ALIGNING NEXT GENERATION SCIENCE STANDARDS WITH SCIENCE INSTRUCTION FOR ENGLISH LANGUAGE LEARNERS

An Undergraduate Research Scholars Thesis

by

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Submitted to Honors and Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as an

UNDERGRADUATE RESEARCH SCHOLAR

Approved by
Research Advisor: Dr. Fuhui Tong

May 2015

Major: Interdisciplinary Studies

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ABSTRACT

Aligning Next Generation Science Standards with Science Instruction for English Language Learners (May 2015)

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Science is the lowest performed subject in all content areas nationally and in the state. Even more severe is that English language learners (ELLs) perform the lowest among all groups. Science concepts are introduced as early as kindergarten. In Texas students begin to be tested in science at grade 5 which is the grade this research will examine. When reviewing the state standardized assessment in science (i.e., STAAR) test scores for grade 5, compared to all the other core subjects, science is the only subject that has not had a change in test scores since the 2011-2012 academic school year. More specifically, the passing rate for last year's science STAAR test was 73% and this number only decreases when reviewing upper grades test scores such as 8th grade whose passing rate was 70% (Texas Education Agency [TEA], 2011). Furthermore, studies conducted show that there is a significant gap in the science test scores of ELLs and non-ELLs where ELL students score lower on multiple choice exams (Settlage, Madsen, & Rustad, 2005). Due to the decline in science achievement, the Next Generation Science Standards were created. These science standards that have been developed are rich in content and practice and provide all students an internationally benchmarked science education. The purpose of this study was to conduct a case study so as to gain better understanding on how to incorporate NGSS, state curriculum, and ELP into science teaching to ensure ELLs will succeed in science.

DEDICATION

For my loving parents; whose endless support and hard work has allowed me to achieve many of my goals and aspirations. Thank you for all that you do; your hard work does not go unnoticed and I owe my success to the both of you. I wouldn't be where I am today without the guidance of God who has provided me with opportunities I never thought imaginable. He is at the center of all that I do and I could never thank Him enough.

ACKNOWLEDGEMENTS

I would like to thank Dr. Tong who was a constant support throughout this research. The production of this thesis would not have been possible without all of her efforts. I have learned an abundant amount of information and have a greater appreciation for research. I would also like to extend my gratitude to the bilingual department of Texas A&M for introducing me to the research program and providing me such great information.

CHAPTER I

INTRODUCTION

The Population of English Language Learners and Science Instruction

Science is a subject that continues to shape our understanding of what surrounds us. Through experimentation and observation we have learned an extraordinarily amount of information which attributes to the creation of remarkable inventions such as medicine and technology to name a few. While science continues to transform our understanding of the world, it is a subject that students continue to find challenging to comprehend. Science is a language that includes not only specialized literacy components and skills, such as academic vocabulary and scientific language (Fang, 2005; Gee, 2005; Norris & Phillips, 2003; Wellington & Osborne, 2001), but also dispositions, behaviors, critical language arts skills, higher order thinking, and metalinguistic knowledge needed to understand scientific concepts (Merino & Scarcella, 2005). Unfortunately, science is the lowest performed subject in all content areas, nationally and in the state. Even more severe is that English language learners (ELLs) perform the lowest among all groups (National Center for Education Statistics [NCES], 2014). English-language learners, or ELLs, are students who are unable to communicate fluently or learn effectively in English, who often come from non-English-speaking homes and backgrounds, and who typically require specialized or modified instruction in both the English language and in their academic courses (Abbott, 2014). The first language of these students is not English but they are in the process of learning English. ELL students typically come from immigrant families who speak a language that isn't English. Over the past 3 decades, the population of ELLs has steadily grown in the

United States, with an increase from 4.7 to 11.2 million between 1980 and 2009 (National Center for Education Statistics [NCES], 2011a).ELLs are not only the fastest-growing segment of the school-age population in the United States, but they are also a tremendously diverse group representing numerous languages, cultures, ethnicities, nationalities, and socioeconomic backgrounds (Abbott, 2014). The transition from non-English instruction to English instruction is a diligent process for both the student and educator but numerous students are able to successfully master English in all content areas.

The Implications of the Next Generation Standards in Science Instruction

However, there seems to be a significant underachievement of ELL students in science and reading. Studies conducted show that there is a significant gap in the science test scores of ELLs and non-ELLs where ELL students score lower on multiple choice exams (Settlage, Madsen, & Rustad, 2005). Educators are becoming increasingly aware of the underachievement in science of all students including ELLs which is why a new approach to science has been fabricated. The Next Generation Science Standards (NGSS, 2013) were created as a result of the current science education system that has failed to provide sufficient stimulation for students. Through NGSS New K–12 science standards have been developed that are rich in content and practice, arranged in a coherent manner across disciplines and grades to provide all students an internationally benchmarked science education. The NGSS (2013) also seeks to prompt an interest in STEM (science, technology, engineering, and mathematics) majors to students since these fields continue to have shortages in being selected as a career. Many states have already adopted the NGSS but that does not include Texas, however, they may eventually be implemented. The NGSS emphasize three dimensions that are needed so students can experience a high quality science education which are practices, crosscutting concepts, and disciplinary core ideas. The

integration of these three dimensions provides students with a context for the content of science, how science knowledge is acquired and understood, and how the sciences are connected through concepts that have universal meaning across the disciplines (nextgenscience.org).

Analyzing the Next Generation Science Standards for ELL Instruction

The NGSS also provides a solid plan to increase student's better understanding of science but in order for ELL students to succeed in this program their instructions need to be modified to meet their linguistic needs. The purpose of my study is to conduct a case study so as to gain better understanding on how to incorporate NGSS, state curriculum, and ELP into science teaching to ensure ELLs will succeed in science. The NGSS not only needs to align with all of the students Texas Essential's Knowledge and Skills (TEKS) but for ELLs the English Language Proficiency (ELP) standards must also work cohesively with the NGSS. The English Language Proficiency (ELP) standards focus on the student's progression in how the English language is being applied to content from the curriculum. Educators may find this challenging to do since they are taking three components into account which are the NGSS, TEKS and ELP standards when it comes to creating lesson's for ELLs. The NGSS sets the standards for science but it is not a curriculum so for ELLs this means that educators are given the opportunity to form instruction that fulfills both the students culturally and linguistic needs as long as the standards are met. For example, the new conceptual framework for the NGSS promotes the use of science inquiry in science teaching and learning as scientific thinking and discourse are developed. In urban schools, including those classroom of diverse students and those who are poor, the use of science inquiry in the classroom has been demonstrated to be successful (Tong, Irby, Lara-Alecio, Guerrero, Fan & Huerta 2014).

The Effects of Academic Language and Literacy in ELLs' Science Instruction

Science is complex in its language and content so academic language and literacy cannot be negated in this subject. However, ELLs greatly benefit from the application of these elements because it provides them the opportunity to continue to develop their English proficiency in a different context. The language of science students are required to learn mainly adheres to science, so the vocabulary used are words they do not encounter nor use on a regular basis. Language functions (e.g., describing, hypothesizing, explaining, predicting, and reflecting) develop simultaneously with science inquiry and process skills (e.g., observing, describing, explaining, predicting, estimating, representing, inferring) (Casteel & Isom, 1994). Science requires these higher order thinking skills but it isn't sufficient for students to know how to apply these skills, they must also be able to present this information. Unfortunately, there is a lack of credible, replicable research on effective instructional programs in science or mathematics for various diverse student populations (Lee & Luykx, 2004). With that in mind ELL students are at a greater disadvantage since they are still learning the fundamental principles of the English language.

Reading in Science Instruction

Another component that is closely associated and affects students' performance in science is reading. Maerten-Rivera et al. (2010), who examined student and school predictors of science achievement among 198 schools in a large urban district with a high concentration of linguistic and cultural diversity confirmed that reading is critical to science learning. In addition, similar findings were reported by Tong, Irby, Lara-Alecio, where reading was found to be a statistically significant predictor that accounted for about 25% of the student-level variation in science

achievement (Tong, Irby, Lara-Alecio, Guerrero, Fan, & Huerta 2014). If students are not able to effectively read and comprehend text from science then their ability to excel in science will not be as probable. Success in reading is especially critical for ELLs. The recently released National Assessment of Educational Progress (NAEP) data indicate that at Grade 8.26% of ELLs achieved at or above basic level in reading, compared to 78% of non-ELLs (NCES, 2014. A study conducted examined the impact of a 12week science-based unit on the reading achievement of low-SES, fourth-grade students of color; the intervention group received lessons that integrated science-related informational texts with reading and writing activities and demonstrated significantly higher performance than the nonintervention group. This study is an example of the benefits to student reading achievement when using explicit reading instruction with the infused content area of science. (Tong, Irby, LaraAlecio, Guerrero, Fan & Huerta, 2004). With the NGSS slowly becoming the expectation for students nationwide it is important for educators to begin to examine these standards and note how ELL students will be affected by this innovation. For the past decades, an ideal method of instruction for ELLs in science that produces positive results has not been created until recently.

Effective Science Instruction for ELLs

Research has suggested that, instructional interventions should build on effective first language science research but also take into account the language and cultural backgrounds of ELLs (August, 2009). In a recent study, found that approximately 88% of key science words selected for instruction were cognates; about half of the words were high-frequency words in Spanish, making them more likely to be known by Spanish speakers even if they had not had high levels of schooling in their first language (Bravo, Hiebert, & Pearson 2007). Another study conducted by Matthews and Smith found higher outcome scores and more positive attitudes toward science

when Native American students in Bureau of Indian Affairs schools used culturally relevant curriculum materials (compared with materials not so modified) (Lynch, Kuipers, Pyke, & Szesze 2004). Acknowledging ELL students cultural backgrounds gives them a sense of comfort where they do not feel alienated due to the language barrier. ELL students should not be given the same instruction as there English speaking peers foremost due to their dissimilar language. The terms used in science in itself can be difficult for English speaking students to understand so with the same rigor of the curriculum, ELLs should be taught in a different way, a way that is more conductive for ELLs to succeed in science.

Correlation between Teacher Preparedness and ELLs Success

Through extensive research and studies conducted, educators are becoming well aware of the factors that affect ELLs' advancement in science and the gap between effective and poor instruction is slowly bridging. Effective instruction in science for ELL students begins with the teacher. According to the National Center for Educational Linguistics [NCES] (1999b), most mainstream teachers believe that they are not adequately prepared to meet the needs of ELLs in academically demanding subjects, such as science and literacy. Teachers need to be fully qualified and need professional development opportunities in teaching science to meet the culturally and linguistic needs of ELLs. Students whose science teachers received professional development in laboratory skills were 44% ahead of those whose teachers lacked such training (Lynch, Kuipers, Pyke & Szesze, 2004). To provide effective instruction, teachers need opportunities to develop their own deep and complex understandings of science concepts and recognize how student's misconceptions cause learning difficulties (Lee, at, 2008). Having a qualified teacher is an essential component for the academic achievement of these students but

the instruction that the teacher delivers is just as important. Research on science instruction with ELL students focuses on hands-on, inquiry-based science instruction to promote science learning and English proficiency simultaneously (Lee et al,, 2008). With the NGSS in close proximity it is urgent for educators teaching ELLs to seek professional development in how to integrate these standards into the classrooms.

CHAPTER II

METHODS

Case Study

For this study I examined a National Science Foundation (NSF)-funded project titled, Middle School Science for English language learners and Economically Disadvantaged Students (MSSELL) which targets 5th grade ELLs. The purpose of project MSSELL is to provide a longitudinal experimental/quasi- experimental design in which the language/literacy is infused into science content standards (Lee & Luykx, 2006; Merino & Scarcella, 2005; Minicucci, 1996). Project MSSELL brought abrupt changes that primarily focused on the professional development of the teachers who were teaching science to ELL students and the English literacy integration that allowed students to better understand science through writing.

Literacy-Integration in Project MSSELL

The English literacy integration consisted of an 85-minute daily science instruction, usually began with Daily Oral and Written Language in Science (DOWLS, approximately 10 minutes), a warm-up activity in which students were presented with a science-related prompt or scenario, given individual think time, recorded written responses, and then discussed responses with a student partner. (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012). By being given the daily opportunity to practice their academic language students simultaneously strengthened their science and reading comprehension. Different methods were implemented to help reinforce the use of English literacy integration such as. Content Area Reading in Science for English Literacy and Language Acquisition (CRISELLA), which focused on vocabulary

development and extension through science-related expository text to improve students' understanding of science concepts and Written and Academic oral language Vocabulary development in English in Science (WAVES), in which individual science notebooks were used to help students process science content through written academic science vocabulary (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012).

Professional Development

For the professional development component bi-weekly meetings training workshops were offered to teachers by the research providers. During the trainings teachers (a) thoroughly examined and practiced forthcoming lessons and materials, (b) talked over science concepts and clarified their misunderstandings, (c) analyzed the learning of students, (d) evaluated their approach in teaching for the intervention, (e) facilitated experiments and inquiry activities, and targeted areas that students may find challenging, and (f) were prompted on the following ESL strategies that were incorporated into the researcher-developed lessons: questioning strategies, language scaffolding, visual scaffolding, manipulatives and realia, advanced organizers, cooperative grouping, content connections, and technology integration. (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012). The scripted lesson plans were tightly aligned to state science standards, national science standards, and English language proficiency standards with leveled questions that included cognitive verbs (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012).

Overall Project MSSLLE had a positive impact on students' performance in both science and reading thus resulting in an increase in exam results such as the benchmark test, where a

considerably larger percentage of treatment students performed above the state passing standards with a thorough understanding of the TEKS in 4 out of 5 benchmark tests (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012).

Analysis

A content analysis and qualitative research was intended for this study as I thoroughly investigated the possibility of there being discrepancies between the NGSS and TEKS for 5th grade. While Project MSSLLE does align with the state science standards, national science standards and ELP standards, it is important to note that Project MSSLLE must also align with the NGSS. By discovering the correlation between the NGSS and the science TEKS for fifth grade I was able to examine how this new approach to science will have a significant impact on project MSSELL. Firstly, I analyzed the NGSS in its entity meaning I looked at what the performance expectations are for grade 5 and its primary focus. The performance expectations, ranging from elementary to high school, include an overview of what students should demonstrate understanding in along with the different science topics the NGSS covers for each grade level. I was able to obtain this information through the NGSS main public website. Although ELL students are not proficient in the English language they are still required to take state and national standardized exams such as the STAR test in all subjects. These exams derive from the TEKS which is the reason this component was also closely reviewed. Since the TEKS are the foundation of the school's curriculum, it is essential that we review the science content ELLs are being introduced to and the best manner this material can be taught to maximize their learning. The 5^{th} grade science TEKS can be found in the Texas Education Agency public website.

Major components

The ELP standards were also assessed during these studies to view how those standards correlate with the NGSS and the TEKS. We know that the ELP standards align with Project MSSLLE so it is important to know what those standards look like and in reviewing the ELP standards I was able to see why Project MSSLLE produced positive results. Through existing materials from Project MSSELL lesson plans I was able to determine how compatible NGSS is going to be with the ELP standards and ultimately Project MSSELL. In regards to ELLs, if the NGSS and TEKS are not closely related to their ELP standards then that can continue to gravely impact their academic performance in science. In addition to the Project MSSELL lesson plans I also examined lessons developed from a literacy-integrated science intervention that too proved to be successful. My focus for these lesson plans was to acquire information that reveals how the integration of the NGSS could be made possible from lessons that have already been implemented. Understanding how these lesson plans were created also allowed me to view how the TEKS played a role in the creation of the lessons which we know is a crucial basis since students are tested on these skills. The NGSS, TEKS, and ELP standards are all vital elements that need to work cohesively and have an equal important role in ELLs' academic learning which is why all three had to be thoroughly reviewed because these are the standards and skills ELL students are being introduced to.

CHAPTER III

RESULTS

Project MSSLLE

The goal of Project MSSLLE is to improve the science achievement and the academic English language proficiency of middle school Spanish-speaking English language learners. The data I observed and evaluated contained lesson plans for one particular week, from Monday through Friday, for a low ethnic minority 5th grade classrooms. Prior to the implementation of this program, the teachers at this urban school district in Southeast Texas received extensive training and preparation. This was exhausted because Project MSSLLE is not only a literacy-embedded science intervention but it is also an ideal reflection of the incorporation of the NGSS. The curriculum was tightly aligned to the state science standards, national science standards (based on the 1996 standards as the New Generation National Science Standards were not developed at the time of the implementation of this study), and English language proficiency standards (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012). Data from Project MSSLLE suggest that this program was effective because of the literacy intervention that was a part of science instruction and more so if this integration was established in the students previous grades before reaching 5th grade. With this in mind, it is important to note the emphasis the NGSS places on making science education more closely resemble the way scientist work and think and in order for thoughts to effectively generate literacy support needs to be there.

Lesson Plans

The unit learned for that week was Mixtures and Solutions. The most vital piece of information that the lesson plan rubric details is the science objectives, reading objectives, ESL strategies, ELPs, TEKS and target vocabulary that are integrated into the lessons. We know that in higher grades, particularly at the intermediate level, the focus of instruction should shift to science, which is inclusive of English-reading literacy strategies. (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012) All of these factors are essential to the development and learning of science instruction for ELL and they each play an important role. The lesson plan for the week is outstandingly 11 pages long and it meticulously details everything the teacher will be doing for each day. This information ranges from the materials that will be used to rubrics, PowerPoint presentations and the time frame for which the class is given to work on a designated activity. After the objectives the next piece of information you will come across is a list of materials that will be used each day and for what activity. Some of these materials will be used for a learning cycle heavily used in ELL instruction known as the 5-E engage, explore, explain, evaluate, and elaborate model. However, all of the components from the model are not used so for example for day 1 the lesson utilizes engage, explore and explain which are listed. Each day, regardless of the lesson, begins with engage which is important because science instruction should capitalize students' interest in the subject in connection with the natural world. (Lara-Alecio, Tong, Irby, Guerrero, Huerta & Fan 2012).

Another component that the lesson plan provides is how the teachers can provide feedback. "Restating or confirming the correct response, scaffold by asking a question that may lead them to the answer and monitoring writing activities and suggest correction of grammatical

errors" are just a few areas teachers can help facilitate a better understanding to students. The performance expectations from the NGSS for fifth grade students in regards to this lesson is that students develop an understanding of the idea that regardless of the type of change that matter undergoes, the total weight of matter is conserved. Students determine whether the mixing of two or more substances results in new substances (nextgenscience.org). The lesson of Mixture and Solutions is listed under the NGSS unit Matters and Its interactions and the lessons I closely entailed are from day 1, day 3 and day 5.

Lesson Plan: Day 1

Day 1 (Monday) – The student will demonstrate that physical properties stay the same in mixtures using an investigation. The duration of this lesson was to be 76 minutes long and it started with a Daily Oral and Written Language in Science (DOWLS) activity. This lasted approximately 7-10 minutes long in which students were presented with a science-related prompt and asked to think, record written responses, and discuss with a student partner (Tong, Irby, Lara-Alecio, Guerrero, Fan, & Huerta 2014). Following the DOWLS activity the students were presented a power point that showed students slides of different items and have them observe the different mixtures. Students discussed what they felt was common with their group. The question was that students had to describe what the pictures all had in common in which the teacher called on students to respond. Throughout this entire process the teacher had to be cognizant to refer to the objective for the day in all its elements such as, "what is the cognitive verb of the day?" This activity was the *engage* portion of the lesson. Afterwards the students were asked to notate on their journals for the following activity. The students were asked to create trail mix but could not be told that they were creating a mixture. A set of

instructions were presented that informed the students of the quantity of each item that they were to combine for the trail mix. The students were asked to create a chart in their journals where they were to write down their predictions if whether or not each item would have a physical change. They also wrote down the question, "do the physical properties change when these ingredients are put together?" Other questions of interest were, "identify the ingredients in the mixture," "explain what a mixture is." This activity aligns with the **Science and Engineering Practices** where, students are to conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (5-PS1-4) (nextgenscience.org). The trail mix activity is a representation of this demonstration. The next segment of this lesson that follows this activity is where the teacher uses *explain* from the 5-E model. The teacher uses EduSmart to help facilitate the question of "what is a mixture?" and "properties of mixtures." Shortly after another PowerPoint is shown which consists of vocabulary words that are used when discussing mixtures and solutions. The Disciplinary Core Ideas of the NGSS framework entices that, when two or more different substances are mixed, a new substance with different properties may be formed. (5-PS1-4) (nextgenscience.org). This framework has a direct correlation with the questions the teacher was facilitating throughout the lesson which allows students to understand what occurs when two or more substances are mixed. The generating of questions illustrates the manner in which students should be thinking when approaching science related content, like a scientist. During the closure portion of the lesson the students answered the closure questions in their journals then as a class they were to discuss, "identify a mixture," "identify a physical property of the ingredient chocolate chips." Lastly the teacher gave a brief preview of the weekly homework which told students that they will need to bring a

mixture from home on Wednesday. Two of the three fundamental principles of the NGSS were utilized during this lesson along with heavy literacy integration.

Lesson Plan: Day 3 and Day 5

The lessons for these days follow the same routine as day 1 with minor differences. Day 3 begins with the DOWLS then the *engage* portion of the 5-E model follows where a PowerPoint again is displayed. Questions continue to be facilitated and the teacher must be cognizant to refer to the objective for the day. The objective of this lesson is, the student will evaluate different mixtures using mixtures from home. *Explore* from the 5-E model follows where students are asked to discuss their mixtures with their groups and complete a rubric. During the *Explain* portion of this lesson engage in an interactive activity called high five which takes up majority of the lesson (20 minutes). Lastly the students are asked to answer the closure questions in their journals. As noted this unit is repetitive in schedule which allow students to be aware of what to anticipate thus making transitions much smoother. The day 5 lesson however, was a done a bit more different than the previous lessons. The students began with a warm-up where they were asked to complete a chart with examples of solids, liquids, and gases on a half sheet. Then the engage and explore portion of the activity followed where students were conducting an experiment with a 2 liter of soda and creating a solution. The students were to identify the different physical properties and what occurs when they are mixed. This is a representation of **Crosscutting Concepts** found in the NGSS framework which states, Cause and effect relationships are routinely identified, tested, and used to explain change (5-PS1-4) (nextgenscience.org).

CHAPTER IV

CONCLUSION

Overview of ELLs and Science Instruction

In the past years, the population of ELLs has grown rapidly and will only continue to do so. This staggering increase of ELLs means that educators needs to be adequately prepared to formulate effective instruction for these learners in all content areas and in the language that best adheres to the student. Science has introduced us to an abundant amount of significant information that has helped shape our understanding of the world. However, there has been an overall shortcoming of comprehension in science from students that is unsatisfactory because science is such a highly regarded subject. While science is a subject that students in general have difficulties understanding due to its complex vocabulary and higher order thinking skills, ELLs struggle with this subject even more. The underachievement in science has resulted in a lack of preparation for higher education which has resulted in fewer students finding an interest in science related majors. ELLs not only face the challenges of learning a second language but they are also asked to learn content areas such as science in their second language. If science instruction is not altered to meet the needs of these students then this may hinder the success of ELLs. Similarly, the quality of science instruction must also align with the NGSS which have become the standards for science education. While the NGSS is not a curriculum but rather the standards for science instruction, it is vital for educators to become familiar with these standards. In doing this they will obtain a better understanding of how to successfully implement the standards to their curriculum especially for ELLs' science instruction.

Findings from Project MSSELL

For this research I examined a nationally-funded project, Project MSSELL, which was created to aid ELL's science instruction and to bridge the current underachievement these learners are experiencing. The NGSS were also examined which are the new science standard's many states are adapting. The project was implemented in 5th grade science classrooms in school districts south of Texas where a large population of ELLs reside. Overall the project proved to be successful and beneficial to 5th grade ELLs. More importantly, the NGSS fully aligned with and are reflected in the science instruction found in Project MSSELL. Students responded very well to Project MSSELL due to various factors which range from the method of delivery of instruction, strategies used, and the preparedness of the teacher. Project MSSELL is heavily based on reading which is a critical component for the academic achievement of ELLs. Through Project MSSELL I discovered that the incorporation of literacy in a science program is crucial especially for ELLs who are being exposed to text and vocabulary that can be challenging to comprehend. Reading in science is inevitable and is an equal important component of instruction because literacy plays such a huge role in the comprehension of science where it requires the use of complex vocabulary students do not use on a regular basis. This is why ELLs need constant practice in reading to help facilitate and understand the abstract text that constitutes science.

In Project MSSELL the integration of English-reading literacy based activities such as the DOWLS gave the students the opportunity to practice their language skills though journaling which not only benefitted their science learning but also helped with their language development. The instruction found in Project MSSELL also facilitates higher-order thinking

questions and hands-on activities that are key components of the NGSS. The NGSS seek to generate thinking skills from students that are those of a scientist and it is no longer sufficient for the student to be able to recall information but rather know how to apply it. With that in mind, the questions found in the lessons from project MSSELL show a clear representation of the use of higher order thinking questions which are facilitated by the teacher and embedded into the lessons. To conclude, no modifications would need to be made to project MSSELL since it fulfills requirements asked of the NGSS.

Implications for Science Instruction

As previously discussed, science instruction can be difficult for ELLs to understand so their form of instruction should not be the same as their main-stream peers. With that in mind, an important factor to take into account to ensure success in science for ELLs is the teacher. For Project MSSELL the teachers were prepared extensively and in many different domains in science. It isn't sufficient for teachers to be knowledgeable of the content, they must also teach learners how to apply, analyze, comprehend, evaluate, and synthesis information. Teachers need to be fully qualified and need professional development opportunities in teaching science to meet the culturally and linguistic needs of ELLs. The content being taught is just as important as the teacher. To conclude, my findings prove that Project MSSLLE is a successful program for ELLs that aligns with the NGSS.

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