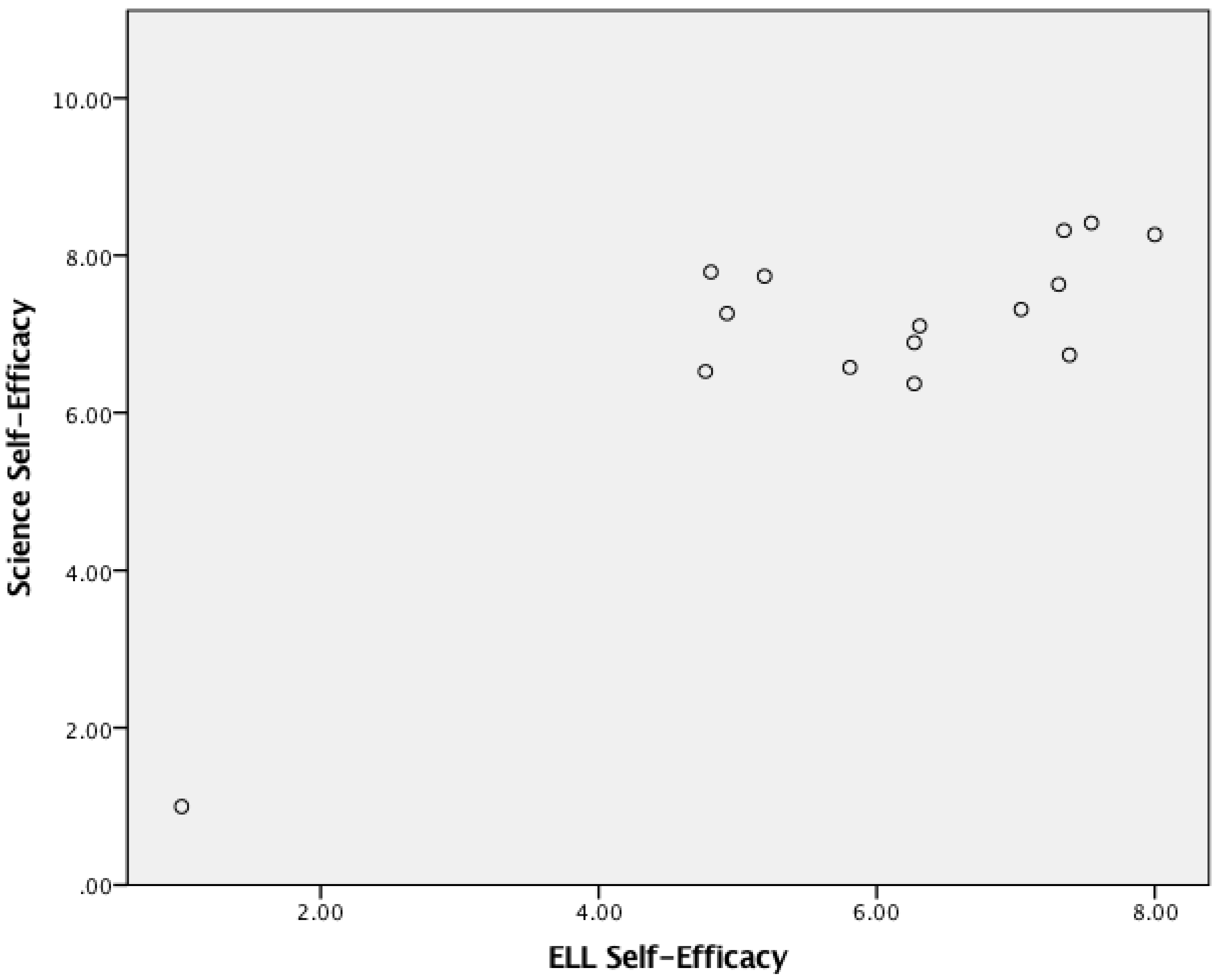
Does the self-efficacy level of 6-12th grade science teachers relate to self-efficacy level of teaching ELL students?

When asked how well they felt their teacher education program prepared them to teach English Language Learners, 5% reported that they were “Very Prepared” (n=1), 15 % reported they were “Adequately Prepared” (n=3), 50% reported they were “Somewhat Prepared” (n=10), and 30% reported that the program “Did not Prepare Me at All” (n=6). When asked: “How often did you have the opportunity to teach/work with English Language Learners (ELL) during your pre-teaching experience, 5 % percent reported “Very Often” (n=1), 10% reported “Often” (n=2), 10% reported “Sometimes” (n= 2), 40% reported “Rarely” (n=8), and 35 % reported “Never” (n=7). Fifty-nine percent reported currently teaching ELL students, and 41% did not currently teach ELL students.

A Pearson correlation was conducted to determine if there was correlation between science self-efficacy and the self-efficacy level of teaching English Language Learners. The Pearson correlation was .828, and the correlation was significant at the 0.01 level (2-tailed). See table below for scatterplot of Pearson correlation of science self-efficacy and ELL self-efficacy.

Table 5

Pearson Correlation of Self-Efficacy of Teaching Science and Self-Efficacy of Teaching ELL Students



The data was disaggregated between participants who teach ELL students and those who do not. The means of their self-efficacy levels were compared between the participants who teach ELL students and those who do not. The mean self-efficacy level for the participants who teach ELL students was 5.8080, and the mean self-efficacy for those who do not teach ELL students was 6.2821. Thus, those who actually currently teach an ELL student reported a lower self-efficacy level for teaching ELL students than the participants who do not currently teach ELL students.

Research Question 3

Is there a relationship between the following variables (gender, ethnicity, years of teaching experience, degree level, grade level taught) and self-efficacy of science and self-efficacy of teaching ELL students by 6-12th grade science teachers?

Tables 6 and 7 below report the results from the one-way ANOVA procedure. The results suggest that the homogeneity of variance was not violated with an *F* (Levene's statistic) of 1.461 and a *p* value of .248 at the alpha level of .05.

Table 7 provides the one-way Analysis of Variance (ANOVA) values for the independent variable, gender, and the dependent variable, self-efficacy teaching science. The resulting *F* value based on 1 and 13 degrees of freedom is .008 (*p*=.930). There was not an effect gender on science self-efficacy with a calculated eta square value of .000.

Table 6

Test of Homogeneity of Variances for Gender with Science Self-Efficacy

SCORE

Levene's Statistic	df1	df2	Sig.
1.461	1	13	.248

Table 7

ANOVA for Gender and Science Self-Efficacy

SCORE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.027	1	.027	.008	.930
Within	43.844	13	3.373		

Groups		
Total	43.871	14

Tables 8 and 9 below report the Levene's statistic and one-way ANOVA values for ethnicity and self-efficacy level of teaching science. Because there was only 1 participant in the African-American group, it was grouped with "Other" for statistical analysis. The Levene's statistic *F* value (1, 13) was 35.727 and a *p* value of < .000 at the alpha level of .05. Homogeneity of variance was violated since the p value was .000. There was not any statistical significance ethnicity and self-efficacy of teaching science, $F(1, 13)=3.517$, and a two-tailed *p* value of .083. The calculated effect size for ethnicity and science self-efficacy was .212.

Table 8

Test of Homogeneity of Variances for Ethnicity

SCORE

Levene's Statistic	df1	df2	Sig.
35.727	1	13	<.000

Table 9

ANOVA for Ethnicity and Science Self-Efficacy

SCORE

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	9.342	1	9.342	3.517	.083
Within Groups	34.529	13	2.656		
Total	43.871	14			

A one-way ANOVA was completed to address the research question to determine if there was an effect of years of teaching experience on science self-efficacy level. Years of teaching experience was the independent variable in the analysis, and science self-efficacy level was the dependent variable. Using an alpha level of .05, Levene's test indicated that the assumption of homogeneity of variance was violated, $F(3,10)$, p=.037. The one-way ANOVA was not statistically significant, $F(4,10)$=.459 and a two-tail p=.765 The calculated effect size for years of teaching experience and science self-efficacy was .155.

Table 10

Test of Homogeneity of Variance for Years of Teaching Experience with Science Self-Efficacy

SCORE

Levene's Statistic	df1	df2	Sig
4.184	3	10	.037

Table 11

ANOVA for Years of Teaching Experience and Science Self-Efficacy

Score

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6.802	4	1.701	.459	.765
Within Groups	37.068	10	3.707		
Total	43.871	14			

A one-way ANOVA was completed to address whether grade level of teaching had an effect on science self-efficacy level. Grade level taught was the independent variable and science self-efficacy level was the dependent variable. Using an alpha level of .05, Levene's test indicated the assumption of homogeneity of variances was violated, $F(1, 13)=12.867$, $p=.003$. The one-way ANOVA was statistically significant, $F(1, 13)=6.373$ and $p=.025$. There was statistical significance with grade level taught and the participants' science self-efficacy level. The calculated effect size for grade level taught and science self-efficacy was .329. The mean for science self-efficacy with 6-8th grade participants was 5.3026, and the mean for 9-12th participants was 7.5207. Thus, high school teachers had a higher self-efficacy level in terms of teaching science.

Table 12

Test of Homogeneity of Variance for Grade Level of Teaching and Science Self-Efficacy

SCORE

Levene's Statistic	df1	df2	Sig.
12.867	1	13	.003

Table 13

ANOVA for Current Grade Level of Teaching and Science Self-Efficacy

SCORE

	Sum of Squares	Df	Mean Square	F value	Sig.
Between Groups	14.431	1	14.431	6.373	.025
Within Groups	29.439	13	2.265		
Total	43.871	14			

A one-way ANOVA was completed to address whether highest degree obtained had an effect on science self-efficacy. Highest degree obtained was the independent variable, and science self-efficacy was the dependent variable. Using an alpha level of .05, Levene's test indicated that the homogeneity of variance was violated, *F* (2,12)=16.523, *p*=.<000). The one-way ANOVA was statistically significant, *F*(2,12)=1.728, and a two-tailed *p*=.219. Thus, highest degree earned did not have an effect on science self-efficacy. The calculated effect size for highest degree obtained and science self-efficacy was .223.

Table 14

Homogeneity of Variance for Highest Degree Obtained and Science Self-Efficacy

SCORE

Levene's Statistic	df1	df2	Sig.
16.523	2	12	<.000

Table 15

ANOVA for Highest Degree Obtained and Science Self-Efficacy

SCORE

	Sum of Squares	Df	Mean Square	F value	Sig.
Between Groups	9.809	2	4.904	1.728	.219
Within Groups	34.062	12	2.839		
Total	43.871	14			

A one-way ANOVA was utilized to address whether gender had an effect on self-efficacy of teaching ELL students. Gender was the independent variable, and self-efficacy of teaching

ELL students was the dependent variable. Using an alpha level of .05, Levene's test indicated that the assumption of homogeneity of variance was not violated, $F(1,13)=1.499$, $p=.243$. The one-way ANOVA was not statistically significant, $F(1, 13)=.133$ and a two-tail $p=.721$. Thus, gender did not have an effect on self-efficacy level of teaching ELL students. The calculated effect size for gender and science self-efficacy was .010.

Table 16

Homogeneity of Variance for Gender and Self-Efficacy of Teaching ELL Students

SCORE

Levene's Statistic	df1	df2	Sig.
1.499	1	13	.243

Table 17

ANOVA for Gender and Self-Efficacy of Teaching ELL Students

SCORE

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.435	1	.435	.133	.721
Within Groups	42.485	13	3.268		
Total	42.920	14			

A one-way ANOVA was completed to address whether ethnicity had an effect on self-efficacy of teaching ELL students. Because of only one African American participant, this group was grouped with "Other" when running the statistical analysis. Ethnicity was the independent variable, and ELL self-efficacy was the dependent variable. Using an alpha level of .05, Levene's test indicated that the assumption of homogeneity of variances was violated, $F(1, 13)=7.229$, $p=.017$. The one-way ANOVA was not statistically significant, $F(1, 12)=3.670$ and a two-tailed $p=.078$. Thus, ethnicity did not have an effect on self-efficacy of teaching ELL students. The calculated effect size for ethnicity and self-efficacy of teaching ELL students was .220.

Table 18

Homogeneity of Variance for Ethnicity and Self-Efficacy of Teaching ELL Students

SCORE

Levene's Statistic	df1	df2	Sig.
7.229	1	13	.017

Table 19

ANOVA for Ethnicity and Self-Efficacy of Teaching ELL Students

SCORE

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	9.449	1	9.449	3.670	.078
Within Groups	33.470	12	2.575		
Total	42.919	13			

A one-way ANOVA was completed to address whether years of teaching experience had an effect on participants' self-efficacy level of teaching ELL students. The independent variable was years of teaching experience, and the dependent variable was self-efficacy level of teaching ELL students. Using an alpha level of .05, Levene's test indicates that the assumption of homogeneity of variances was not violated, $F(3,10)=2.308$, $p=.138$. The one-way ANOVA was not statistically significant, $F(4, 10)=.294$, and a two-tailed $p=.876$. Thus, years of teaching experience did not have an effect on self-efficacy level of teaching ELL students. The calculated effect size for teaching experience and self-efficacy of teaching ELL students was .105.

Table 20

Homogeneity of Variance for Years of Teaching Experience and Self-Efficacy of Teaching ELL Students

SCORE

Levene's Statistic	df1	df2	Sig.
2.308	3	10	.138

Table 21

ANOVA for Years of Teaching Experience and Self-Efficacy of Teaching ELL Students

SCORE

	Sum of Squares	Df	Mean Square	F.	Sig.
Between Groups	4.511	4	1.128	.294	.876
Within Groups	38.408	10	3.841		
Total	42.920	14			

A one-way ANOVA was completed to address whether participants' grade level that they teach has an effect on ELL self-efficacy level. The independent variable was the current grade level the participants were teaching, and the dependent variable was the self-efficacy level of teaching ELL students. Using an alpha level of .05, Levene's test indicated that the assumption of homogeneity of variances was not violated, *F*(1, 13)=3.995, *p*=.067. The one-way ANOVA was not statistically significant, *F*(1,13)=1.427 and a two-tailed *p*=.254. Thus, grade level teaching did not have an effect on self-efficacy of teaching ELL students. The calculated effect size for grade level teaching and self-efficacy of teaching ELL students was .099.

Table 22

Homogeneity of Variance for Grade Level Teaching and Self-Efficacy of Teaching ELL Students

SCORE

Levene's Statistic	df1	df2	Sig.
3.995	1	13	.067

Table 23

ANOVA for Grade Level Teaching and Self-Efficacy of Teaching ELL Students

SCORE

	Sum of Squares	Df	Mean Square	F value	Sig.
Between Groups	4.246	1	4.246	1.427	.254
Within Groups	38.674	13	2.975		
Total	42.920	14			

A one-way ANOVA was completed to address whether highest degree earned by participants had an effect on self-efficacy of teaching ELL students. The independent variable was the highest degree earned by participants, and the dependent variable was self-efficacy of teaching ELL students. Using an alpha level of .05, Levene's test indicated that the assumption of homogeneity of variances was not violated, *F*(1, 13)=1.995, *p*=.067. The one-way ANOVA was not statistically significant, $F(2, 12)=.545$ and a two-tailed $p=.594$. Thus, highest degree earned by participants did not have an effect on self-efficacy level of teaching ELL students. The calculated effect size for highest degree earned and self-efficacy of teaching ELL students was .083

Table 24

Homogeneity of Variance for Highest Degree Earned and Self-Efficacy of Teaching ELL Students

SCORE

Levene;s Statistic	df1	df2	Sig.
3.995	1	13	.067

Table 25

ANOVA for Highest Degree Earned and Self-Efficacy of Teaching ELL Students

SCORE

	Sum of Squares	Df	Mean Square	F value	Sig.
Between Groups	3.572	2	1.786	.545	.594
Within Groups	39.348	12	3.279		
Total	42.920	14			

Research question 4: What type of vocabulary instructional practices are 6-12th grade science teachers using when teaching students?

Table 26

Percent of Teachers Who Use Strategies Teaching Vocabulary

	Always	Very Often	Fairly Often	Sometimes	Almost Never
Concept Maps	21.4	21.4	28.6	21.4	7.1
Students read texts	14.3	50	7.1	14.3	14.3
Write science words with definitions	38.5	15.4	23.1	7.7	15.4
Word Walls	28.6	7.1	21.4	28.6	14.3
Use Diagrams	28.6	42.9	21.4	7.1	0
Provide a list of words prior to teaching unit	42.9	21.4	14.3	7.1	14.3
Complete labs	42.9	28.6	28.6	0	0
Use Demonstrations	42.9	21.4	28.6	7.1	0
Assess students' learning of science vocabulary	21.4	50	28.6	0	0
Allow students to converse with one another	64.3	14.3	7.1	14.3	0
Use Technology	57.1	14.3	21.4	7.1	0
Use Pictures	42.9	35.7	21.4	0	0
Use Science Textbook	21.4	35.7	14.3	7.1	14.3
Encourage Students to Memorize Words with Definitions	14.3	14.3	35.7	21.4	7.1
Use Notebooks	35.7	50	7.1	7.1	0
Use Lectures	14.3	42.9	28.6	14.3	0
Use Projects	21.4	50	21.4	7.1	0
Use Cooperative	46.2	38.5	7.7	7.7	0

Learning					

Table 26 above shows the results of respondents to the percentage of teachers who use the various strategies in their instruction to teach vocabulary. There were 10 people who began the survey that did not answer these questions. A total 15 respondents completed these questions. Only 13 completed the last question regarding the use of cooperative learning. The majority of the respondents all claimed to use these methods with a very few reporting that they almost never use these instructional strategies. A large percentage claimed to use labs and pictures to teach vocabulary with all respondents reporting to use these methods fairly often or more. A large percentage also claimed to assess knowledge of student science vocabulary with everyone claiming to assess fairly often or more.

Summary

This chapter presented results for each of the research questions in the study. Self-efficacy of teaching science was compared to self-efficacy of teaching English Language Learners was compared with a Pearson correlation. One-way ANOVA were used to determine significance of self-efficacy levels among variables that included grade band taught, gender, ethnicity, highest degree obtained, and years of teaching experience. Frequencies of various types of vocabulary strategies in the classroom were also calculated. The next chapter will focus on discussion and elaboration of these results.

Chapter V

Discussion and Implications

The purpose of this study was to investigate 6^{th}-12^{th} grade science teachers ' self-efficacy with teaching science and their self-efficacy level of teaching ELL students. Teachers were from 6^{th} -12^{th} secondary science education classrooms. Results from this study indicated that some participants in the study may not have much experience teaching English Language Learners since 41% of the participants did not currently teach any ELL students. However, the average self-efficacy level for teaching ELL students was 5.995 based on the response scale, which would indicate an average level. The study provided insight on teacher participants' perspectives on their level of preparation based on their teacher education programs. This study also provided teacher participants' self-efficacy levels of teaching science and teaching science to ELL students. The study provided insight as to the type of vocabulary strategies science teachers are using in their classrooms.

The following research questions were under investigation in the study to determine self-efficacy levels of teachers using Bandura's self-efficacy theory (1977):

(1) What are the self-efficacy levels of 6-12^{th} grade science teachers when teaching science?

(2) Does the self-efficacy level of 6-12^{th} grade science teachers relate to self- efficacy level of teaching ELL students?

(3) Is there a relationship between gender, ethnicity, years of experience, degree level, and grade level taught with self-efficacy of science and self-efficacy of teaching ELL students by 6-12th grade science teachers?

(4) What type of vocabulary instructional practices are 6-12th grade science teachers using when teaching students?

Discussion

This research endeavor adds to existing research relative to teaching English Language Learners. There is a need for more research in the area of self-efficacy levels for teaching ELL students. The majority of research on ELL students in the science classroom has investigated pre-service elementary teachers' self-efficacy as opposed to veteran and/or secondary level teachers. Results from Pearson correlation indicated that if teachers had a high self-efficacy level of teaching science, they also had a high self-efficacy level of teaching ELL students. Subsequently, 6th-12th grade science teachers with a high self-efficacy for teaching science were also likely to have a high self-efficacy for teaching ELL students, which adds to the existing literature.

A perceived high self-efficacy level of the participants has the potential to be beneficial to students according to previous research. For example, Bolshakova, Johnson, and Dzerniak (2011) suggest that students' future science achievement and attainment of science-related careers is a result of self-efficacy of their teachers. Additionally, teachers with a high self-efficacy level tend to have classrooms that allow for student choices, the teacher delivers feedback to students, and the teachers have a caring rapport (Hoy & Davis, 2006).

The study also examined the variables of gender, ethnicity, degree level, years of teaching experience, and grade level taught to determine if there was a relationship between self-efficacy levels. More specifically, one-way ANOVAs were conducted to determine the relationship between these variables. According to the findings from this study, the only variable that had statistical significance for science self-efficacy levels was grade level teaching on science self-efficacy with a *p* value of .025. Therefore, according to findings from this study, the grade level can have an effect on self-efficacy level. In addition, gender, highest degree obtained, ethnicity, and years of teaching experience did not have an effect on self-efficacy levels of teaching science or ELL students. These statistical analyses provide additional insight on self-efficacy levels of teaching science and self-efficacy levels of teaching science to ELL students.

This study also supports some of the findings in previous research on 6^{th}-12^{th} science teacher preparation. For example, 5% of the teacher participants reported feeling very prepared and 14% reported that they were adequately prepared. The remaining participants responded that they were not prepared to teach science to English Language Learner students after leaving their teacher education programs. This would indicate that only a few of the participants responded that their teacher preparation programs prepared them for teaching science to ELL students.

According to Arens, Stoker, Barker, Shebby, Wang, Cicchinelli, & Williams (2012), many teachers are not adequately prepared to teach ELL students. These researchers also suggest that in 2002, 41% of teachers reported teaching ELL students, but less than 13% reported receiving professional development to teach these students effectively. There is little information on the number of teachers that receive professional development for teaching ELL students. It is important to note that some of the teacher participants in this study did not currently have ELL students in their classroom. This may have been attributed to the demographics of the school based on school location.

Results from the study suggest that all teachers use some form of science vocabulary instruction. All participants reported using some type of vocabulary instruction and a variety of instructional strategies. This finding would suggest that 6^{th} -12^{th} grade science teachers from this study differentiated instruction to facilitate their students with learning science vocabulary. Shore, Ray, and Gooklasian (2015) suggest that students often lack retention and comprehension of science-related vocabulary. These authors suggest that learning science vocabulary is a first step to learning science. Furthermore, if students do not learn the necessary vocabulary, this could prevent students' understanding of important scientific concepts.

Pearson, Hiebert, and Kamil (2007) assert that vocabulary assessment is often given little attention in the classroom relative to theoretical and experiential forms. Many times the study of vocabulary has been guided by psychometrics, tradition, and ease. Moreover, economy effort of learning as opposed to enhanced conceptualization of meanings, connections to proficiency and comprehension has often occurred (Pearson, Hiebert, & Kamil, 2007).

All teachers reported completing labs from "Often" to "Fairly Often." The types of labs used by participants could not be determined as this was not included in the survey. The participants were asked how often they used labs as a form of instruction to teach vocabulary. However, labs can be considered a form of inquiry, and Husty and Jackson (2008) suggest that ELL students have a deeper understanding of science concepts and better understanding of science-related vocabulary when they have opportunities for inquiry-based activities. Use of inquiry to promote conceptual understanding of science concepts and vocabulary has been supported by Weinburgh, Silva, Smith, and Groulx (2014). Weinburgh, Silva, Smith, and Groulx (2014) integrated an inquiry-based model during two different years in a summer school program with ELL students. Results from their study suggested a trend of growth for ELL students.

Subsequently, the ELL students did develop a more sophisticated understanding of concepts. The ELL students also used more language to communicate the knowledge they learned after implementation of the inquiry-based activities (Weinburgh, Silva, Smith, and Groulx, 2014).

In this study, most of the teacher participants used notebooks for students to learn science vocabulary with 92.8% reporting that they use them. The use of vocabulary notebooks can be an effective form instruction of vocabulary in science according to some studies (Walters and Bozkurt, 2009) .Walters and Bozkurt (2009) conducted a study to determine the effectiveness of vocabulary notebooks among students learning English. Notebooks were incorporated over a four-week period. With the analysis of a one-way ANOVA, results suggested that students had a higher acquisition of vocabulary of target words with the use of vocabulary notebooks (Walters & Bozkurt, 2009).

The majority of the teacher participants in this study also allowed students to converse with one another and use cooperative learning. Only 7.7% of the respondents said that they rarely used cooperative learning in their science classroom, and 14.7% rarely allowed students to converse with another. Use of cooperative learning is consistent with research as an effective strategy with English Language Learners. Hansen (2006) suggests allowing ELL students to work in cooperative groups and use different avenues of communication. For example, the ELL students are allowed to draw pictures instead of words. They are also allowed to use short sentences or phrases in their science journals when communicating. Thus, the majority of the participants allow students to use a strategy that can be effective with ELL students.

According to findings from this study word walls were not commonly used to teach vocabulary with 42.9% of the participants reporting that they rarely use them or do not use them at all. While the majority of the teachers do not use word walls, this strategy can be an effective technique for ELL students. Jackson, Tripp, and Cox (2011) suggest that word walls can be a visual clue for ELL students. Many times students will have exposure to an unorganized list of words on a wall, but a word wall should be a visual scaffold. Word walls can be created to be like semantic maps (Jackson, Tripp, & Cox, 2011). Word walls are also a form of direct instruction for vocabulary instruction (Sibold, 2011). Direct instruction, such as with word walls, allows for ELL students to have specific and definite instructions to learn new definitions (Sibold, 2011).

Implications

Implications for School Systems

Results of the survey from this study suggest different types of vocabulary strategies were used by the 6^{th}-12^{th} grade science teachers. The findings from this study can help administrators target areas for professional development with science teachers teaching science to ELL students. Even though many of the participants had high self-efficacy levels, this could be attributed to social desirability. The validity of the survey could be affected due to social desirability (Lee & Woodliff, 2010). Moreover, based on findings from this study, professional development can promote confidence and self-efficacy levels and be beneficial for teachers of ELL students, especially considering many of the participants did not have preparation for teaching ELL students in their teacher education programs. Duran, Duran, Haney, and Beltyukova (2009) provide an example of professional development enhancing self-efficacy levels. These researchers used a professional development program called Active Science Teaching Encourages Reform (ASTER III) on teachers' self-efficacy and perceptions about inquiry-based science. Results from their study suggested that teacher beliefs were positively impacted by ASTER III.,

Implications for Teacher Education Programs

Sheng, Sheng, and Anderson (2011) suggest that with the growing number of English Language Learners in classrooms, there is a need for implementation of cultural understanding in teacher education programs. Moreover, based on findings from this study, it may be important for teacher education programs to provide more opportunities for pre-service teachers to teach ELL students during their program of study. Additional courses on ELL students in the science classroom may also be necessary considering the predicted increase of ELL students over the next decades. Integrating courses and experiences that provide more pedagogical strategies for teaching ELL students is also essential towards promoting equity in the science classroom.

Curricula also include the knowledge, skills, and dispositions relative to teaching ELL students and opportunities to teach ELL students with support and mentorship from teachers with experience teaching ELLs. Curricula that provide the skills, knowledge, and field experiences with ELL students can shape positive teacher attitudes toward ELL students (Polat, 2010).

Some states have begun to mandate ELL endorsements for pre-service teachers (Jiminez-Silva, Olson, & Hernandez, 2011). This is to help ensure they are prepared to meet the needs of all of their students. The endorsement is designed to help teachers feel more confident with teaching ELL students and promote instructional practices that engage all students. More specifically, the endorsement courses should cover more than the required content for the course (Jiminez-Silva, Olson, & Hernandez, 2011).

Future Research

Results from this study suggest that if participants had a high self-efficacy for teaching science, they also had a high self-efficacy for teaching ELL students. Many reported that their teacher education programs did not prepare them for the demands of teaching ELL students.

Additionally, all teachers differentiated instruction for students to learn science vocabulary. As mentioned earlier, the small sample size was a limitation for this study. Future research could include teachers from additional school districts to enhance sample size. Further research could also include a mixed method design with both qualitative and quantitative data collection techniques. Moreover, observations and interviews of teacher participants can provide additional insight into teacher self-efficacy levels in teaching science to ELL students. Lastly, a longitudinal study of 6th-12th grade science teachers could be provide insight as to whether or not teacher self-efficacy levels increase over time and after sustained professional development.

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Appendix A

E-MAIL INVITATION FOR ON-LINE SURVEY

Dear ______________________,

I am a graduate student in the Department of Curriculum and Teaching at Auburn University. I would like to invite science teachers in grades 6-12 to participate in my research study to determine self-efficacy levels of teaching English Language Learners and determine types of vocabulary instructional strategies used with English Language Learners. Anyone who is currently a teacher that teaches science in grades 6-12 is eligible to participate. If you have teachers in your district that fit this description, please feel free to forward this email to them with the information letter that contains a link to the survey.

Participants will be asked to complete a survey that may take 15 minutes in Qualtrics.

There will be no compensation for teachers to complete the survey. Benefits from the study will include knowledge about teachers' self-efficacy with teaching English Language Learners and what types of vocabulary strategies are used in the classroom.

Names will not be used in the study. By clicking on the link to the survey, answers will be compiled in Qualtrics without any identifying information. Names will not be asked in the survey nor will where a person is currently employed. Decisions of whether to forward or take the survey will have not have an effect on anyone's relations with Auburn University.

If you would like to know more information about this study, please feel free to email me at lmt0010@auburn.edu. If you decide to forward this to potential participants, they may participate after reading the information letter. The letter will contain a link in the letter for the survey.

If you have any questions, please contact me at lmt0010@auburn.edu or my advisor, Dr. Russell, at russeml@auburn.edu.

Thank you for your consideration,

Laura M. Crowe

Appendix B

LETTERHEAD

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)

INFORMATION LETTER

for a Research Study entitled

" Self-Efficacy of Science Teachers and English Language Learners"

You are invited to participate in a research study to the self-efficacy of science teachers, their self-efficacy of teaching English Language Learners, and determine what types of vocabulary strategies are used to teach science vocabulary. The study is being conducted by Laura Michelle Crowe, graduate student, under the direction of Dr. Melody Russell, Associate Professor in the Auburn University Department of Curriculum and Teaching. You are invited to participate because you are a science teacher in Alabama and are age 19 or older.

What will be involved if you participate? Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a survey. Your total time commitment will be approximately 15-30 minutes.

Are there any risks or discomforts? The risks associated with participating in this study are revealing your name. To minimize these risks, we will not ask your name or the school you work at. A discomfort is the time to take the survey, and your email could be identifiable information in the survey. Your email address, however, will be password protected.

Are there any benefits to yourself or others?

If you decide to complete the survey, you will have the option to enter your email address to have a chance to win a ten dollar gift card. For every ten surveys completed, your email address will be entered into a drawing for a ten dollar gift card.You do not have to enter your email if you do not wish to. The only purpose for the email address is for the gift card giveaway.

If you participate in this study, you can expect to for the results to be presented in my dissertation and defense of dissertation. We/I cannot promise you that you will receive any or all of the benefits described. Benefits to others may include knowledge about self-efficacy levels of science teachers, self-efficacy of teaching English Language Learners, and knowledge about current strategies used by teachers to teach science vocabulary.

Will you receive compensation for participating? There will be an open-ended question at the end of the survey for you to enter your email address. For every ten surveys completed by different individuals, the email addresses will be entered into a drawing for one person to have a chance to win a ten dollar gift card.

Are there any costs? There are no costs to this study.

If you change your mind about participating, you can withdraw at any time by closing out the survey. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Curriculum and Teaching or your current place of employment.

Any data obtained in connection with this study will remain confidential. We will protect your privacy and the data you provide by locking up the information with a password protection. No identifiable information, however, will be discussed in the results. Information collected through your participation may be used to complete my dissertation and doctoral program degree.

If you have questions about this study, please contact Laura M. Crowe at lmt0010@auburn.edu or Dr. Russell at russeml@auburn.edu.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334) 844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE LINK BELOW.

YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

___________________________ _________________________

Laura M. Crowe Date

The Auburn University Institutional Review Board has approved this document for use from 10/12/15, 2015 to 10/16/16. Protocol #14-455 EP 1410.

LINK TO SURVEY

Appendix C

Part I

Thank you in advance for completing the following survey. Your answers will help build knowledge regarding self-perceived capabilities of teaching science and teaching science to English Language Learners (ELL). The survey will also provide information about what current instructional strategies are currently being employed to teach science vocabulary. Your answers will remain anonymous and confidential. Any information from the survey will be used for a dissertation. The survey should take about 15-30 minutes to complete.

To better help you answer the questions, and English Language Learner is a student who meets the criteria of being limited English proficient (LEP) (Uro & Barrio, 2013) A student who is considered to be LEP is an individual who is:

(A) who is aged 3 through 21;
(B) who is enrolled or preparing to enroll in an elementary school or secondary school;
(C) (i) who was not born in the United States or whose native language is a language other than English;
(ii) (I) who is a Native American or Alaska Native, or a native resident of the outlying areas; AND
(II) who comes from an environment where a language other than English has had a significant impact on the individual's level of English language proficiency; OR
(iii) who is migratory, whose native language is a language other than English, and who comes from an environment where a language other than English is dominant; AND
(D) whose difficulties in speaking, reading, writing, or understanding the English language may be sufficient to deny the individual —
(i) the ability to meet the State's proficient level of achievement on State assessments described in section 1111(b)(3);
(ii) the ability to successfully achieve in classrooms where the language of instruction is English; OR unity to participate fully in society.

Source: No Child Left Behind Act, P.L. 107-20110, Title IX, Part A, Sec. 9101 (25) (Uro & Barrio, 2013, p. 17).

If you have any questions or concerns, please contact Laura Crowe at lmt0010@auburn.edu.

1. What is your gender?

◯ Female

◯ Male

2. What is your ethnicity?

☐ African American

☐ Caucasian

☐ Latino

Other (please specify)

3. How many years of teaching experience do you have?

- ◯ 0-5
- ◯ 6-10
- ◯ 11-15
- ◯ 16-20
- ◯ 21-25
- ◯ 26 years or more

4. What grade level do you teach?

- ◯ 6th-8th
- ◯ 9th-12th

5. What is the highest degree level you attained?

- ◯ Bachelor's degree
- ◯ Master's degree
- ◯ Education Specialist degree
- ◯ Doctoral degree
- ◯ Other

6. Please list the institution you recieved your initial teaching certification.

7. Do you currently teach students who meet the critieria of being an English Language Learner?

- ◯ Yes
- ◯ No

8. What content courses do you currently teach? Please mark all that apply.

- ☐ Science
- ☐ Social Studies
- ☐ Language Arts
- ☐ Math

Other (please specify)

9. What science content course(s) do you currently teach? Please mark all that apply.

- [ ] Earth Science
- [ ] Physical Science
- [ ] Life Science
- [ ] Biology
- [ ] Chemistry
- [ ] Physics
- [ ] Anatomy
- [ ] Botany
- [ ] Zoology

Other (please specify)

10. What science courses are you currently certified to teach? Please check all that apply.

- [ ] Earth Science
- [ ] Physical Science
- [ ] Life Science
- [ ] Biology
- [ ] Chemistry
- [ ] Physics
- [ ] Anatomy
- [ ] Botany
- [ ] Zoology

Other (please specify)

11. How often did you have the opportunity to teach/work with English Language Learners (ELL) during your pre-teaching experience?

	Very Often	Often	Sometimes	Rarely	Never
Very Often	◯	◯	◯	◯	◯
Often	◯	◯	◯	◯	◯
Sometimes	◯	◯	◯	◯	◯
Rarely	◯	◯	◯	◯	◯
Never	◯	◯	◯	◯	◯

12. Please rate how well you felt your teacher education program prepared you to teach English Language Learners (ELL).

	Very Prepared	Adequately Prepared	Somewhat Prepared	Did Not Prepare Me At All
Very Prepared	◯	◯	◯	◯
Adequately Prepared	◯	◯	◯	◯
Somewhat Prepared	◯	◯	◯	◯
Did Not Prepare Me At All	◯	◯	◯	◯

Part II

13. Please rate yourself accordingly on the scale with regards to your expected capabilities on what you can and cannot do as a teacher. There are not any right or wrong answers. Please answer honestly and candidly. Please use the following scale:
0-10 Cannot Do
11-20
21-30
31-40
41-50
51-60 Moderately Certain I Can Do
61-70
71-80
81-90
91-100 Highly Certain I Can Do

	Cannot Do 0-10	11-20	21-30	31-40	41-50	Moderately Certain I Can Do 51-60	61-70	71-80	81-90	Highly Certain I Can Do 91-100
When a student needs help in science, I can exert extra effort as a teacher.	○	○	○	○	○	○	○	○	○	○
I can find better ways to teach science.	○	○	○	○	○	○	○	○	○	○
When I try very hard, I can teach science as well as other subjects.	○	○	○	○	○	○	○	○	○	○
When the science grades of students improve, it is because I have found a more effective teaching approach.	○	○	○	○	○	○	○	○	○	○
I can teach science concepts very effectively.	○	○	○	○	○	○	○	○	○	○
I can overcome students' inadequacies	○	○	○	○	○	○	○	○	○	○

in science by effective teaching.										
I can effectively monitor science experiments.	○	○	○	○	○	○	○	○	○	○
Low achievement in science cannot be attributed to my teaching effectiveness.	○	○	○	○	○	○	○	○	○	○
If a student who is generally low-achieving in science progresses, it is likely due to that I can give extra attention to the student.	○	○	○	○	○	○	○	○	○	○
I understand science concepts well enough to teach them to my students.	○	○	○	○	○	○	○	○	○	○
When I increase effort with my teaching, there is often little change in some students' science achievement.	○	○	○	○	○	○	○	○	○	○
I can have a positive impact on a student's achievement.	○	○	○	○	○	○	○	○	○	○
If a parent comments that their child is showing more interest in science, it is likely because I can perform my duties as	○	○	○	○	○	○	○	○	○	○

their teacher.										
I often cannot explain to students why science experiments do not work.	○	○	○	○	○	○	○	○	○	○
I can usually answer students' questions about the content I teach.	○	○	○	○	○	○	○	○	○	○
I do not have the necessary skills to teach science.	○	○	○	○	○	○	○	○	○	○
When a student has difficulty understanding a science concept, I can help the student understand it better.	○	○	○	○	○	○	○	○	○	○
I can constantly seek ways to improve teaching strategies in my class.	○	○	○	○	○	○	○	○	○	○
I cannot get students motivated in science.	○	○	○	○	○	○	○	○	○	○

Part III

14. Please rate yourself accordingly on the scale with regards to your expected capabilities on what you can and cannot do as a teacher. There are not any right or wrong answers. Please answer honestly and candidly. Please use the following scale:

0-10 Cannot Do

11-20

21-30

31-40

41-50

51-60 Moderately Certain I Can Do

61-70

71-80

81-90

91-100 Highly Certain I Can Do

	Cannot Do 0-10	11-20	21-30	31-40	41-50	Moderately Certain I Can Do 51-60	61-70	71-80	81-90	Highly Certain I can Do 91-100
When an English-Language Learner (ELL) student performs better in science, it is because I can give more attention to this student.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I can find better ways to teach science to my ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
When I try very hard, I can effectively teach science to my ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
When the science grade of an ELL student does not improve, I can find a more effective approach to teach the student.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I can effectively teach science concepts to ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
If ELL students are underachieving in science, I can improve my teaching strategies.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I can effectively teach science to ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I can overcome an ELL student's inadequacies in science by effective teaching.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I cannot effectively monitor sciene experiments with ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Low aachievement in science with an ELL student cannot be attributed to my teaching effectiveness.	○	○	○	○	○	○	○	○	○	○
If a student who is generally low-achieving in science progresses, it is likely due to that I cannot give attention to the student.	○	○	○	○	○	○	○	○	○	○
I understand science concepts well enough to teach them to my ELL students.	○	○	○	○	○	○	○	○	○	○
When I increase effort with my teaching, I cannot have an impact on ELL students' science achievement.	○	○	○	○	○	○	○	○	○	○
I can have a positive impact on an ELL student's science achievement.	○	○	○	○	○	○	○	○	○	○
An ELL student's achievement is because I can effectively teach.	○	○	○	○	○	○	○	○	○	○
If a parent comments that their ELL child is showing more interest in science, it is likely because I can perform my duties as a teacher.	○	○	○	○	○	○	○	○	○	○
I often cannot explain to ELL students why science experiments do not work.	○	○	○	○	○	○	○	○	○	○
I can usually answer ELL students' questions about the content I teach.	○	○	○	○	○	○	○	○	○	○
I cannot learn the necessary skills to teach science to an ELL student.	○	○	○	○	○	○	○	○	○	○
When an ELL student has difficulty understanding a science concept, I can help the student understand it better.	○	○	○	○	○	○	○	○	○	○
I can constantly seek ways to improve teaching strategies for ELL students in my class.	○	○	○	○	○	○	○	○	○	○
I cannot get ELL students motivated in science	○	○	○	○	○	○	○	○	○	○
I can get more professional development to help meet the needs of my ELL students.	○	○	○	○	○	○	○	○	○	○
I can get more professional	○	○	○	○	○	○	○	○	○	○

development to help meet the needs of my ELL students.										
I often seek ways to effectively teach ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
I can communicate with my ELL students.	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

15. Please indicate how often you use the following vocabulary instructional strategies in your science class to teach English Language Learners (ELL). Please use the following scale:

1 Always
2 Very Often
3 Fairly Often
4 Sometimes
5 Almost Never
6 Never

	Always	Very Often	Fairly Often	Sometimes	Almost Never	Never
I use concept maps to teach science vocabulary.	◯	◯	◯	◯	◯	◯
I have students read texts to learn science vocabulary.	◯	◯	◯	◯	◯	◯
I have students write science words with their corresponding definitions.	◯	◯	◯	◯	◯	◯
I use word walls to teach students science vocabulary.	◯	◯	◯	◯	◯	◯
I use diagrams to teach science vocabulary to students.	◯	◯	◯	◯	◯	◯
I provide students with a list of an upcoming units' vocabulary words prior to each unit I teach.	◯	◯	◯	◯	◯	◯
Students complete labs in my class to learn science vocabulary.	◯	◯	◯	◯	◯	◯
I use demonstrations to help teach science vocabulary.	◯	◯	◯	◯	◯	◯
I use inquiry methods to teach science vocabulary.	◯	◯	◯	◯	◯	◯
I assess students' learning of science vocabulary.	◯	◯	◯	◯	◯	◯
I allow students to converse with one another to learn	◯	◯	◯	◯	◯	◯

science vocabulary.						
I use technology in the classroom to help students learn science vocabulary.	○	○	○	○	○	○
I use pictures to help students learn science vocabulary.	○	○	○	○	○	○
I encourage students to use their science textbook to learn science vocabulary.	○	○	○	○	○	○
I encourage students to memorize science vocabulary words with their respective definitions.	○	○	○	○	○	○
I encourage students to use notebooks to learn science vocabulary.	○	○	○	○	○	○
I use lectures to present science vocabulary words to students.	○	○	○	○	○	○
I incorporate projects for students to complete to learn science vocabulary.	○	○	○	○	○	○
I promote cooperative learning in my classroom to help students learn science vocabulary.	○	○	○	○	○	○

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