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Inquiry-Based Learning in the Science Classroom: A Focus on English Language Learners and Literacy

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by

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Dedication

This capstone is dedicated to my first group of English language learners at the Charter School for Applied Technologies. It is your hard work, resilience and kindness that has inspired me in my first year of teaching.

Abstract

In the current climate of the New York State (NYS) educational system high-stakes assessment is imperative to all students receiving a high school diploma including English language learners (ELLs). The linguistic demands of these assessments are extremely high and non-commanding ELLs must demonstrate content knowledge using language and literacy skills that are beyond their linguistic repertoire. The capstone is written through a sociocultural lens with an emphasis on Vygotsky's social constructivism. The proposed solution is the addition of an inquiry-based framework to the secondary science classroom which integrates language, literacy and content with careful consideration to the needs of ELLs. In order to mitigate the problem and increase assessment scores secondary science teachers will be introduced to the inquiry-based framework through a professional development opportunity. The participants will identify the problem occurring among ELLs, explore the framework including research-based evidence of success and interventions for the classroom. Finally, teachers will work collaboratively to modify a lesson of their own to integrate the inquiry-based approach and emphasize content and language simultaneously. The goal of the PD is for ELLs to receive more contextualized learning that develops English language skills and content knowledge, ultimately leading to increased proficiency scores on high-stakes science assessments in NYS.

Keywords: high-stakes assessment, English language learner, inquiry-based framework, language, literacy, content

Chapter 1: Introduction

Problem

During late January I circulated the living environment proctoring room offering words of encouragement and a hopeful smile to a group of English language learners (ELLs) who were pouring their hearts into the assessment. At that point the students were approaching hour ten of testing, my eyes met the eyes of a twenty-year-old senior from Syria, who was now sitting for the living environment exam for the fifth time. His eyes began to well up, he took a deep breath and quickly looked down at his paper. Right there in that moment I was struck; the exam was not assessing his content knowledge or the things he had been studying for two years but rather his ability to read, write and understand academic language. But was he prepared for that? A few weeks following the exam a science teacher in my building stopped me in the hall; she shared how she was frustrated with the results of the exam – the twenty-year-old boy who had prepared and studied endlessly had failed yet again. She was at a loss – and told me "I know he knows the material, but he just cannot show it!"

The experience of the student and teacher from my school highlights the clear evidence that the language and literacy demands present on high stakes exams are incredibly high and the current curriculum does not prepare ELLs to extend their learning beyond science content. ELLs, like the boy previously described, spend years in prep courses, taking the exam five or more times, feel the heightened pressure of graduation requirements, and sometimes even age out of the system before finding success.

Currently, in New York state to earn a Regents diploma a student must pass at minimum one science Regents exam and in some cases two in order to meet the pathways requirement (New York State Department of Education Curriculum and Instruction, 2019). Most

commonly ELLs are enrolled in living environment during their freshman year to meet the graduation requirement as soon as possible. Yet in two large districts in upstate New York most recent data reports only 22% of ELLs passing the living environment exam (New York State Department of Education Data Site, 2018-2019b) and in the other district a slightly lower passing rate of 21% (New York State Department of Education Data Site, 2018-2019a).

Due to the staggering numbers it is critical we look towards a way to mitigate the problem and increase ELL proficiency in science to strengthen graduation rates and help our students be more successful. One way to mitigate the problem is to shift the focus from typical teacher led, textbook driven classrooms to a classroom that integrates language, literacy and content development through an inquiry-based approach. The use of an inquiry-based model will allow teachers to balance content and language development simultaneously. The outcome of the concept will result in sustained language and literacy skills among ELLs as well as more effective classroom instruction that meets the needs of all learners. Additionally, students will be actively learning in a highly engaging environment with the ultimate goal of heightened living environment Regents exam scores for ELLs. The capstone will explore literacy integrated inquiry-based science learning using a sociocultural perspective lens with an emphasis on Vygotsky's theory of social-constructivism.

Before moving forward, it is critical to understand a few key concepts that will be used throughout the capstone, those include ELLs and inquiry-based learning. The New York State Education Department describes an ELLs as "students with home or primary languages other than English who need support in reaching English language proficiency." (New York State Department of Education, Bilingual Education and English as a New Language, 2018) Another concept that is important to understanding the capstone in its entirety is inquiry-based learning.

According to Guccione (2011), inquiry-based learning can be "defined as a student-centered approach to teaching and learning through the use of teacher scaffolding to guide independent and group investigations that interest students."

Significance of the Problem

To demonstrate the impact New York State Regents exams are having on ELLs overall academic achievement it is necessary to examine the language and literacy demands of the assessment. When considering the significance of the problem there are three key areas identified – linguistic challenges, cultural adjustments and complexity of assessment.

Linguistic Challenges

Linguistic challenges are at the heart of the problem particularly due to the academic language and general literacy skills necessary to demonstrate proficiency on the living environment Regents exam. In order to have a true understanding of the complexity of the assessment and the linguistic challenges it is important to break down a sample question from the January 2020 exam. While doing so, consider the linguistic and language demands of this question and the makeup of a possible student taking the exam. For example, an ELL identified at the transitioning level, meaning a student who has some independence in using academic language skills but is still unable to exhibit English proficiency in a variety of contexts (New York State Education Department, Office of State Assessment, 2020). The example question refers to a narrative about a set of identical twins, it is four sentences in length and the focus is on explaining the differences between the twins. In this question an ELLs must be able to compare the twins noting the slight differences mentioned while following the wordy narrative. Then the student must select from a set of multiple-choice responses that completes the final sentence of the question. In this section students need to demonstrate content knowledge while

applying a high level of linguistic and language understanding. The responses are particularly challenging as they use phrases like “only” and “completely”, a variety of punctuation and are generally overly complicated in terms of language. Finally, the question is decontextualized which is a common problem ELLs face in content area classrooms and during assessments (Stoddart et al., 2002). Consequently, we have to wonder whether the question is assessing a student’s content knowledge or linguistic abilities?

Based on the example, the need to demonstrate science specific knowledge and register, strong literacy skills and solid linguistic abilities is evident. After thoughtful reflection of the sample question, the capstone proposes the integration of an inquiry-based framework so teachers are able to target both language and content during daily instruction. The emphasis will be on the use of an inquiry-based learning to draw attention to learning content while frequently reading and writing in a science context. Science has a specific register that includes high level vocabulary often rarely used outside of the science classroom that must be explicitly taught and used. Beyond that, the need to read in the science classroom has become increasingly vital as well as and the necessity of applying science knowledge to demonstrate understanding in descriptive and reflective writing. Stoddart et al. (2002) describes the importance of viewing “science learning and language learning as reciprocal and synergistic.” making the argument for combining the two together clear. Through the meaningful addition of reading and writing in the daily science classroom, content teachers can build language and literacy skills as they teach content. Mastropieri et al. (2005) indicates the need for providing starting off points and ways to initially access information in science since the language and literacy demands are often high. Although, this does not mean lessening the load for ELLs since they must attain the language and literacy skills necessary to be successful. Instead giving ELLs the proper context, a hands-on

activity or connecting new information to background knowledge or experience in order to make the reading and writing increasingly accessible. Beyond this, secondary science teachers are faced with tight curriculums and high exam pressure which often lends itself to textbook style or note packet learning which increases reading and writing without ever considering the linguistic tasks in a meaningful way. Simply, increasing the amount of reading and writing in the classroom will not improve literacy skills and overall outcomes on the exam. Therefore, there is a need for teachers incorporate language through inquiry-based learning which allows for careful exploration and use of language. By focusing on an inquiry-approach with the addition of literacy will be an increase in exposure to reading and writing while attending to the linguistic challenges and content, ultimately allowing for improved Regents exam results. According to August et al. (2014), the important use of inquiry-based approaches allows for teachers to carefully attend to academic language and cultural backgrounds while increasing literacy demands.

Cultural Adjustments

Beyond the linguistic challenges that the assessments provide the general concept of high stakes and standardized testing is highly relied on in the American education system especially to meet graduation requirements, college acceptance, etc. High stakes testing can provide pressure for students while maybe being new and confusing to some families. Since Regents exams are here to stay, it is important to provide ELLs and their families with the means to understand the purpose, preparation and overall goal of the assessments. The use of standardized and high stakes testing is particularly great in New York State yet critical in obtaining a high school diploma. Unfortunately, under the current system ELLs are provided with only a few accommodations. Therefore, it is critical to look towards enacting an inquiry-based model, in the science

classroom, which provide a focus on language and literacy building throughout the course. As a result, students will be more equipped with the content knowledge as well as able to approach linguistic challenges independently.

At the classroom level it is essential that teachers capitalize on students' funds of knowledge (Gonzalez et al., 2006) and enact culturally responsive pedagogy (Maaruf et al., 2016) to make learning science more accessible. Through the use of funds of knowledge and culturally responsive teaching pedagogy student's individual knowledge and experience is valued and students are more supported from the start making access to higher level language and literacy demands possible. To support this idea even further, Lee (2008a) adds "effective science instruction incorporates students' prior linguistic and cultural knowledge in relation to science disciplines". Additionally, ELLs may be better able to access higher level linguistic and language demand with the meaningful incorporation and use of their home language in the science classroom. For example, the addition of translanguaging pedagogy in which students use their full language repertoire to understand and express themselves (Garcia & Wei, 2013). One example, may include teachers carefully planning opportunities and activities for ELLs to use both their home language and English in the science classroom. The thoughtful addition of both languages can be purposefully added as a facet of inquiry-based learning, making language and content more accessible to ELLs. All of additional strategies aiding in the overall goal of higher passing rates on science Regents exams.

Sociocultural Complexity of Assessment

Finally, a third significant aspect of the problem to consider is the complexity of assessment even beyond the linguistic challenges of individual questions on the exam. The

careful examination of what other challenges the science Regents exams pose for ELLs, teachers and schools as a whole is vital.

Arguably most impacted by the dilemma are the ELLs themselves who spend years in prep courses and sitting for exams over and over. Compound this with the pressure to meet graduation requirements, anxiety is heightened. Due to the extreme pressure many ELLs consider dropping out and some even age out of the system before they are able to obtain a high school diploma. Due to the difficulty posed by Regents assessments some ELLs spend much of their academic years retaking classes and enrolled in prep courses. Therefore, leading to missed out opportunities to take elective courses, explore career options or partake in internships outside the school walls. Often overlooked is the impact the assessments have on the social and emotional needs of ELLs. Unfortunately, the complexity of assessments means students eighteen and older are in classes with freshman which can be uncomfortable or create a stigma around ELLs. Students may feel judged and singled out making it difficult for them to focus on truly learning as opposed to how they are feeling in that setting. Using an inquiry-based approach students will improve literacy skills while learning content. The outcome being that ELLs will pass exams at a normal rate decreasing the troubles related to exam pressure and ELLs social emotional needs.

Additionally, the complexity of the assessment makes it difficult on teachers, many of which have little background knowledge on working with ELLs beyond a brief overview in their undergraduate studies. Teachers then faced with tight demands to teach information quickly and well from administration to increase Regents passing rates. Through an inquiry-based approach teachers will integrate language and literacy development during content instruction to continue developing all the skills necessary for success on high-stakes assessment. Finally, the science

Regents exams often end with many students including ELLs failing and the need for teachers to teach prep courses, counselors to spend time on scheduling changes and increased costs on the school.

Purpose

Due to the linguistic challenges and complexity of the living environment Regents assessments school districts across New York state are reporting low passing rates for ELLs. One way to mitigate the problem is through the introduction of an inquiry-based model in which content area teachers will be able to focus on the integration of literacy and content learning. The goal is for teachers to provide a balanced curriculum which incorporates both language and content into daily instruction in order to better prepare ELLs and the general classroom for the demands of the Regents assessment.

In order to mitigate the problem a well thought out professional development has been designed to share with all members of a high school level science department. While much of the focus has been on living environment the information will be beneficial to all members of a given science department especially those who commonly teach ELLs. The intended outcome of the professional development is for science teachers to walk away with a better understanding of how to incorporate literacy into a commonly used inquiry-based approach as well as have a draft of a lesson to try in their own classroom.

Teachers will participate in a three-part hour and a half professional development training. The first part of the professional development will begin with a detailed look at Regents results and data for ELLs. Teachers will brainstorm reasons as to why the poor results are a reoccurring difficulty. In order to better highlight and help teachers identify the problem ELLs are facing the group will break down a multiple-choice question. The facilitator of the

professional development will guide teachers to better understand the linguistic and literacy demands of the question and assessment as a whole.

Once the group has a well-developed concept of the problem the facilitator will introduce the idea for mitigating the problem, the incorporation of an inquiry-based approach which integrates reading and writing. As a group they will brainstorm the idea of inquiry-based learning and come to an agreed upon definition followed by the true definition from the facilitator. Most critically the facilitator will share with the participants research-based evidence of success in the classroom. The facilitator will then share the basic features necessary for an inquiry-based model in each lesson, encouraging teachers to incorporate a few in each lesson. Additionally, the participants will understand the key elements of the approach, possible interventions to incorporate into the classroom and a closer look at the integration of literacy in content area classrooms. Finally, in this part of the session, the facilitator will introduce the writing of language-based learning targets in daily lessons to go side by side with the inclusion of reading and writing in the science classroom. In the latter portion of this phase the group will partake in a sample lesson which uses an inquiry-based approach with the combination of literacy as a focus. Teachers will act as students and the facilitator as the teacher. In effect, the group will be provided with a sound example of what it would really look like in the classroom.

Following the example, phase three will begin and teachers will break up by science content areas and work in small groups to an adapt a current lesson of their own that utilizes an inquiry-based approach. The groups will also decide on one or two language learning targets to add to the lesson following examples provided by the facilitator. Teachers will be encouraged to use an inquiry-based approach which they have used in the past and feel comfortable with and

now add a reading and writing portion. The facilitator will offer guidance and work with each group to develop their ideas.

Following the completion of the professional development teachers will try out the lesson they adapted in the classroom in an extension phase. Pairs will observe one another's lesson using a peer observation form to provide support and a more meaningful reflection. After the lessons have been completed in the classroom all of the teachers will complete a reflection Google forms to share with the professional development facilitator.

Conclusion

Currently school districts with high ELL populations are reporting low proficiency and passing rates in living environment as the Regents exams requires a high level of language and literacy skills to be successful. Through the integration of an inquiry-based approach content area classrooms will emphasize reading and writing while learning content information, leaving ELLs more prepared for the exams at the end of the course. Students will have increased exposure to academic language, heightened literacy skills as well as newfound stamina and confidence to be successful on the exams. In chapter three, I will present a professional development for secondary science teachers. The group will participate in a hour and half three part professional development which they will explore why ELLs are having difficulty passing the Regents exam, the concept of inquiry-based learning, how to integrate literacy into that pedagogy and how to make this come alive in their classroom. In the end, science teachers will be equipped to try out a lesson in their own classroom, observe one another and reflect on the process and outcomes. Finally, in chapter four I will discuss the implications inquiry-based teaching with a literacy focus has on student learning and teaching as well as provide recommendations for further research.

Chapter 2: Literature Review

Social Constructivism

In order to address the low passing rates on the literacy heavy New York State Regents exams this capstone proposes that secondary science teachers consider an inquiry-based learning model which incorporates the purposeful addition of reading and writing into the content area. With the use of an inquiry-based approach teachers are better able to attend to the language and linguistic development of ELLs while simultaneously teaching content area information. In this approach students are at the center of learning; forming questions, making meaning and collaborating through experiment. Teachers act as facilitators of exploration while providing carefully planned scaffolds that allow ELLs to hone in their reading and writing skills. Ultimately, this will leave ELLs more prepared to tackle literacy focused high stakes assessment in the content area.

When examining this problem and proposed solution it is critical to view it through a sociocultural lens with an emphasis on Vygotsky's social-constructivist theory. Elliot (2000) defines social constructivism as "an approach to learning that holds that people actively construct or make their own knowledge." Adding to this, Arends (1998) emphasizes the importance of learner exploration to construct meaning. Both definitions aligning directly with an inquiry-based approach in which students formulate meaning through authentic context themselves or collaboratively with the teacher serving as a guide (Stoddart et al., 2002).

Tenants of Social Constructivism

Lev Vygotsky highlighted several significant principles of social constructivism that are imperative to the problem I am addressing in this capstone. The foremost tenant, human learning is created not innate, learners build new knowledge on the foundation of prior knowledge

(Vygotsky, 1978). Commonly, people hold the assumption that English proficiency is a pre-requisite for acquiring content knowledge. In alignment with social constructivism ELLs use the linguistic and cultural understanding they already possess to continue obtaining new information as they construct meaning through a variety of methods. Equally important, Vygotsky calls learning an active process. In the proposed solution of a literacy embedded inquiry-based approach in the science classroom students are at the heart of learning through contextualized, hands-on, multi-modal exploration. Perhaps, most notable to this capstone is the concept that cognitive development stems from social interaction within the zone of proximal development (ZPD). The ZPD refers to the zone between what a student can do independently and what a student can do given assistance (Vygotsky, 1978). In this the teacher acts as a facilitator to allow students to reach higher through purposeful scaffolds. In this proposal, teachers in the secondary science classroom will serve as guides as they collaboratively create meaning with ELLs, all within an authentic context to promote language use, question formation and expression of understanding. Since Vygotsky refers to cognitive development as a social process it is critical teachers strike a balance between teacher guidance and student initiative. This is likely achieved when ELLs are given meaningful language scaffolds with multiple forms to express their understanding. The goal is to not only put students at the heart of meaning making in an inquiry-based science approach but to continue developing their linguistic register through an active process.

Context of the Problem

While the number of ELLs entering American classrooms is rising as well as the use of high stakes standardized assessment it is critical to move towards a direction that permits the simultaneous development of content and language skills. Often people operate under the

assumption that English language proficiency is necessary for content area success. While in part there may be some truth this leaves an impossible feat as academic register may take between seven to ten years to fully develop. Instead, an inquiry-based approach within the science classroom will enhance scientific knowledge while facilitating English language acquisition. Through an inquiry-based approach language is contextualized, the role of teacher and student is balanced and students use language and content to construct meaning while learning in both is heightened.

The current difficulty is that ELLs are ill prepared for the literacy heavy New York State standardized assessments. While the exams are primarily content assessments they require a well-developed level of language and linguistic capability to be successful. The trouble is that many ELLs lack the reading comprehension abilities as well as writing structures due to limited background knowledge and underdeveloped vocabulary (Guccione, 2011). In today's climate, secondary teachers focus on delivering all the assessment content quickly and often in a decontextualized fashion. When subject areas are decontextualized ELLs have difficulty as they are no longer able to use context clues, activate prior knowledge or lean on personal experience. The inquiry-based framework directly supports the needs of ELLs as it contextualizes language and allows for real life, hands-on exploration as opposed to more traditional methods.

Due to this, this capstone proposes that secondary science teachers adapt a model that carefully combines an inquiry-based approach with continual integration of science related reading and writing opportunities. The purpose of continual reading and writing is to develop the science linguistic register necessary for the standardized assessment. This linguistic register requires ELLs to form hypothesis, propose solutions, describe, classify, refer to time, infer, interpret data, predict, communicate findings, all of which are possible when students are

permitted to construct meaning in a highly supported fashion (Lee, 2008a). Through an inquiry-based approach ELLs will develop their ability to communicate those language functions while being at the center of their own learning. Teachers will act as guides who provide carefully planned scaffolds, well-thought out group collaboration and a variety of methods for students to explore and demonstrate understanding.

Relevant Literature

In the following section I will review literature from a variety of experts which support the concept of incorporating an inquiry-based approach to the science classroom. In a comprehensive review the authors explore the benefits of integrating content and language simultaneously and it's effects on language learning, assessment and the socio-emotional needs of ELLs. Beyond this, several authors describe the development of meaningful professional development opportunities as a critical element for implementing an inquiry-based framework in the science classroom.

Inquiry-Based Learning and Language Learning

In this section, there will be a focus on the impact an inquiry-based approach has on language learning of ELLs. The goal of August et al. (2009) was to integrate an inquiry-based approach to help ELLs and their peers develop academic vocabulary and science knowledge. Teachers in the experiment were provided with instructional materials and three professional development opportunities and ongoing mentoring to provide ELLs with an intervention that aligned with the national science standards, inquiry-based learning, literacy and content knowledge development and drew on students cultural and linguistic strengths. Teachers focused on providing a hands-on approach to learning that peaked student interest. In addition, teachers provided meaningful scaffolds to support students as they created meaning and developed

language skills collaboratively. The results of the intervention indicated positive outcomes in scientific reasoning and content knowledge. In fact, even more important in academic vocabulary development. The issue in this capstone indicates the high literacy demands of ELLs on New York State high stakes testing and students' weaknesses in literacy skills. Students difficulty on the assessments may be linked to an underdeveloped academic vocabulary which leads to trouble in reading comprehension. This study indicates that with the integration of an inquiry-based approach ELLs will be better able to develop the vocabulary necessary to demonstrate their content knowledge on New York State Regents assessments. August et al. (2009) incorporated the use of mentoring for teachers to reflect on strengths, learning opportunities and possible areas of growth as a component of the professional development. With any new approach or idea reflection is a critical piece. Therefore in the professional development I highlight in chapter three teachers will provide feedback to one another following peer observations as well as monthly opportunities to reflect with the facilitator.

Shaw et al. (2014) sought to address two critical questions; how to improve science learning for ELLs and how to provide teachers with proper support in teaching these new strategies. Based on these challenges the authors created a study to examine the impact of a modified methods course and professional development opportunity for pre-service teachers. The goal was to develop their understanding and skills towards promoting an inquiry-based science method that integrates language and literacy development. Pre-service teachers focused on six key inquiry-based interventions to add to the science classrooms including facilitating collaborative inquiry, improving the use of science talk, literacy, the addition of scaffolded language in science, providing contextualized learning opportunities and advocating for higher

level thinking. Shaw et al. noted that ELLs developed a strong ability to apply evidence in oral and written language once science and literacy intersected in the inquiry approach interventions.

The pre-service teachers were paired with a cooperating teacher. Both attended a two-day professional development to practice hands-on learning with the inquiry-based interventions previously mentioned. Pre-service and cooperating teachers worked in pairs throughout the year in a mentoring program for continued reflection on the effects of the framework's practices. The professional development method of pairing teacher's in long-term analyzation allows students to receive best practice in the integration of science and literacy.

Shaw et al (2014) enacted a pre and post assessment for all students who received the inquiry-based interventions. The findings indicate heightened learning in science, writing and vocabulary, most notably learning achievement for ELLs was on par with their non-ELL counterparts. The author shares that improved learning outcomes may stem from the contextualization of language. Currently in New York we note the low passing rates of ELLs in high stakes science assessments due to an underdeveloped academic vocabulary, low reading comprehension abilities and inability to express themselves in written form. This study reveals that vocabulary and writing improved through the purposeful addition of authentic activities. This study illustrates that by utilizing the interventions enacted by the pre-service teachers ELLs will develop greater language skills that will in turn lead to higher achievement on the New York State Regents assessment.

In another study, Buxton et al. (2008) describes a professional development intervention that was implemented to increase teacher understanding and practices for teaching science and language to ELLs. A goal of this professional development was to equip teachers with inquiry-based interventions to aid in student success on high stakes assessment. During the professional

development teachers were provided with units that centered around an inquiry-based framework. The activities within the units aimed to progressively give students higher levels of independent in experimentation, meaning making and overall learning. Students were also provided with work booklets to integrate reading and writing in the context of science. The goal in practicing a variety of language functions and improving comprehension abilities of ELLs. This study aligns directly with the need to introduce a greater frequency of reading and writing opportunities to develop the communicative skills of ELLs for success on the New York State Regents assessment.

Moreover, the goal of the professional development was to bring collaboration among teachers, working in cross-grade and subject specific collaboration. This professional development is unique as it is has been done for several years and teachers gain new insight each year working with peers who have been implementing inquiry-based interventions for the same amount of time as them. This allows for continued growth, reflection and a focus on new strategies each year. The problem addressed in this capstone recognizes the difficult task content area teachers are given, providing instruction that covers all the material necessary before the standardized assessment and that meets the needs of increasingly diverse classrooms. Many teachers lack the understanding or proper training on how to best meet the needs of ELLs in content area classrooms. However, through professional development opportunities as described in this study we move towards a greater emphasis on an integrated inquiry-based approach. Through meaningful workshops and learning opportunities in-service teachers will begin addressing the language needs of ELLs while developing their scientific reasoning and general content knowledge.

Weinburgh et al. (2017) is to find an appropriate approach to meeting the demands of the national science standards. ELLs and their peers are required to demonstrate an ability to make connections, demonstrate science and mathematic knowledge and a high level of communication skills to demonstrate their understanding. For this reason, Weinburgh et al. have placed an emphasis teachers with the tools necessary to implement effective content and language intervention strategies. The authors examined student growth in content knowledge and academic vocabulary following an inquiry-based learning experience. Through the use of interviews, the findings indicate that ELLs were more equipped to communicate their science content knowledge using more sophisticated language. The authors note an increase in student's ability to communicate using multiple language functions and overall in a more clear and concise fashion. This is a vital factor towards success in high stakes assessment as ELLs must be able to use their language skills to express understanding of content information. This study indicates that an inquiry-based approach allows for further development of writing skills necessary for the New York states Regents assessment.

Inquiry-Based Learning and Assessment

In this section, there will be a focus on the impact an inquiry-based approach has on assessment achievement of ELLs. For example, Lee et al. (2008a) carried out a five-year professional development intervention with the objective of enhancing science and literacy performance of elementary aged ELLs. Notably, this study was carried out in an urban school district in an environment focused heavily on standards-based instruction and high stakes testing, similar to that of the districts mentioned in Upstate New York. Teachers participating in the study took part in a variety of workshops which emphasized a shift towards an inquiry-based science intervention. The intervention introduced to students was designed to attend to the

language and literacy needs of ELLs including meaningful teaching of academic vocabulary, the use of multiple modes of communication and representation as well as lessons that underlined students unique cultural knowledge and experiences. Lee et al. focused on providing active learning opportunities for teachers during professional development workshops. Through this teachers developed understanding on the inquiry-based intervention through hands-on trial and group interaction. The study emphasized that teachers develop a clear pedagogical understanding of the intervention, getting teachers to buy in to the potential gains for ELLs and intended results.

The addition of an inquiry-based learning approach the study reports increased scores on statewide assessments for ELLs, this may be contributed to the intervention meeting the learning needs of students in English and the content area simultaneously. This finding is critical to report as teachers now effectively covered all material necessary for the high-stakes assessment. This is often a major concern of content areas in an environment highly focused on accountability. With this teachers provided meaningful instruction to all students that drew on their unique abilities while moving beyond a typical textbook, decontextualized approach. These findings link directly to the need to address the content and literacy demands of New York State Regents assessments. This study reveals that an inquiry-based approach allows for increased language learning in particular student's development of reasoning skills and writing, assessment scores may increase. Also, important to the issue is the need for continual professional development that aids secondary science teachers in expanding their understanding of the inquiry-based learning framework as well as opportunities to explore its possible use in the classroom. In chapter three of the capstone, teachers will be given an opportunity to build upon their knowledge of inquiry-based learning and be given opportunities to update their current lessons to align with an inquiry-based approach. Beyond this, they will be provided with a multitude of examples to draw on

following the workshop as well as being able to try out several directly with the science department during the PD.

Greenleaf et al. (2011) places emphasis on the need for combining literacy and content area skills rather than placing ELLs in remedial groups where they lose out on other opportunities at the secondary level and literacy difficulties are perpetuated in decontextualized stigma ridden classrooms. Greenleaf et al. shares the reason for integration of language and linguistic development in content area classrooms, "greater literacy proficiency is essential to students' acquisition of deep scientific understandings and inquiry skills." Through this it can be drawn that literacy and content should not be separate but rather learned together in an inquiry-based method to unlock abilities in both areas. In the study teachers implemented an inquiry approach to integrate literacy and reading instruction to support greater success in high level content area learning. A key goal of the study was finding ways to develop the instructional strategies and interventions of secondary science teachers to better support the needs of ELLs.

Greenleaf et al. (2011) utilizes this experiment to show how professional development can improve learning outcomes for students as well as continue the development of teacher quality. During the professional development the author explained the use of hands-on learning with teachers for them to develop their own understanding of the interventions. A variety of inquiry approach strategies were introduced including teacher modeling of reasoning through think-alouds and textual annotations. In this stuy the teacher acts as a facilitator with the goal of putting students at the center of their own learning. Teachers practice how to conduct collaborative group work with interventions like think-pair-share techniques, jigsaws and comprehension protocols. In the end teachers brought these new strategies into the classroom and found time for metacognitive reflection on the effects of these pedagogies. Results show that

teachers involved in the professional development, as opposed to those in the building who were not, were more likely to create a collaborative student-centered classroom as well as provided support to improve science literacy and reading comprehension. ELLs who utilized an inquiry-based approach which integrated science and language outperformed their counterparts who didn't receive this intervention in English language arts, reading comprehension and science. As students moved away from a highly structured, teacher ran, textbook oriented classroom ELLs began to progress in English language development while learning new content knowledge.

This study directly supports the proposed solution of this capstone by demonstrating the possible benefits in assessment scores when teachers integrate language and literacy instruction alongside content area instruction. With this, students take ownership over their learning and show stronger results across assessment areas. The importance of strong language skills is critical towards demonstrating content knowledge but often overlooked; this study shows how we can approach both simultaneously. While this capstone is centered around improving science high stakes assessment scores the benefit would extend to the English assessment as well which must be passed by all ELLs in New York State to receive a Regents diploma.

An additional study by Santau et al. (2011) describes a three-year professional development that provides teachers across six schools with curriculum and workshops aligning with an inquiry-based framework. Through the long-term professional development teachers develop an understanding of the approach, implement interventions to integrate science and language while preparing students for high stakes testing in an urban district. Over one thousand students took part in the inquiry-based interventions and learning achievement was assessed using a pre and post assessment. Students showed a substantial increase in science achievement following the post assessment and ELLs achieved similar results as their non-ELL counterparts.

Based on these results it is evident that an inquiry-based approach which simultaneously integrates content and language may weaken the learning gap between ELLs an non-ELLs. The reducing of the achievement gap using an inquiry-based approach may have positive effects on passing rates of ELLs. Meaning they may be more likely to receive a proficient score like their non-ELL counterparts. This indicates an increase in attention and development to the language developed of ELLs in a contextualized manner.

In a final study focused on the inquiry-based method and assessment, Stoddart et al. (2002) focuses on the assessment of teachers who work with ELLs. The author asserts that content classrooms provide a meaningful context for language and literacy development specifically through an inquiry-based framework. The author pushes for the use of student exploration of science embedded with language activities. The activities should link to objectives, provide hands-on learning opportunities and occur in a highly contextualized environment. While the ideas presented are beneficial the authors recognize teachers lack understanding about the integration of science and language simultaneously. Based on this, Stoddart et al. (2002) designed a rubric to assess teachers understanding of the science-language integration framework. The benefit of such an assessment is that we are better equipped to prepare teachers with the skills necessary to understand, design and implement an inquiry approach which provides ELLs with language embedded science instruction. The study found that majority of teachers surveyed using the rubric were at the novice level and needed specialized professional development opportunities to enact a science-language integration model appropriately. Currently, in New York State ELLs are demonstrating low passing rates on high stakes science assessment likely due to a lack of language skills. Due to low passing rates it is critical we educate teachers and provide them with opportunities to develop their

understanding about the inquiry-based framework and ways to effectively implement it in the classroom.

Inquiry-Based Learning and Socio-emotional Needs of ELLs

In this section, there will be a focus on the impact an inquiry-based approach has on the socio-emotional needs of ELLs. For example, Lee et al. (2008b) examined a long-term professional development intervention focused on science achievement of linguistically diverse ELLs. Teachers were provided with materials, student booklets and supplies all of which combined national standards and a focus on inquiry-based learning. Students were given ample opportunities to improve their reading and writing skills through the context of science. The units were thoughtfully designed to provide a high level of support at the start and guide the students towards increased independence in literacy and meaning making. In the end, the results showed persistent positive outcomes and a narrowed achievement gap between ELLs and their counterparts. When students are provided with equitable opportunities the achievement gap is lessened and ELLs feel less stigmatized, are less likely to be placed in remedial classes and miss out on other meaningful opportunities. Furthermore, inquiry interventions allow for group collaboration and the importance of all student voices being valued, again focusing on the socio-emotional needs of students.

The Lee et al. (2009b) professional development focused on sharing the importance of drawing on students cultural and linguistic backgrounds when promoting English language and literacy progression. Most importantly, teachers were taught how to facilitate student exploration in English as opposed to a teacher dominated classroom. The integral aspect of this was supporting the language needs of ELLs while providing them increased autonomy in learning. In chapter three of the capstone, I will draw on the importance of the social constructivist

framework during the professional development which focuses on the teacher guiding students to make meaning.

In an additional study, Settlage et al. (2005) describes a pair of teachers in a culturally diverse urban district in Southern California who enacted a deliberate plan to adapt a previously used science unit to align with an inquiry-based framework. The teachers followed a guide which offered interventions including hands-on activities, multi-sensory learning opportunities, peer collaboration, reflective thinking and development of science reading comprehension skills. The results indicate that ELLs ability to form questions and think scientifically continually increased as the unit progressed. The students became increasingly independent and equipped to take initiative in activities as the pair of teachers relied more heavily on inquiry-based learning interventions. Most notable, the teachers reported they were better able to draw on student's funds of knowledge once students were at the center of learning. The teachers started each lesson by drawing on student's personal experiences and enlisting any possible background knowledge. According to the authors, ELLs may feel a stigma surrounding them in content area classes as they can be ill prepared to be at the center of learning due to a lack of language skills. Using an inquiry-based framework this pair of teachers was able to slowly move from a teacher led to a teacher facilitated classroom which allowed ELLs to slowly gain confidence and develop higher level communicative skills to participate in a meaningful way. It is critical that we attend to the socio-emotional needs of ELLs; through slow transition to group collaboration, student- initiated experiment and drawing on ELLs funds of knowledge the stigma is lessened and students are better able to develop content knowledge and language skills.

Application

The articles presented in the literature review focus on providing teachers with professional development opportunities in order to further their understanding of the possible benefits of an inquiry-based framework and deliver intervention strategies for ELLs. In order to develop a meaningful professional development for this capstone in chapter three it is vital to take a deeper look at the materials and methods used by various authors. The goal is to integrate an inquiry-based model into the secondary science classroom to deliver more effective content instruction with language and literacy embedded in a contextualized manner. If this is done effectively, we will note an increase in passing rates and heightened scores on the New York State science Regents assessments.

Materials

Stoddart et al. (2002) designed a rubric for teachers to identify their understanding of the inquiry-based framework with attention to the integration of content and language simultaneously. The development of a rubric which allows teachers to self-identify their understanding through answering a variety of questions is that it lets us know where to begin, how to group teachers and what each individual needs to make progress towards more effective inquiry-based learning opportunities. A rubric such as this may even serve as a potential pre-assessment of knowledge before progressing in a professional development workshop. Most importantly, Stoddart et al. (2002) found that majority of the teachers who responded to the rubric were at a novice level therefore it cannot be assumed teachers know this information and we need to properly teach the framework before intervention strategies.

Another important aspect to mention is the student workbooks and list of interventions provided to teachers during professional development workshops in order to implement the

inquiry-based approach (Lee et al., 2008b; Buxton et al., 2008) As mentioned this framework may come new to in-service teachers therefore a full list of strategies and ideas for integrating language and literacy into the curriculum in critical. The facilitators of professional development workshop whether short or long term will provide the list of possible interventions as to make the framework attainable. Based on the work of Lee et al. (2008b) and Buxton et al. (2008) teachers are given the intervention materials necessary and time for exploration during the professional development and will enact strategies in the classroom through trial and reflection.

Methods

The varying studies provide a plethora of successful methods for delivering information and creating a strong foundation for the implementation of an inquiry-based framework in the science classroom. For example, Santau et al. (2011) mentions the importance of in-service teachers developing an understanding of the framework before overwhelming them with interventions, strategies or ideas for the classroom. When teachers buy in to the concept, understand the theoretical lens and recognize the potential benefits for ELLs they are then prepared to begin exploring the ins and outs of actual strategies. Once teachers are prepared to begin exploring interventions that embed language and literacy in the science context authors Greenleaf et al. (2011) and Lee et al. (2008a) support a hands-on, active learning opportunity. In these professional development workshops teachers play the role of students and explore the intervention through the facilitated use of them. With this teachers are able to identify possible strengths and weaknesses of strategies and how to possibly implement the interventions in their unique contexts. In addition to teachers actively engaging with the strategies of an inquiry-based approach Lee et al. (2008a) and Buxton et al. (2008) call for group collaboration during

exploration. The authors argue that cross-subject and cross-grade collaboration can offer a variety of perspectives and a strong team effort in learning.

Once the professional development workshop itself is completed authors August et al. (2009) and Shaw et al. (2014) suggest continuing teacher growth in inquiry-based learning beyond those few hours or days. Implementing the interventions into the classroom is an important first step. In fact, August et al. (2009) calls for reflection on how the interventions are going. This reflection may include analyzing the strengths and weaknesses of a particular intervention or how to adapt it to better fit the students in a specific classroom. Shaw et al. (2014) adds that a mentor program between paired up teachers, cooperating teachers and pre-service teachers or facilitator to teachers may aid in this reflection. With this, teachers become increasingly accountable, gain new insights and continue their learning process beyond the individual professional development.

Empirical Findings

The findings from various descriptive and experimental studies (Lee at al., 2008a; August et al., 2009; Greenleaf et al., 2011; Shaw et al., 2014; Lee et al., 2008b; Santau et al., 2011; Settlage et al., 2005; Weinburgh et al., 2017) indicate an increase in learning outcomes for ELLs when an inquiry-based framework in which language, literacy and science is carefully integrated. The studies imply that the development of scientific knowledge and language skills increase when language is contextualized and interventions that place students at the center of learning are added. The literature empathically supports the proposed solution of the capstone, the addition of an inquiry-based framework to develop the language and literacy skills necessary for ELLs to be successful on New York State high stakes science assessments.

For example, some critical findings to support the integration of an inquiry-based framework to improve science high stakes testing include an increase in science content knowledge and heightened academic vocabulary (Shaw et al., 2014; August et al., 2009), an increase in science content knowledge and improved writing skills (Shaw et al., 2014; Weinburgh et al., 2017) and an increase in science content knowledge and reading comprehension (Greenleaf et al., 2011; Settlage et al., 2005). These studies indicate that through a focus on contextualized and purposeful language instruction embedded in the science classroom ELLs demonstrate an increase their language and literacy skills. This increase in language and literacy skills is necessary for students to be successful on high stakes, standardized assessment.

Due to the increase in content knowledge, academic vocabulary, writing skills and reading comprehension, several authors indicate the increased achievement of ELLs in high stakes assessment (Lee et al., 2008a; Greenleaf et al., 2011) as well as a narrowed achievement gap among ELLs and their non-ELL counterparts (Shaw et al., 2014; Lee et al., 2008b; Santau et al., 2011) Based on these findings, an inquiry-based framework which focuses on language and literacy in the content area matches the overarching goal of this capstone - to increase the ELL passing rate on New York state Regents assessment.

Due to low passing rates among ELLs on high stakes content area assessment it is critical steps are taken towards developing the language and literacy skills alongside content knowledge. The authors suggest a move towards an inquiry-based pedagogy which expands the academic register, reading comprehension skills, writing abilities and content knowledge. Based on this, the subsequent chapter will review a professional developed designed to mitigate the problem and improve assessment scores of ELLs.

Chapter 3: Description of the Professional Development

In the following chapter I will review a professional development designed for a science department at charter high school in Western New York. The school currently faces low passing rates among ELLs on high stakes New York state Regents exam assessment. A great deal of this problem may be due to the language and literacy demands of the assessment and students underdeveloped reading and writing skills in the content area. In order to mitigate the problem the science department will be introduced to an inquiry-based framework which integrates language and literacy into content area instruction. The goal is to further develop the academic vocabulary, advance ELLs ability to interact with science language functions and provide opportunity to develop reading comprehension skills in the content area. With this shift in focus teachers will be equipped to meet the needs of ELLs while continuing to deliver the course content necessary for the end of year high stakes assessment. The end goal is an increase in assessment scores and an overall higher passing rate in the school.

Content of Professional Development

This professional development (PD) consists of four parts each lasting between twenty and forty minutes. The PD is designed to provide secondary science teachers at a charter high school in Western New York an opportunity to develop their understanding of an inquiry-based approach. The sessions are designed to explore an inquiry-based approach which integrates language, literacy and content and modify a lesson of their own to give the framework a try in their own classroom. This PD workshop is designed to take place before the start of the school year following the student's completion of the June and August New York state Regents assessment. The rationale for this timing is to have the results from the most recent assessment to analyze as well as before the start of the school year as to start with a new concept in mind. The

PD will involve the science department including teachers within the content areas of living environment, earth science, chemistry and physics. The teachers in this specific content area all co-plan and follow the same lessons with another teacher in the department. Based on this purposeful grouping and collaboration will be implemented throughout the PD.

PD: Part One

Upon arrival teachers will be advised to sit with the person who teaches the same specific subject as them, i.e. living environment pairs, earth science pairs, etc. The teachers will also pick up the "tools packet" which will include all the necessary materials to be used throughout the PD (see Appendix, Figure 1). On the front page of the packet will be the agenda (see Appendix, Figure 1) with intended learning outcomes for the teachers to review independently and eventually as a group at the start of the workshop. When all teachers have arrived, the facilitator will begin by welcoming the teachers, introducing them self and sharing the norms for the PD. The facilitator will move forward with material by sharing the intended learning outcomes, reviewing the agenda for the four-part PD and explaining the "tools packet" they received.

Introduction and Data Analyzation

Teachers will be advised to look at the data in the "tools packet" which draws on assessment results from local districts in Western New York with similar student population. The facilitator of the PD will also call upon the department lead to bring any results they may have available from their school. The facilitator will then guide groups to look at the ELL population in particular as the name of the PD is titled "An inquiry-based framework for the science classroom: ELLs and literacy." The facilitator will ask the teachers to think about why the results are so low, why is the ELL population reporting such low passing rates? The facilitator will begin a brainstorm on the front board allowing teachers to shout out any thoughts or responses

they may have for it. All of the responses will be considered valid and added regardless of whether they directly meet the goal or not.

Assessment Question Analyzation

Once the group has finished the initial brainstorm the facilitator will tell teachers to keep this question on their mind as they begin to analyze a multiple choice and short response question modified to appear similar to the Regents assessment (see Appendix, Figure 2). Participants will be provided with the definition of the level transitioning according to NYSESLAT and examples of student work at that level. This will allow teachers a better understanding of how an ELL at this level may approach the questions. In their co-teaching pairs they will take a close look at the first sample question, the facilitator will ask teachers to read the question carefully and imagine they were an ELL student them self. The facilitator will ask teachers to jot down any challenges the question may pose for an ELL as well as general remarks as they result to ELLs and question itself. Co-teaching pairs will share their responses aloud with the whole group before moving on to the second analyzation of the short response question. Once the pairs have had sufficient time to think and collaborate on the topic the facilitator will again pose the question, “Why is the ELL population reporting such low passing rates?” Any responses will be added to the brainstorm with the facilitator circling any responses pertinent to the answer. The facilitator will explain the problem facing ELLs on the literacy and language heavy New York state science Regents assessments. The facilitator will turn back to the intended learning outcomes to highlight the focus of today’s workshop and form of mitigating the problem: integrating language and content through an inquiry-based approach.

PD: Part Two

Establishing an Understanding of the Inquiry-Based Approach

After establishing the problem through clear and concrete examples from the Regents assessment the teachers will move forward with building their understanding of the proposed solution, an inquiry-based framework. As shared in the article from Santau et al. (2011) it is critical that teachers develop a base understanding of the framework with it's potential benefits to create a solid ground before moving forward into action. The group will turn to the page in their "tool packet" titled "Inquiry-Based Framework" (see Appendix, Figure 3). To begin this part of the PD teachers will take a look at the title and jot down anything that comes to mind, this may include words, phrases, a definition or examples. Once teachers have been given ample time to begin eliciting background knowledge the facilitator will ask the whole group to combine their thoughts and create a definition of the framework. Following the creation of the group definition the facilitator will share with the group that they just used inquiry-based learning. Using collaboration that was learner centered they constructed their own meaning, an essential aspect of inquiry-based learning. The facilitator will then provide a combined definition of inquiry-based learning based on the literature in chapter two.

Using the literature from chapter two the facilitator will provide some of the findings to illustrate the benefits of integrating these interventions into the classroom. The facilitator will then provide the key phases of an inquiry-based approach, explain possible examples and review the concepts for literacy integration. On this guide (see Appendix, Figure 3) teachers will also be provided with additions to make to their future lessons, writing content and language objectives as well as a checklist for the inquiry-base framework.

Review of the Sample Lesson

In the latter half of part two of the PD the facilitator will walk teachers through a lesson that is centered around an inquiry-based approach which purposefully integrates content, language and literacy. In the "tool packet" teachers will be provided with the lesson and space to add annotations (see Appendix, Figure 4). In the lesson the facilitator will point out the addition of content and language objectives, something they will add to their own modified lessons in part four. The facilitator and teachers will play a balanced role in this portion both being given the opportunity to pause to ask questions and share personal annotations for the whole group. The goal of this portion of the PD is for teachers to see how this framework comes to life in the classroom as well as the feasibility in adding simple aspects daily.

PD: Part Three

The following aspect of the PD will allow teacher to collaborate and work hands-on with the framework to modify a lesson of their own to fit within the inquiry-based model. Lee et al. (2008a) and Greenleaf et al. (2011) suggest providing teachers opportunities to apply the interventions directly rather than simply reading about them. Through this process teachers are able to analyze the strengths and weaknesses of each, how it may apply in their unique classroom and to get generally comfortable with the strategies.

Lesson Modification

Co-teaching pairs have been asked to bring their lesson binder to draw on a material they have used in the past as to not overwhelm teachers with the creation of a completely new lesson. Co-teaching pairs will use the "Inquiry-Based Framework" (see Appendix, Figure 3) page from the "tool packet" as well as the sample lesson (see Appendix, Figure 4) to reference suggestions, language and content objectives as well as examples. In the tools packet participants will be

provided with a step by step guide to aid them in modifying their lessons (see Appendix, Figure 5) This will serve as a base to guide the participants but they are welcome to make additions or changes outside the step by step guide (see Appendix, Figure 5). The facilitator will circulate the room to offer suggestions, answer any questions as they arise and review the objectives with each pair as this will be new to all participating teachers.

Once pairs feel they are completed they will swap plans with a pair from a different science subject to offer feedback. Buxton et al. (2008) recommends the use of cross-subject collaboration as it provides another set of thoughts and possible points of view. It is also beneficial for the department to feel like a team taking on the new framework together and eventually able to support one another as they enact the interventions in the classroom. The facilitator will ask the participants to share a few of the area they modified to make their previous lesson fir within the inquiry-based framework.

Final Reflections and Exit Ticket

Finally, the facilitator will ask the teachers to return to the agenda (see Appendix, Figure 1) with the written intended learning outcomes. The teachers will answer two final reflection questions for the workshop before the facilitator explains part four of the PD that extends beyond the workshop. The participants will answer the exit-ticket (see Appendix, Figure 6) questions, “Which ideas, strategies or interventions that fall within the inquiry-based framework will you try in the classroom?” and “How will you ensure you attend to language and content development of ELLs in your classroom?” The PD will conclude with an explanation of part four to the participants, the sharing of final thoughts by any members and the facilitator providing contact information for future reference or communication.

PD: Part Four

The final aspect of the PD will not take place during the workshop but rather in the classrooms with students.

Inquiry-Based Approach Lesson Delivery and Observation

Co-teaching pairs will individually deliver their modified inquiry-based lesson to their students while the other observes. As one of the members of the pair observes they will complete the feedback guide (see Appendix, Figure 7) to discuss following the lesson. Each co-teaching pair will play both roles and meet afterwards to discuss the feedback and share general feelings about how the lesson went. This extension of the workshop is to give teachers an opportunity to test out the interventions in the classroom and for teachers to stay accountable after the workshop itself is completed. The teachers will receive a Google Form (see Appendix, Figure 8) from the facilitator to complete to help the reflection process of the lesson, the use of inquiry-based strategies and the effects it had on ELLs. August et al. (2009) notes the importance of time for reflection to continue teacher growth and the expanded application of interventions. At the end of the form the facilitator will add a note to encourage teachers to turn back to their "tool packet" and continue finding ways to integrate the inquiry-based approach into the classroom.

Tools and Rationale

Five tools are used throughout the four-part workshop and extension phase. Each of the tools will be picked up by participants upon arrival in a neat stapled grouping and referred to as the "tools packet." The first page of the "tools packet" will start with an agenda (see Appendix, Figure 1) that provides participants with a guide of what to expect during the PD. This page will also contain the intended learning outcomes of the PD which will be referred to at the beginning and returned to throughout. Following the introduction the remaining four part of the workshop

each have a tool to go alongside including a data/assessment breakdown (see Appendix, Figure 2) in part one, an inquiry-based framework guide (see Appendix, Figure 3) in part two along with a sample lesson (see Appendix, Figure 4). In part three teachers will receive a step by step aid (see Appendix, Figure 5) to assist in modifying their lesson as well as an exit ticket slip (see Appendix, Figure 6). Lastly, in part four teachers will utilize a peer observation form (see Appendix, Figure 7) and a Google Forms (see Appendix, Figure 8) for reflection in the extension phase.

The data/assessment breakdown tool (see Appendix, Figure 2) is designed to get teachers interested from the start and make the PD workshop highly relevant and applicable to their population. The data is derived from districts in the Western New York area with a similar ELL population. Additionally, the facilitator has asked the head of the department to bring relevant data from their own school to view. The assessment breakdown includes two questions modeled after examples from the January 2020 Regents exam to provide teachers with an opportunity to closely analyze the questions from an ELL perspective. The first is a multiple-choice question with a large amount of academic vocabulary, a variety of language functions necessary and a high level of reading comprehension skills in science. The second question is a short response question which indicates the writing skills in the content area ELLs must possess to be successful. The goal is to put teachers at the center of discovery and have them identify the problem occurring on these high-stakes assessments. A section is provided with each assessment question for teachers to jot down their thoughts and general conclusions about the questions.

In part two of the PD the participants begin constructing the understanding of the inquiry-based framework and how it applies to the science classroom. The inquiry-based framework tool (see Appendix, Figure 3) provides participants with a section for writing down their current

understanding of the topic, deriving their own group definition followed by a box to highlight the facilitator's definition. It then provides teachers with current research about the potential benefits of integrating language, literacy and science. Finally, teachers are provided with a tips and tricks section which highlights possible interventions to incorporate into the classroom and a guide to writing language and content objectives. This tool is highly information based and will be used as a reference sheet moving forward.

In the latter portion of part two of the PD teachers are provided with a sample lesson plan (see Appendix, Figure 4) and the facilitated walk through. This tool includes the lesson plan itself with an additional space provided to add notes, annotations or key information. The lesson will be adapted from lesson plan used at the school combined with modified aspects of the SIOP plan. Throughout this portion, the facilitator and participants alike will highlight critical aspects of the lesson the interventions utilized and specifically the content and language objectives. The intended outcome of this portion is for participants to see the framework come to life in a lesson similar to something they may incorporate in their own classroom.

In part three of the assessment teachers will receive a step by step guide (see Appendix, Figure 5) to assist in their lesson modification. The guide will list a learning outcome, provide directions and give steps to integrating portions of an inquiry-based approach. The guide will serve as a base for participants to draw from, but they will be encouraged to go beyond the simplified step by step guide. In addition, teachers will utilize a short exit ticket (see Appendix, Figure 6) with two reflective questions at the conclusion of the lesson modification and PD. The exit ticket will include the following two questions, "Which ideas, strategies or interventions that fall within the inquiry-based framework will you try in the classroom?" and "How will you ensure you attend to language and content development of ELLs in your classroom?" Both

questions are used to wrap up the PD and push participants to think about the information they learned in terms of their own classrooms.

During the extension phase of the PD, part four, teachers will observe one another in the classroom delivering the newly modified lessons to students. During this portion of the extension phase teachers will utilize a peer observation form (see Appendix, Figure 7) to structure the observation. The intention is for teachers to actively learn and make reflections as they teach the lesson and observe. The peer observation tool (see Appendix, Figure 7) will be used to facilitate discussion between teachers following the lesson. It will highlight the strengths, areas for growth, careful observations of ELLs and general thoughts. The final tool that will be incorporated in the PD will be sent out to participants following the workshop and the completion of the extension phase. In this phase teachers take turns incorporating their new lesson into the classroom an observe one another doing so. Teachers will receive a copy of the Google Form (see Appendix, Figure 8) via email which will provide a section to rate their understanding of the framework, ability to apply interventions and overall success of their lesson on one through five scale. In an additional section participant will respond to three open-ended response questions. Finally, a general feedback and final thoughts to the facilitator section will be provided. The goal of this section is for teachers to extend their thinking and do a final reflection on the complete process. The facilitator will also gain meaningful feedback to adjust the PD for future sessions. A final note will be added to the Google Form encouraging teachers to look back at the inquiry-based framework guide (see Appendix, Figure 3) in the future to continue incorporating the interventions and strategies for the benefit of ELLs and all students alike.

Professional Development as a Solution to the Problem

The PD is designed to provide teachers with an introduction to the inquiry-based framework which supports the development of language and content knowledge of ELLs in the science classroom. The poor assessment results of ELLs on high stakes testing may be in part due to underdeveloped language and literacy skills leaving students unable to demonstrate content knowledge.

During the professional development participants will construct a base understanding for the framework and be provided with possible intervention strategies for their own classroom. Most importantly, teachers will modify a current lesson to align with inquiry-based learning to integrate language and literacy into an everyday lesson. The goal is for teachers to understand the potential benefits for ELLs and the feasibility of adapting what they already use to assist ELLs in finding greater success. Teachers will recognize the potential this framework offers to all students including underdeveloped readers, a common difficulty in urban districts. Additionally, participants will see that simple modifications and addition of strategies to lessons will allow for a focus on language while also delivering the same content.

It is important to recognize that this is a base for building teachers understanding of the framework and its potential benefits towards mitigating the problem. This is one lesson they have adapted; the goal is to continue the integration of the strategies, language and content objectives and a focus on language, literacy and content. While this is not a simple fix to the problem it is one step in providing meaningful instruction to all students including ELLs.

Intended Outcomes of the Professional Development

Based on the findings of a variety of descriptive and experimental on the effects of an inquiry-based approach in the science classroom and its impact on ELLs the PD has been

designed to inform secondary science teachers on the potential benefits of an integrated science and language classroom. The PD has been purposefully planned to take steps towards mitigating the low passing rates on high stakes New York state science assessment for ELLs. Due to this, there are three critical intended learning outcomes that will be clear to the participants at the beginning and throughout the PD.

The participants will be provided with an agenda (see Appendix, Figure 1) for the workshop which details the intended learning outcomes. First, teachers will develop a base understanding of the framework and it's researched based evidence for success. This will be a critical aspect of part two of the PD, providing participants an opportunity to construct meaning, ask questions and create a sound base of understanding before gaining a sample or direct practice. Additionally, teachers will be equipped with a variety of strategies to assist in integrating language and literacy into the classroom including research-based interventions and the ability to construct content and language objectives. Participants in the PD will have access to the inquiry-based framework guide (see Appendix, Figure 3) to continue integrating strategies and objectives into the classroom following the workshop. Finally, teachers will be able to modify a lesson to include an emphasis on language and literacy while continuing to deliver the same content material. This will provide participants with an opportunity to apply the framework, interventions and objectives into their own classrooms to make the inquiry-based approach come alive. The ultimate goal is for participants to continue drawing on the information from the PD to make small steps towards developing ELLs language, literacy and content knowledge for ultimate success on high stakes testing.

Chapter 4: Conclusion

This capstone served to answer the question "How do we improve high-stakes assessment scores of ELLs in the content areas in particular science?" After carefully reviewing assessment scores, having conversations with secondary science teachers and drawing on my own experiences in the classroom I decided to analyze the assessment even further. It became clear after reviewing several multiple-choice questions that the linguistic demands were extremely high and a need for nearly proficient literacy skills including reading comprehension, writing and more appeared necessary. Based on these findings, I set out to find a solution to mitigate the problem and increase passing rates among ELLs in the science content area. After reading a variety of research I concluded that an inquiry-based approach which simultaneously emphasizes content area learning and the integration of language and literacy skills was a critical first step.

Major Conclusions

After thorough research on this topic there are two clear conclusions that respond to the problem being mitigated and an additional two conclusions on the intended results of the professional development. The initial conclusion is that in order to strengthen assessment results and ease the pressure of graduation requirements on ELLs the solution is no longer increased remedial classes or after school intervention. Rather the solution is to design and deliver a curriculum that purposefully teaches language and develops literacy skills alongside a content driven course. Also, this type of integration requires a framework that moves beyond textbooks, note-taking and overhead presentations. An inquiry-based approach puts meaning-making, question forming and hands-on experience in the hands of students while providing carefully planned scaffolds to support student learning. In addition, the professional development is designed to provide teachers with a base understanding of how the framework works, its

potential benefits and an opportunity to apply learned strategies in their own classrooms. Ultimately, the objective is for teachers to take small steps in adding an inquiry-based framework that starts by integrating content and language objectives into each lesson to encourage all content area teachers to consider attending to both critical needs in every lesson.

Implications

After conducting this research, it is imperative to examine the impacts this proposed solution will have on student learning as well as teaching. The use of an inquiry-based approach that emphasizes both content and language provides a variety of benefits for students and teachers alike.

On Student Learning

Throughout the research the potential benefits for students stayed at the heart of the issue. Principally, ELLs will directly benefit from contextualized language and literacy development that goes beyond the typical ESL or English instruction. The use of an inquiry-based approach will develop skills that are applicable beyond that science classroom and are considered cross-curricular. Furthermore, an inquiry-based approach is hands-on and student-center with learning facilitated by the teacher. Consequently, the needs of ELLs are emphasized with greater support in their achievement of independent and collaborative meaning making and question forming. For example, this includes increased use of visuals, attention to words, eliciting background knowledge, drawing on student experience, purposeful grouping and demonstration of techniques. ELLs benefit from increased attention to their individual learning needs, potential for academic achievement and overall sense of belonging in the learning environment. Finally, in secondary classrooms applying an inquiry-based framework students will benefit from increased passing rates on high stakes assessments. Thus, ELLs will encounter decreased assessment

pressure, face less challenges surrounding graduation and the opportunity to access other learning opportunities during their high school experience.

On Teaching

The introduction of an inquiry-based framework will allow content area teachers to develop their knowledge of working in the content areas with ELLS. Teachers will benefit from expanding their understanding on research-based practices to meet the needs of ELLs. Undoubtedly, integrating content and language objectives with an inquiry-based approach will benefit ELLs and others in the classroom. Additionally, teachers will move towards more contextualized and engaging teaching strategies that go beyond standard practices like textbook, note-taking and PowerPoint presentations. While this proposed framework directly considers the needs and potential benefits of ELLs it will affect all students in a positive manner.

Recommendations

After completing a plethora of research on the topic of inquiry-based learning and its effects on ELLS it is evident that researchers have begun to thoughtfully explore the issue but there are still more areas that should be considered. Throughout the process I noted an abundance of research focused on elementary classrooms integrating language acquisition and content. This may indicate a need to expand research in high schools as it relates to inquiry-based learning and ELLs. It is particularly important in the current environment of teacher accountability and high stakes assessment to find ways to integrate teaching approaches that go beyond information dumping and regurgitating of information. Additionally, I am interested in learning more about the impact of this approach with newcomer ELLs. With hands-on activities and student-centered approaches being at the center of the framework we need further research on the effective integration that provides sufficient support. Finally, I was unable to find research that touched on

the impacts of an inquiry-based model and the way it shapes overall student thinking and curiosity. I am wondering if an approach that encourages student meaning-making and question forming changes the way students thinking across content areas and beyond the classroom. While there was a variety of research on the topic it is critical to think beyond this and other directions it may head.

Final Thoughts

During the exploration, research and writing phase of this capstone my own students remained at the forefront. With each article I read, I considered my students. How would this impact their assessment results? Would this be effective in the classroom? How would I give them proper support to this in a cooperative group or independently? In the end, it seems an inquiry-based approach which considers content, language and literacy is one possible solution towards heightened NYS Regents assessment scores among ELLs. A framework which develops the whole student considering all their language needs while increasing learning opportunities in the content area.

References

Arends, R. I. (1998). *Resource handbook. Learning to teach* (4th ed). McGraw-Hill.

August, D., Branum-Martin, L., Cardenas-Hagin, E., & Francis, D. (2009). The impact of an instructional intervention on the science and language learning of middle grade English language learners. *Journal of Research of Educational Effectiveness, 2(*4), 345-376. https://doi.org/10.1080/19345740903217623

August, D., Branum-Martin, L., Cardenas-Hagin, E., Francis, D., Powell, J., Moore, S., & Haynes, E. (2014). Helping ELLs meet the common core standards for literacy in science: The impact of instructional intervention focused on academic language. *Journal of Research on Educational Effectiveness, 7*, 54-82. https://doi.org/10.1080/19345747.2013.836763

Buxton, C., Lee, O., & Santau, A. (2008). Promoting science among English language learners: Professional development for today's culturally and linguistically diverse classrooms. *Journal of Science Teacher Education, 19(*5), 495-511. https://doi.org/10.1007/s10972-008-9103-x

Elliot, S. N., Kratochwill, T. R., Littlefield Cook, J., & Travers, J. (2000). *Educational psychology, Effective teaching, effective learning* (7th ed.). McGraw-Hill College.

Garcia, O., & Wei, L. (2013). *Translanguaging: Language, bilingualism and education.* Palgrave Macmillan.

Gonzalez, N., & Moll. L., & Amanti, C. (2006). *Funds of knowledge: Theorizing practices in households, communities, and classrooms.* Routledge.

Greenleaf, C., Litman, C., Hanson, T., Rosen, R., Boscardin, C., Herman, C., Schneider, S., Madden, S., & Jones, B. (2011). Integrating literacy and science in biology: Teaching and

learning impacts of reading apprenticeship professional development. *American Educational Research Journal, 48(*3), 647-717. https://doi.org/10.3102/0002831210384839

Guccione, L. (2011). Integrating literacy and inquiry for English learners. *The Reading Teacher, 64*(8), 567-577. https://doi.org/10.1598/RT.64.8.2

Lee, O., Deaktor, R., Enders, C., & Lambert, J. (2008a). Impact of a multiyear professional development intervention on science achievement of culturally and linguistically diverse elementary students. *Journal of Research in Science Teaching, 45*(6), 726-747. https://doi.org/10.1002/tea.20231

Lee, O., Maerten-Rivera, J., Penfield ,R., LeRoy, K., & Secada, W.G.(2008b). Science achievement of English language learners in urban elementary schools: Results of a first-year professional development intervention. *Journal of Research in Science Teaching, 45*, 31–52. https://doi.org/10.1002/tea.20209

Maaruf, S., Kamal, A., Othman, N., & Zulkifli, V. (2016). Approaching a culturally responsive pedagogical module through the Delphi technique. In R. Anwar, M. Mahamood, D. H. Md. Zain, M. K. Abd Aziz, O. H. Hassan & S. Z. Abidin (Eds.), *Proceedings of the art and design international conference* (203-214). Springer Singapore.

Mastropieri, M., Scruggs, T., Graetz, J., Norland, J., Gardizi, W., & Mcduffie, K. (2005). Case studies in co-teaching in the content areas: successes, failures, and challenges. *Intervention in School and Clinic, 40*(5), 260-270. https://doi.org/10.1177/10534512050400050201

New York State Department of Education Data Site. (2018-2019a). *Buffalo city school district New York state report card.*

https://data.nysed.gov/essa.php?instid=800000052968&year=2019&createreport=1&regents=1&cohort=1

New York State Department of Education Data Site. (2018-2019b). *Rochester city school district New York state report card.* https://data.nysed.gov/essa.php?instid=800000050065&year=2019&createreport=1&regents=1&cohort=1

New York State Education Department Bilingual Education and English as a New Language. (2018). *Blueprint for English language learner / multi language learner success.* http://www.nysed.gov/common/nysed/files/nys-blueprint-for-ell-success.pdf

New York State Education Department Curriculum and Instruction. (2019, January). *New York state diploma requirements for students enrolled in grades 9-12.* http://www.nysed.gov/common/nysed/files/programs/curriculuminstruction/diplomarequirementsfinal011019.pdf

New York State Education Department Office of State Assessment. (2020). *NYSESLAT parent information brochure.* http://www.nysed.gov/common/nysed/files/programs/bilingual-ed/nyseslatparentinfobrochure-english.pdf

Santau, A., Maerten-Rivera, K., & Huggins, A. (2011). Science achievement of English language learners in urban elementary schools: Fourth-grade student achievement results from a professional development intervention. *Science Education, 95*(5), 771-793.

Settlage, J., Madsen, A., & Rustard, K. (2005). Inquiry science, sheltered instruction and English language learners: Conflicting pedagogies in highly diverse classrooms. *Issues in Teacher Education, 14*(1), 39.

Shaw, J., Lyon, E., Stoddart, T., Mosqueda, E., & Menon, P. (2014). Improving science and literacy learning for English language learners: Evidence from pre-service teacher preparation intervention. *Journal of Science Teacher Education, 25*(5), 621-643. https://doi.org/10.1007/s10972-013-9376-6

Stoddart, T., Pinal, A., Latzke, M., & Canaday D. (2002). Integrating inquiry science and language development for English language learners. *Journal of Research in Science Teaching, 39*(8), 664-687. https://doi.org/10.1002/tea.1004

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Weinburgh, M., Silva, C., Smith, K., Groulx, J., & Nettles, J. (2017). The intersection of inquiry-based science and language: Preparing teachers for ELL classrooms. *Journal of Science Teacher Education, 25*(5), 519-541.

Appendix

Figure 1

Agenda

An Inquiry-Based Framework for the Science Classroom: ELL's and Language

Outcome

Your department will gain the knowledge and skills necessary to integrate an inquiry-based approach that focuses on the development of content, language and literacy skills of ELL's in the science context.

Learning Goals

Your department will:

1. Develop a common understanding of the inquiry-based framework and its potential benefits for ELL's.
2. Be equipped with interventions that align with the integration of literacy and language and an ability to write quality content and language objectives.
3. Modify a current lesson to emphasize an inquiry-based approach that provides the same content with the addition of language and literacy.

Agenda Items

Part 1: Identifying the Problem (20 minutes)

- Data review
- Assessment item analyzation – multiple choice and short response
- Group think

Part 2: Inquiry-Based Framework (40 minutes)

- What is it? – definition creation
- Research-based evidence
- Interventions / writing content and language objectives
- Sample lesson walk through

Part 3: Lesson Modification (30 minutes)

- Step by step lesson modification
- Final reflections and exit ticket

Part 4: Extension Phase – Inquiry-Based Lesson Alive in the Classroom

- Lesson delivery + peer observation
- Google forms reflection form

Figure 2

Data and Assessment Analyzation

Living Environment 2018-2019

English language learners	Total # of students tested	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Proficient (Levels 3 + 4)
School 1	567	55%	23%	21%	1%	**22%**
School 2	833	60%	19%	21%	0%	**21%**
School 3	451	54%	26%	20%	0%	**20%**

Earth Science 2018-2019

English language learners	Total # of students tested	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Proficient (Levels 3 + 4)
School 1	182	68%	22%	9%	1%	**10%**
School 2	343	68%	17%	14%	1%	**15%**
School 3	61	61%	20%	20%	0%	**20%**

The above data can be found at: https://data.nysed.gov/

THINK - Why is the percentage of proficient ELL's so low?

Sample assessment question 1:
Which reactions are associated with metabolism? Use the list below.

(A) Photosynthetic reactions that store energy
(B) Cellular reactions that release energy
(C) Muscle reactions that use energy

1. A and C, only
2. B and C, only
3. A and B, only
4. A, B, and C

STOP + JOT: Imagine you are an ELL – what difficulties may this question pose?

Sample assessment question 2:
There are some poinsettia plants that have green leaves that eventually turn red. Since poinsettias change color when there are short days with less light during the winter months. A group of scientists want to explore the effect that different amounts of daylight have on leaf color change in poinsettias.

Design an experiment the scientists could use, remember to include the following:

a. state the hypothesis to be tested

b. describe how the experimental group will differ from the control group

c. share one way to increase the validity of the experiment

STOP + JOT: Imagine you are an ELL – what difficulties may this question pose?

THINK AGAIN - Why is the percentage of proficient ELL's so low?

Figure 3

Inquiry-Based Framework Guide

My ideas:
Group ideas + definition:
Definition:

Why apply this framework? List of Potential Benefits
1. Increase in content knowledge + academic vocabulary (Shaw et al., 2014; August et al., 2009)
2. Increase in content knowledge + writing skills (Shaw et al., 2014; Weinburgh et al., 2017)
3. Increase in content knowledge + reading comprehension skills (Greenleaf et al., 2011; Settlage et al., 2005)
4. Increased achievement on high-stakes testing (Lee et al., 2008a; Greenleaf et al., 2011)
5. Reduced achievement gap between ELLs + non-ELL counterparts (Shaw et al., 2014; Lee et al., 2008b; Santau et al., 2011)

Check your lesson for basic features.
A. Grouping B. Use of visuals C. Background knowledge D. Demonstration of techniques E. Words + more words F. Hands-on activities G. Literacy integration H. Scaffolding I. Assessment

Key to Inquiry-Based Learning	**Integration of Literacy**
1. *Interact* - gain information, elicit background knowledge (add reading) 2. *Clarify* - dig deeper, analyze data – teacher facilitated (add oral discussion) 3. *Question* - student question forming (add writing)	- Building oral language in class discussion - Construct academic vocabulary - Integrate reading – before, during and after strategies Examples: anticipation guide, admit slips, list-group-label, FLIP, marking the text, double-entry journal, ABC books

4. *Create* - student exploration, experimentation and hands-on learning (add reading or writing) **Examples:** - Using timelines - Creating surveys - Constructing graphs - Reading + applying informational materials - Simulations - Cooperative learning	- Integrate writing – apply science-based language functions, daily journals or notebooks

Content + Language Objectives
- The ***content objective*** tells *what students will learn during the lesson*. Example: "Today you will learn about the phases of metamorphism." - The ***language objective*** tells *how the students will learn.* Language objectives describe how students will demonstrate their understanding of the lesson by reading, speaking, writing, or listening. Example: You will be able to explain the cycle of metamorphism using a diagram and written explanation.

Figure 4

Sample Inquiry-Based Lesson

Date: 4 days **Grade/Class/Subject:** Seventh Grade Science

Unit/Theme: Inquiry-based fossil investigation: A focus on language acquisition **Standards:** Next Generation Science Standards, LS4.A and ESS2.B.

Content Objectives: Students will be able to identify fossils and record data.	*Notes:*
Language Objectives: Students will be able to construct a hypothesis, use oral language in a group to identify fossils and share their findings in a written reflection.	*Notes:*

Key Vocabulary: - Fossils Ex: cephalopods, trilobites, brachiopods + more - Function words/phrases Ex: because, since, such as, however, in conclusion, we found that	**Materials:** - Realia: fossils – 1 dozen in variety - Background knowledge PowerPoint - NYS fossil reading - Jigsaw graphic organizer - Word wall - Word wall index cards - Data collection sheets - Compare and contrast writing half sheet - Graph paper - Reflection slips	*Notes:*

Inquiry-Based Framework Features:		*Notes:*
1. Grouping	X	
2. Use of visuals	X	
3. Background knowledge	X	
4. Demonstration of techniques	X	
5. Words, words, words	X	
6. Hands-on activities	X	
7. Literacy integration	X	
8. Scaffolding	X	
9. Assessment	X	

Lesson Sequence:	*Notes:*
Day One A. Introduction + Building Background Knowledge - Teacher will show a Prezi presentation that incorporates pictures from the locations in New York State (NYS) where the fossils they will be examining were recently found. - Teacher will begin oral discussion to elicit background knowledge by asking questions that require students to think about the environment in which the fossils were found. - After having time to look closely at the fossils themselves students will share where these types of fossils may be found. Students may respond with answers that include some sort of body of water. - The teacher will then show these types of bodies of water on the PowerPoint for reference for all students and any students who lack the background experience. - The teacher will break students into groups and give each group a set of pictures with the fossils just viewed so they can begin exploring more closely. - Students will work in these small groups to discuss aloud responses to a set of short questions. As a whole class they will share and draw conclusions that will assist them in hypothesis writing the following day. B. Literacy Integration – NYS Fossil Reading + Anticipation Guide - To further their understanding of the topic and give general information students will read an informational text about NYS fossils. - In small groups they will complete the reading as a jigsaw with each member becoming an expert on one section of the reading. - Students will complete a graphic organizer of information as they read and share out. - ELLs will be given basic question prompts to help them summarize the findings of their given paragraph. *Day Two* A. Setting the Stage - Once students have built proper background knowledge the previous day, they will begin by forming hypothesis about the teacher provided question. In this lesson the teacher has chosen the question and students will explore it in small groups. What do fossils do to indicate environmental change over time?" - The teacher will provide a sentence starter for the "if-then" hypothesis statement. The teacher will also give a completed hypothesis that responds to a hypothetical scientific question for students to use as a model. Both of these are provided as a scaffold. - Each group will receive a set of index card with images of the fossils on one side and the name of the other. These will be used by groups as reference during the investigation. B. Guided Exploration	

- The teacher will explain the activity and break the class into groups. Groups have been prepared ahead of time with a variety of abilities and skill base in each group. Each group will have an ELL student. - The teacher will demonstrate the processes groups will need to use during examination on the front board and to each group individually. - The whole group will complete a full process of the identification together. Examining the fossils, tallying information and recording data. C. Group Exploration - Groups will begin the first set of fossils together using their data collection sheet. *Day Three* A. Group Exploration Continued - The remainder of fossils will be explored as a group. B. Literacy Integration – Compare + Contrast Writing - Each member of the group will complete a compare and contrast mini writing at the end of the investigation. They will choose two fossils from their data sheet to compare. - The teacher will review language functions used to compare and contrast on the front board for students to reference as they complete the writing. - A checklist of items to compare and write about will be provided to guide the writing. Students should complete 4-6 sentences comprising a paragraph. *Day Four* A. Oral Group Discussion of Findings + Analysis - Following the completion of the investigation the teacher will place write the two most common hypothesis written by the class on the board with a tally of how many students wrote each. They will discuss the findings and which hypothesis supports the final findings. - Each student will turn back to their own hypothesis and share whether they were correct or incorrect in their original idea. The teacher will provide sentence starters for each possible response. B. Visual Representation of Findings - As a class they will represent the findings from the exploration in a visual. On a large poster in the front of the room each group will share one type of marine example they found. The teacher will then place a pre-printed visual representation next to it. As a class they will draw from their findings an add the number that was found to each identified name and image. - Once the class completes the poster together sharing their findings each individual student will construct a bar graph to represent this information in a more scientific way. - The teacher will assist the class in the creation of the axis names, the scale, etc. Students will plot the information and create a key to match. - The ultimate goal is to use the bar graphs students created to assist them in being able to discuss the findings. The group will discuss the	

type of environment these animals are generally found and compare it with New York State (NYS). The teacher will place a map of NYS how it appears on the front screen. C. Literacy Integration – Final Reflection - Using the map on the front screen and the findings from the bar graph each student will make an inference about the change in NYS. - The teacher will provide a definition of the word inference before students begin writing. Each student will write 3-4 sentence response to demonstrate their understanding of what occurred in NYS based on all the information and exploration.	

This material was adapted from the National Science Foundation.

Figure 5

Step by Step Lesson Modification Guide

Learning Outcome: Participants will modify a current lesson used in the classroom to incorporate various aspects of the inquiry-based framework.

Directions: Use the inquiry-based framework in the tools packet to assist you in each step. Jot ideas down as you go on a separate sheet of paper or in the margin of the lesson. Lessons will then be modified electronically based on new ideas.

Step 1: Select a partner who teaches the same subject.

Step 2: Select a lesson from the first unit of your lesson plans to modify.

**Think about which lesson you could add reading or writing, a lesson that ELLs need greater support, a lesson you feel could be emphasize language development, etc.

Step 3: Update the content objectives and add language objectives.

Step 4: Look at the basic features of an inquiry-based model and think about which areas you want to focus on. You must add an activity that is student-centered and hands-on. Then select 2-3 more.

Step 5: Focus on the integration of literacy and language. This can include reading, writing, listening, academic vocabulary building, etc.

Step 6: Switch lesson ideas with another pair and offer further feedback.

Step 7: Update your lesson electronically.

Step 8: Make a plan to try the new lesson in the classroom and observe your partner.

Figure 6

Exit Ticket

1. Which ideas, strategies or interventions within the inquiry-based approach will you try in the classroom?

2. How will you ensure you attend to language and content development of ELLs in your classroom?

Figure 7

Peer Observation Form

Teacher: _____ Observer: _____

Date: _____ Lesson Title: _____

Part 1: Checklist

Place an "X" next to any items that fit within an inquiry-based approach you observed.

- Content and language objectives ____
- Grouping ____
- Use of visuals ____
- Background knowledge ____
- Demonstration of techniques ____
- Words + more words ____
- Hands-on activities ____
- Scaffolding ____
- Assessment ____
- Integration of literacy – reading ____
- Integration of literacy – writing ____
- Integration of language – academic vocabulary building ____
- Student exploration ____
- Question forming ____

Part 2: Observation of ELLs in the Classroom

Jot down any observations you make about ELL learning during the lesson.

Part 3: General Feedback

Think about the modifications particularly the inquiry-based approach and literacy integration.

Strengths	**Areas for Growth**

Figure 8

Reflection Form

1. What are your general thoughts or feelings following the delivery of the modified lesson?

   Enter your answer.

2. What went well in the lesson? What were the areas of strength?

   Enter your answer.

3. What are areas of growth for future lessons? What would you change or o differently?

   Enter your answer.

4. How did the students react to the inquiry-based approach? Particularly ELL's.

   Enter your answer.

5. How are you going to use the information from the PD or what you learned from delivering the lesson moving forward?

   Enter your answer.

6. Do you have any final thoughts, comments or ideas regarding any aspect of the PD? Please share any pertinent feedback to the facilitator.

   Enter your answer.

Thank you for your participation in all parts of the PD. Please continue to reference the information provided in the workshop to help ELL's reach greater success in the content area and high stakes assessment. Don't hesitate to reach out with further questions or thoughts in the future.

Figure 9

Presentation with Explanation of the Professional Development

https://voicethread.com/share/14943349/