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Learning Science In A Second Language

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LEARNING SCIENCE IN A SECOND LANGUAGE

by

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This work is dedicated to the twenty-three reasons I began this project-ser su maestra ha sido una gran aventura. Gracias.

"He who stops being better, stops being good."

-Sir Oliver Cromwell

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CHAPTER ONE

Introduction

It was my first day of teaching kindergarten, and I was prepared for anything. The tables were labeled. Coloring sheets had been laid out for all the students, and sixteen boxes of crayons had been unboxed for their coloring convenience. The first bell of the day rang, and my kindergarten students wandered into the classroom, confused about where to go and what to do. As I spoke to them, their confusion only grew, until finally one little girl began to cry. I knelt and asked her, "What's wrong?" and her reply through her tears was, "I don't understand you! Can you just speak English?!" My first day of Spanish immersion kindergarten, and already I had a student in tears.

The first day of kindergarten can be rough for any child, but there's something about not being able to understand the teacher that seems to make that first day even harder. Students are confused and a little scared of the new circumstances they find themselves in, and I spent many of the first days of language-immersion kindergarten are spent soothing students and making the first crucial inroads to building their working vocabulary in Spanish. As I worked with my brand new kindergarteners during the first few weeks of school, I saw many of them coming in with a wealth of knowledge of the world around them, but unable to understand what I was telling them to do or share their knowledge with their classmates who didn't share their language abilities. I found myself wondering-although language learning is a process, a long, slow road of making connections and learning expression-was there a way to connect some of what students might already know to help develop their budding Spanish language ability?

The guiding question behind this project is *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused*

learning objectives. This chapter looks at my background as a Spanish language speaker, an educator, and as a language immersion educator. In this chapter, I also explain my personal and professional motivations for choosing this topic and creating this resource for teachers. I conclude this chapter with an explanation of the rationale behind my topic.

Background

My personal language acquisition journey was long, winding, and nonlinear. I did not learn Spanish from school or family, as many do, but rather learned from family friends, librarians, shop clerks, and other children. Possessing a decent-sized vocabulary in Spanish and a fluid understanding of grammar, I spent much of my adolescence moving in and out of Mexico, and was fully fluent in colloquial Mexican Spanish by the time I was 16. Having never taken Spanish classes or attended classes in a Spanish speaking school, I was not aware of the deficiencies in my academic vocabulary until I began to teach in Spanish, and I had to work extensively to gain the same vocabulary I needed to teach my students.

I share my language journey to acknowledge that learning language is a process, not a skill easily learned or quickly mastered. Language immersion is both a difficult and rewarding sub-field of teaching, and Kindergarten sees students face some of their biggest triumphs and greatest challenges as they learn to express themselves in the new and different ways language affords.. Many of the students come in at the beginning of kindergarten knowing little more than the most basic vocabulary, and it can be frightening, frustrating, and boring for them to have a teacher who only speaks to them in a language they do not yet have the skills to understand. However, as the year progresses, the students make blindingly fast gains in the target language, accumulating vocabulary and grammar at such a rapid pace that it can be overwhelming even for the teacher. It is the responsibility of the teacher, then, to model appropriate grammar and

vocabulary for students to be able to understand and produce academic language for their school careers.

As a Spanish immersion teacher, exposure to vocabulary for students is constantly on my mind. I have to be vigilant in the words I choose to use with them, aiming to give them a wide vocabulary but also acknowledging that they will not understand everything I say at all times. I have to be deliberate about how their vocabulary is presented, as well as giving them organic and authentic opportunities in the classroom to produce language, as well. Language development is always the goal in my classroom, whether it's an obvious vocabulary exercise or a math lesson with underlying linguistic pieces. Much emphasis is placed on modeling grammar and vocabulary for students, which they in turn internalize and copy as they being to produce language themselves.

Motivations Behind this Project

Personal Motivation

After completing my undergrad in Intercultural Studies, I decided to move back to Mexico permanently, and took a job working at a children's home. The children's home where I worked was large enough to feature an on-site school, and I was assigned to work in the school teaching English to three to four classes a day. It was there that I learned that I had a gift and a passion for teaching. After teaching for several years, I chose to return to Minnesota to get my teaching license and began teaching at a Spanish immersion elementary school soon after.

My personal motivation for this project comes from wanting to provide my students with the same kinds of opportunities that were afforded to me by being fluent in another language. Because I can speak Spanish, I've been able to work abroad, teach in a very rewarding field, help others through translation, and enrich my personal life through relationships with non-English

speaking friends. Speaking Spanish is a part of who I am, and has made an indelible mark on my life. This is something I want for my students, as well.

This project has a dual focus, as it looks at using science to develop target language skills. I chose science for the simple reason that I think the natural world is fascinating, and I want to be able to transmit that sense of wonder to my students. At the beginning of the school year I began to consider how I might do that, when so few of them understood anything I was saying, and I landed on using science to help build those vocabularies. So much of kindergarten standards are vocabulary based, it seemed like a great opportunity to build their language skills and get to explore the natural world at the same time.

Professional Motivation

As stated above, vocabulary, especially in kindergarten, is one of the foremost goals I have for my students. They need to accumulate throughout the year a working vocabulary that allows them to go into first grade able to understand their work and their teacher. Of course, on top of this they have the same academic goals as any other kindergartener in the state, learning to read, add, subtract, etc. That is why this project is so essential: when teaching language immersion, every lesson is a language lesson. That is why I chose a language-centered project topic: it is my goal to improve in my practice every year that I teach, and teaching vocabulary is essential in early elementary immersion practice.

While this project is largely language based, I chose to also look at science in kindergarten, as well. In kindergarten, and in elementary school as a whole, science is under-taught, taking second place to math and literacy education. However it is my belief that science could and should be used to support math and literacy. The natural world is a cornucopia of math and literacy connections, and ignoring these connections does a disservice to students and

teachers alike. I chose to connect language acquisition within science content to underline a possible connection, as well as to acknowledge the importance of beginning to develop academic language skills early. Students can use their senses to discover the world around them while connecting their discoveries to vocabulary provided in Spanish, creating opportunities for comprehension based on both visual and auditory information.

Another aspect of this project is that it is inquiry based. Inquiry based learning (IBL) has been growing in popularity over the past few years. To summarize, IBL asks the teacher to allow students to be able to direct their own learning, to ask questions and have the time and materials to find answers for themselves. There are various ways to implement IBL in the classroom, but when done correctly, the end result is students who have both a deeper understanding and enjoyment of the subject matter, which is definitely a goal I have for my kindergarten students.

Rationale and Research Question

It is because of this underlying vocabulary goal that my guiding question developed. If every lesson is a vocabulary lesson, what can teachers do to enrich and enlarge that vocabulary? I chose to focus on one subject in particular-science-to give a specific focus to my question, though the linguistic aspects of the project can be used regardless of lesson topic. The focus of my project is using science to expand kindergarten Spanish immersion vocabulary. Science is such a rich medium through which to learn language because it provides many language opportunities for students: they are asked to look at the world around them and describe it, to identify living and non living things, to identify seasons, and many other things. Every standard in kindergarten science is one that is rife with the opportunity to teach language around it. My research question, then, is *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives.*

This project provides immersion educators a set of tools to help develop language vocabulary in kindergarten emerging multilingual students. Using Kindergarten science lessons and target objectives as a medium, teachers can explore methods and strategies with which they can help student vocabularies grow authentically.

Summary

I became a teacher because I love learning, and I teach Spanish immersion because of the opportunities afforded to me at a young age. I want to give those same opportunities to the students I teach, and accomplish this through teaching them Spanish as well as meeting other required standards. In immersion education, especially kindergarten, every lesson is also a language lesson. Therefore, I am researching ways to enrich and expand students' vocabularies. I chose to use science as the medium for this project because of the language opportunities it allows and the robust vocabulary it requires.

In Chapter Two, I will review literature pertaining to science and language acquisition, as well as inquiry-based learning and language arts/science connections. Using this literature, I will connect the current research in these areas with my project and how it impacts student learning and teacher practices. Chapters Three and Four will focus on an in-depth description of and reflections on the project based on this research.

CHAPTER TWO

Literature Review

Introduction

The guiding question behind this project is *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives.* This chapter looks at the literature surrounding major themes found in this project. The goal is to consider various aspects of language and science education with a specific eye towards lower primary and kindergarten education. The major themes explored in this chapter are language acquisition and immersion education, science standards, inquiry-based learning, and connections between language and science.

In order to understand the ultimate purpose of this project-enriching and expanding immersion learners' vocabulary-it is important to first understand how vocabulary and language acquisition works. Thus, the first section of this chapter provides a definition of immersion education, explores the strengths and weaknesses of immersion programs, and gives an overview of how students in immersion programs acquire vocabulary in the target language.

This chapter also looks at the science standards used in primary education, both Common Core and Next Generation. The strengths and weaknesses of each type of standard are looked at, as well as how they might be applied in kindergarten. Also considered is how these standards might be used with the goal of language acquisition in mind.

Inquiry-based learning (IBL) is a growing trend in science education, since it generates in students deep understanding and passion for the subject. The underlying understanding in IBL is that students will be able to direct their own learning, and it is the task of the educator to facilitate that learning. In primary education, IBL learning is a tool that allows students a way to

explore the world around them and helps to foster a love of science in students by allowing them to approach the subject with less structure than traditional methods might encourage.

Finally, this chapter also looks at connections between language and science. The chapter looks at what learning science in a second language might look like, how science might be used to build vocabulary in a student's native language, and what implications there might be for second language development, as well. This chapter underlines the overlap between language and science that is seen in my research question, and helps the reader to see how these two subjects are inherently connected.

Immersion Education and Language Acquisition

This section presents literature concerning the immersion school model, defining what immersion education is as well as considering some of its goals. This section also takes a close look at what language acquisition looks like in an immersion setting, citing both general and specific language acquisition research that has been conducted with students learning language through immersion education.

When considering the immersion school, it is important to keep in mind that each program is unique, and offers different options for students. Schools may use a full, partial, or dual immersion model. These designations refer to the amount of time spent learning in the second language (L2; the target language which is to be acquired) during the day, and whether or not instruction in the first language (L1; the majority language most students already speak) is offered.

Language immersion programs also have a variety of motivations: some are in place to help students learn the languages of power, such as English language immersion programs one might find outside of the United States. Some have the goal of teaching minority languages or

languages that are growing in politica/social power to students. Other programs aim to teach students heritage or endangered language (Genesee, 1985). The motivation of the program is an important consideration when looking at immersion programs, as is the amount of time learning L2 during the school day.

Connecting back to the original research question, *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives,* this subsection endeavors to paint a picture of what immersion education looks like, providing the reader with some of the history of this unique school model as well as some of the strengths and weaknesses inherent in it. This subsection will also provide the basics of how students learn language, both in general and in an immersion setting.

Language Immersion Programs

As stated above, language immersion programs are common around the world, have many purposes and take many different forms. In general, immersion programs are an answer to a linguistic need in a community, whether it is for students to learn the languages of power to better prepare for their futures or to learn the language of the pasts to celebrate their heritage (Genesee, 1985). Not all models of immersion education are the same; some schools choose to utilize a dual-language model, which allows for instruction in both L1 and L2 throughout the school day, usually at specific times, while other schools utilize a more radical, full immersion model, which calls for nearly all daily instruction to be done in the target language (Li, J., Steele, J., Slater, R., Bacon, M. & Miller, T, 2016). While individual immersion programs may vary, this subsection will look at commonalities found in immersion education and posit what some

inherent strengths and weaknesses of various models might be according to the literature found on the subject.

Soderman (2010) considers the question of which immersion model is best in the 2010 study of one Chinese-English immersion school located in Beijing. Soderman states that learning a new language is a greater task than simple acquiring vocabulary. Students are required to interact with one another in L2, navigating social tasks and academic instruction in the target language. This is a full immersion model, in which Soderman outlines the best practices seen for teachers and instructors, emphasizing the importance of consistent, ongoing assessment which ensures accountability. The assessments that Soderman encourages look at both language gains and academic growth, as the meshing of both areas in immersion education is of the utmost importance and a careful balance teachers must continuously monitor. Soderman concludes that in order to be successful, language immersion programs must be carefully constructed and monitored to provide the greatest learning and skill building for students.

Language Acquisition in Immersion Settings

Grøver, Lawrence, and Ryland's 2016 study follows language immersion preschoolers as they develop their second language (L2). The study concludes that, as previous research has demonstrated, development in L2 is greatly affected by proficiency in the students first language (L1). The study makes much of the connection between existing vocabulary in L1 and the seemingly easy transfer of this known vocabulary to L2. When students have already been exposed to a variety of words in L1, they are more easily able to make connections between existing vocabulary in L1 and the new vocabulary in L2, especially where conceptual or abstract language may be concerned.

The study supports another language learning theory, as well, which focuses more on time spent with L2 or the target language. This particular theory posits that any gains in vocabulary are the result of expose to the target language. A commonality between both theories is that they both require the student to be exposed to rich language, either in L1 or L2, for there to be growth in L2.

The transference of language knowledge has long been acknowledged in the linguistic world. Multiple studies have looked at how vocabulary in one language can transfer fluidly to another language, helping learners to grow in proficiency. The study conducted by Horst, White, and Bell (2010) specifically looks at using targeted strategies in L1 in the large/small group instruction to help students grow in their knowledge and understanding of L2.

According to Horst et al. participants in the study were able to compare L1 and L2 and find points of both commonality and difference. The results of this study find that applying L1 to student learning in a meaningful and deliberate way can have a positive effect on student understanding in L2. The study looked at the benefits of using L1 sparingly in the immersion classroom to help students make explicit connections between their native understanding of L1 and their burgeoning understanding of L2.

It is important to note, however, that this study was done with secondary level students, and no like study was perpetrated with primary level students by Horst et al. Many traditional models of immersion education choose to follow a complete immersion model, citing copious research that gives concrete benefits to this approach, where as dual and partial immersion models cite research similar to Horst et al. that gives the positive benefits of that approach. This study highlights one of the more prominent battles in immersion education.

Language immersion schools have the tough job of teaching both content and language at the same time. Schools take different approaches to this, some opting for partial immersion, some dual, and some full. This study particularly looks at full immersion schools that do not speak L1 during instruction time. While there are many positive benefits to this bilingualism in general, and full immersion in particular, there are also deficiencies in the model. According to Cammarata and Tedick (2012), while students gain high level language reception skills, their ability to produce language remains consistently lower than a native speaker. Immersion students generally struggle with grammar, as well as having difficulty with producing more complex language.

Part of the source of these deficiencies may be the lack of explicit language instruction in immersion schools. While immersion teachers may perceive that they are always teaching language through modeling and vocabulary instruction, they do not consistently balance language and content instruction (Cammarata & Tedick, 2012). Students consistently are given more time in content instruction than language instruction in the classroom, resulting in the high language reception abilities that are seen in many students, while explicit language and grammar instruction happen with less frequency. Students are also given less time to produce language, again resulting in the high receptive and low productive abilities that are commonly seen.

Cammarata and Tedick conclude that the only way to improve the current state of immersion language education is through better preparation in language immersion educators, recognizing that many teachers never received any immersion-specific training and are hired based on their high level of fluency in the target L2 language. Cammata and Tedick call for more teacher preparation in immersion education, more professional development, and better materials

available for immersion classrooms that consider the unique challenge of teaching language and content at the same time.

Walker and Tedick (2000) also concern themselves with balancing content and language in immersion education. Teachers are often not given additional training in immersion best practices, and are largely left with instructions to teach in L2 and the students will learn through context and exposure. While the study conducted by Grover et al. does make this conclusion, Walker and Tedick posit that students will learn more appropriately-developing both receptive and productive skills in L2-when they are given explicit instructions in the mechanics of the target language. This is not turning the immersion classroom into a high school language classroom and drilling students on verb conjugations and adjective agreement, but rather conducting the same sorts of grammar and language lessons one would expect to see in a mainstream L1 classroom with higher frequency and deeper explanation in L2 (Walker & Tedick, 2000).

Receiving their lessons in the target language produces excellent reception skills, but according to the findings of Walker and Tedick, students are not being asked to produce enough language to develop their language production skills to a proficient level. Similar to the study by Cammarata and Tedick, the eventual conclusion of the authors is that more teacher training and preparation is needed in order for instruction to happen in such a way that students are able to develop both productive and receptive language abilities.

From this section, we can conclude that immersion language education is a challenging proposition. As seen above, there are various strengths and weaknesses inherent in the various types of language immersion school models. It is important to consider an individual's

motivations for learning language as well as the learner themselves when choosing an immersion program.

One of the major themes seen in this section is the need for explicit instruction to aid language acquisition. In order for students to learn grammar structure and become more proficient in speaking accurately, the teacher must teach them how to say things, rather than speaking to them and expecting them to learn the complexities of an entire language through osmosis. The studies by Cammarata and Tedick and Walker and Tedick are especially adamant that in order for students to grow in language production as well as reception, specific, explicit language instruction must be provided, even in an immersion setting.

Students require understanding and support as they make the language gains to express themselves in the target language, and require their instructor to provide connection with language they may already know as well as giving them explicit language instruction. Teachers also must balance their content instruction and language instruction, making sure they are not simply developing their students receptive language abilities and giving them not outlet to expand language production ability.

Science standards

This section considers the various ways Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS) interact with language and literacy in early primary education. While using the CCSS is now common practice for many schools across the country, NGSS are relatively new and are not yet implemented as widely. Both sets of standards bring different strengths and weaknesses to the table. CCSS emphasizes the connection between success in science and literacy skills, and therefore promotes literacy heavily in lower primary grades (National Governors Association Center for Best Practices, Council of Chief State School

Officers [NGA], 2010). NGSS focus strongly on building the skills and practices needed to perform science in and out of the classroom, promoting a three-dimensional set of standards that allow students to "do" science in real and authentic ways (NGSS Lead States, 2013).

Common Core State Standards and Science Literacy

The CCSS English Language Arts (ELA) standards (NGA, 2010) encompass many aspects of science education, one of the most important of which is science literacy. CCSS include standards that ask students to think critically about what they read, to read and compare multiple sources, and to identify and judge evidence authors use (Young & Ward, 2012). In order to meet the CCSS, teachers are encouraged to provide literature for students in the classroom. In younger grades, special emphasis is placed on finding informational texts for class read-alouds, as students many times are not yet reading individually. This allows the instructor to present students with science related information in a format that they can understand and explore.

Trade books can (and should) be used for these read-alouds, since they are a resource for introducing both discovery and scientific inquiry. These trade books often reflect the passion the authors have for the subject, helping young readers share that passion and kindling their enthusiasm. These trade books can also complement any textbooks or hands on experiences that may be used in class, as well (Young & Ward, 2010). According to authors Young and Ward, the selection of texts should reflect accuracy, style, and design, and different types of informational texts should be included in the offering to students. Giving students access to science literature will help them develop the academic language and literacy skills they will need for ongoing success in science.

A positive by-product of the CCSS found by Young and Ward (2012) is that the standards cause an increase in the amount of informational texts that students hear, read, and

write. The author of this article found that students have limited exposure to information texts, and as a result struggle to comprehend such texts. Young and Ward posit that students need the most exposure to expository text, even claiming their comprehension of such will lead to overall success in school (Young & Ward, 2012). When using CCSS, it is important to remember that the standards promote literacy as well as science skills, as they are linked in the CCSS framework (NGA, 2010).

Though a strong link between science and literacy exists, the two are not often taught in a complementary style, even at times in lower primary. Kaiser and Kaiser (2012) find that the problem begins in early elementary grades, when students are not taught text and reference books as cornerstones of science education. Because students are not taught from a young age how to engage with challenging information texts, they do not find them valuable or relevant later in their academic lives. Authors Kaiser and Kaiser see the solution to this problem to be exposing students to more informational texts. They advocate for close reading in the classroom, teaching comprehension strategies explicitly, and integrating pedagogy into the lessons. The conclusions Kaiser and Kaiser (2012) draw are that the more a student reads and interprets informational texts, the more higher level academic vocabulary they will be exposed to, and this together with teacher interaction will lead to greater levels of comprehension.

Next Generation Science Standards

Built on the framework of previous science standards, NGSS is working for equitable education of students in science. Students gain a deep knowledge of science using these standards, as well as a set of practices for developing that knowledge. The NGSS were developed by state education agencies and other science education experts. Implementing the

NGSS practices in the classroom will cause a shift in the ways of doing things, but ultimately lead to better science education for students (NGSS Lead States, 2013).

Research indicates that educational leaders also have a key part to play in improving long-term science education (Penuel, Harris, & Debarger, 2015). These improvements can develop and sustain science education, keeping it relevant for students in a changing world. Teachers are encouraged to look at curriculum, PD, and assessment in order to best implement NGSS in the classroom, in order to create new and more equitable systems of science education. These equitable systems of science education must prepare all students to do science and use science to improve their communities and the world around them (Penuel et al., 2015)

Combining CCSS and NGSS for Learning

The CCSS and the NGSS are two sets of modern science standards that can be used in the classroom. Both focus on specific sets of skills: CCSS focuses on science literacy and accompanying literacy skills, and NGSS focuses on building science practices. Palincsar's 2013 article proposes a marriage of both sets of standards that would allow for student growth in the subject area. The NGSS builds on the CCSS; for example, the CCSS asks that students be exposed to scientific ideas through informational texts, close readings, and trade books. The NGSS then builds on this intellectual knowledge by requiring students to take part in the science itself, where they are then able to make conclusions and give rationales based on their previous exposure through literature and their current interactions with the science. Teachers can encourage the scaffolding of these ideas by considering CCSS text choices in the light of NGSS 3D standards (Palincsar, 2013).

Educators can also choose to guide their students through sustained inquiry. Students can conduct first hand investigations (developed from NGSS) and secondhand investigations (based

on CCSS informational texts) that provide deep understanding of the topic (Palincsar, 2013). By sharing their findings with others, students are able to not only observe and document the physical world around them, but learn what others have discovered, as well.

Since kindergarteners-although small-are eminently capable and thoroughly voracious learners, there is no reason to deprive them of hands on science education and deep conversation around learning. There is ongoing evidence that many skills related to science, such as disciplinary language and literacy are neglected in lower primary education. Large-scale studies in the United States have found that the average kindergarten teacher spends an average of 2.3 minutes a day teaching science, and 1.6 minutes reading from informational texts (Wright & Gotwais, 2017). In the light of the research outlined above from Young and Ward, as well as Kaiser and Kaiser, this is clearly not enough time spent in the classroom to develop the necessary science literacy skills students need to gain at a young primary level in order to maintain a high level of academic growth through their educational career.

In order to combat the disconnect between science education and science literacy, a study performed by Wright and Gotwais looks at designing and integrating science and language curriculum that meet the NGSS and CCSS standards for kindergarten. Findings indicate that both students' science learning and sophistication of language increased throughout the curriculum. One of the driving factors of this change in both learning and language use was the increase of time spent on science in the classroom, finding preliminary evidence that increasing time spent in the classroom on science education may support primary student learning and their oral academic language development. (Wright & Gotwais, 2017).

A major recurring theme in this section is the importance of science literacy in lower primary education. The literacy skills that students build in science are foundational for their

entire academic experience. Many studies and articles cite lack of exposure and explicit literacy instruction during lower primary years as a reason for underperformance in higher grades (Kaiser & Kaiser, (2012); Young & Ward, (2012; Wright & Gotwais, 2017). Young and Ward (2012) particularly advocate for the exposure of kindergarten students to many different types of informational texts and teaching emerging ways to interpret those texts in order to build science literacy skills instrumental for academic success throughout a students' educational career.

Another prevalent theme throughout this literature is the need for more time for science in the Kindergarten classroom. Various articles and studies reported that Kindergarteners made more growth and development linguistically and in content in classrooms where there was a daily science time (Young & Ward (2012); Kaiser & Kaiser (2012); Wright & Gotwais (2017)). This conclusion is consistent with linguistic research referenced in this work, which puts forth that students need repeated exposure to vocabulary in order to remember it and use it correctly (Grøver et al., 2018).

The need for the development of literary science skills, or exposure to science literature at a young age is another major theme found in this section. The work that the CCSS is doing to promote science literacy in the classroom and the kinds of texts that are suggested for young science learners to beginning to build the academic skills needed to decode informational texts, but it is just a beginning. Students need to be repeatedly exposed to high-quality science literature in order to build science literacy skills that will help them to decode challenging materials. Instructors and educators must curate their science literature selections and find engaging texts that kindle student interest for the scientific world.

Science standards help hold instructors to the highest standard possible in education. They give lessons a framework and connect different aspects of learning in valuable ways.

However, standards, even ones such as CCSS and NGSS, only tell the teacher what to teach; they do not give cues on how to teach the material. The next section gives information around inquiry-based learning practices, a hands-on, language-immersion friendly method of teaching science.

Inquiry-based learning

Inquiry-based learning (IBL) considers what students might be interested in learning, rather than what teachers decide the students need to know. Based on constructivist philosophy, this method of instruction was initially developed in the 1960's and has grown in popularity since it's conception. IBL allows students a sense of ownership over their own work, and helps generate interest and enthusiasm in the classroom. Allowing students to develop a passion for science education by being active participants in their learning creates a dynamic environment in which students are free to explore the world around them (Dostal, 2015). The following section looks at research into IBL and its effect on students academically and personally as it relates to their interests.

Inquiry-based Learning in Primary Education

The study performed by Suduc, Bizoi, and Gorghiu (2015) looked at how inquiry-based learning might make science in general more interesting to students. Suduc et al. asked students in first through fourth grades how enjoyable they found science lessons to be, and how enjoyable they wanted them to be. In order to incorporate questioning and active learning, they implemented inquiry-based learning strategies (IBLS). These are skills that are based on a student's knowledge and are both active and persistent. After implementing the IBLS, Suduc et al. presented the students involved with the same questions about how enjoyable their science lessons were. Over the course of the study, it was found that 95% of the students found inquiry-

based activities to be at least enjoyable, whereas 83% found them to be extremely enjoyable. The finding of Suduc et al. indicate that adding inquiry-based elements to a lesson create a science experience that is on a whole more enjoyable to students.

Samarapungavan, Patrick, and Mantzicopoulos (2011) looked a group of kindergarten classes testing an inquiry-based pilot program. A challenge for the researchers was to design guided inquiry for the students that allowed them to generate meaningful knowledge while using an investigative framework. After developing the frameworks, the researchers observed teachers using the materials in the classroom. At the conclusions of this study, Samarapungavan et al. found that when given appropriate guidance, students using this inquiry-based program show higher understanding of the subject matter and are more interested overall in science. They also perform higher than other students in objective measurements of science learning. Finally, the students, when asked, indicated that they enjoyed the material more than they had previously.

Van Uum, Verhoeff, and Peeters (2017) also considered the effect of student learning through IBL methods. In this study, Van Uum et al. considered the effects on student learning with teachers trained in inquiry-based learning. Teachers were trained to use "hard scaffolds" (documents detailing or providing exercises for the difficult parts of inquiry based learning), and "soft scaffolds." (references and explanations of the hard scaffolds). These scaffolds amount to explicitly teaching concepts around the scientific process in this study, and include templates and resources for the students. According to Van Uum et al. students were able to use the knowledge the teachers provided to further their own understanding through the implementation of specific hard and soft scaffolds used by the teachers in the study.

Inquiry-based Learning for Developing Bilinguals.

Pavlova, Marchev, Borisov and Harizanov (2015) looked at the possible implications of using IBL with emerging multilinguals in Bulgaria. Similar to English as a Second Language education (ESL) in the United States, students in this study were not able to speak the dominant language of education, and so were at a linguistic and academic disadvantage. This study highlights the positive effects of IBL for all student, but considers in particular its implications for second language students. In this study, Pavlova et al. encouraged teachers to model learning for students, using visual cues and demonstrating task for less language-based learning, similar to ESL and immersion practices. Students are able to participate in an experiment and see the results, resulting in easier comprehension than in a traditional heavily language-based science lecture. Teachers are also instructed to be explicit in their instruction of taxonomy, as all students can learn the new academic terms and phrases together, placing them on equal footing.

The literature around IBL contains one major theme; that is, the need for dynamic, engaging science lessons in the classroom. In lower primary and kindergarten education especially, lessons need to get the learner's attention and keep it. Conclusions from Suduc et al., as well as Samarapungavan et al. both support dynamic lessons creating positive learning experiences for students. Research from Pavlova et al. also support the use of IBL practices with emerging multilinguals, since providing them with less language-based instruction and more visual cues can provide a deeper and more positive learning experience for a student who is not yet fluent in a foreign language.

Connecting back to the guiding question of *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives,* the strategies of IBL include allowing students to get up, move around, and look around-providing opportunities for language enrichment and development through

exploration. Much of the language is unknown to all students, and therefore needs to be explored by all students, placing everyone on equal footing. This is an important step for creating an environment that allows for language growth and enrichment.

Connections Between Language and Science

The role vocabulary plays in the development of content knowledge is fundamental for comprehension (Gou, Wang, Hall, Breit-Smith & Busch, 2016). It is impossible to overstate the importance of the connection between language and science in kindergarten. Many, if not most of the targets students are expected to meet are language based, and this first year provides foundational language skills that students will use throughout their academic careers. In this subsection, a selection of literature concerning vocabulary acquisition and second language learning will be presented, concluding with how this information might be used appropriately in language immersion instruction.

This project is formed around the assumption that there is an inherent connection between science and language. It's evident the question: *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives?* This, therefore, is a key section of this chapter, since the reader will learn here why science lessons enrich language learning, and how instructors might further develop their skills in this area.

Effects of Science Instruction on Vocabulary

Although there are science standards in Kindergarten, much of the classroom time is dominated by math and reading/writing instruction. Herichs and Leseman (2014) explore the connection between science instruction and the development of academic language in kindergarteners, looking at the value of the language arts-science connection. They contend that

early science education is indeed a rich part of enhancing a child's motivation for science, and also lays the foundation for scientific concepts taught in higher grades. The results of the study indicate that, in low-pressure situations students are more likely to use the specific vocabulary the teacher has used in a correct and meaningful way (Herichs & Leseman, 2014). The implications of this in the classroom are that teachers who are specific and deliberate in their use of target vocabulary with kindergarteners are more likely to have students with larger academic vocabulary, because they will have been exposed to such language.

Other study results are consistent with this conclusion. Gou et al. (2016) look at the effect of science on young students' vocabularies. The study found that more and more educators and researchers conclude that new science vocabulary should be introduced through rich vocabulary instruction. This involves presenting vocabulary through a variety of contexts, such as discussion and oral conversation, the same kinds of low pressure situations that Herichs and Leseman endorse in their 2014 study.

The study presents several ways to enrich and expand vocabularies of young students, landing on science as the best method to expose students to rich vocabulary, since science is complex and full of processes that expose the student many times in a variety of ways to the target vocabulary. It is through the use of science that students may be introduced to lower-frequency words that will boost their understanding of underlying concepts, thus bolstering their academic language learning. The study concludes that while language and math are rightly the focus of lower primary, science instruction can enrich student vocabulary at no cost to other classroom learning.

In their 2016 study, Parson and Bryant look at deepening Kindergarten science vocabulary through a few methods, such as discussion, text readings, and specific instruction.

Much of the study particularly focuses on the value of explicit instruction of vocabulary with student application in context, since research suggests that teaching related words is a beneficial way to help students make gains in their scientific vocabulary (Parsons & Bryant, 2016).

Parsons and Bryant also found that using scaffolded questioning practices to be a useful way of expanding scientific vocabularies in students. Students use the vocabulary they are learning to answer the scaffolded questions and construct knowledge, helping them move towards deeper vocabulary knowledge as they gain the ability to use the vocabulary in decontextualized contexts. Their conclusions indicate that while there is value in using texts to introduce vocabulary, and that students should use the words in context during conversation, students need to be taught words explicitly before beginning to use them (Parsons & Bryant, 2016).

Learning Science in a Second Language

Lindquist and Loynachan hypothesize in their 2016 study about the suitability of science instruction in a Spanish immersion setting. They believe that science instruction in Spanish immersion schools is uniquely suitable, since students are able to communicate scientific concepts in two different ways, written and orally. Students in this study were able to grow in their Spanish language ability through the use of science notebooks, which allowed them to explore not only written language, but developed oral language skills as well through discussion of their observations in their notebooks.

Students were also able to develop their understanding of the vocabulary and language through the use of sentence stems. The sentence stems helped the students to record what they were setting and finding using the language of science. They also helped students distinguish and comment on the differences between conversation Spanish and the academic Spanish used for

science. (Lindquist & Lynachan, 2016). This notebook can also be used as a method of formative assessment, seeing inside the mind of the student and gauging student understanding and knowledge.

Spanish immersion students, then, need teachers who are consciously specific in question of the vocabulary they use in instruction, as they are providing both the backbone of students' academic language and their introduction to Spanish language vocabulary at the same time. According to the literature of this subsection, in order to develop student academic vocabularies teachers must deliberately and explicitly introduce and define the vocabulary in question, and then provide students with examples of the vocabulary in context. Students must then be given opportunities to use the vocabulary.

Far from being a hardship, this is the common method language immersion teachers use to teach the target language in the classroom. Therefore, teaching academic and science vocabulary becomes of question of planning and implementation, as the teachers in question should already be using the methods suggested by this literature.

Underlining the connection between science and language, a major theme in this subsection was that science education can be used to enrich vocabulary. Teachers can be consistent with the vocabulary they use with students when teaching, and can help students to develop their own vocabularies based both on explicit instruction and on their own experiences. Science education also gives students a low-pressure outlet to practice linguistic concepts and new vocabulary they may have learned from listening to the teacher.

Summary

The research question behind this project is *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused*

learning objectives. This chapter looked at literature surrounding major themes around this project, which are language acquisition and immersion education, science standards, inquiry-based learning, and connections between language and science. These subsections connect clearly back to the main research question and help to provide background information useful to finding an answer to my main query. Based on the research, this chapter made several conclusions about the nature of immersion education, the need for more science in lower primary classrooms, the need for explicit language instruction and judicious use of L1 in L2 classrooms, and the benefits on student learning when using inquiry based learning.

In Chapter Three, I will begin to address the question of what the project this research has been prepared for will look like. I will consider the many aspects included in this project, such as underlying frameworks and theories of adult education, what the setting and intended audience of the project is, and what the timeline of the project might look like. Chapter Three will also include a full overview and description of the project itself, and will clarify how the information presented in chapter two will be disseminated to the professional educators who are the intended audience of this project.

CHAPTER THREE

Project Description

Introduction

This chapter looks at the development of a professional learning for teachers on the subject, meant to help instructors answer this capstone's guiding question: *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives.* The professional development in question has been created using leading research in the field of language and science. It has the purpose of aiding educators in expanding L2 vocabulary through language-immersion friendly science education and enrichment.

This chapter contains a description of the setting and intended audience of the professional learning that is being developed, as well as a thorough description of the project itself. An explanation of the framework and strategies chosen is provided. A timeline for when this professional development could be implemented, and a timeline for the sessions within professional development is also included.

The main concern of this chapter is the composition of the project from which chapter two's literature is based on. It includes a full description of the project, as well as a plan for implementation. In the next paragraphs, I will explain how the project comes together using all of this information.

Overview of project

The project was developed as a response to the guiding question: *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives.* At the beginning of the year, many non-native

L2 speaking immersion students have little to no vocabulary in the target language of the immersion school, and connections need to be made between vocabulary in L1 that students already possess, and vocabulary in L2, which they are just being exposed to. This project proposes using science as the connection. Many students begin kindergarten already familiar with scientific concepts like flowers blooming, rain falling, or differences between animals. They are keen observers of the natural world, and many already possess the vocabulary in L1 to describe their world. The basis of this project then, is using kindergarten science lessons to make connections between L1 and L2 vocabulary, with the intent to enrich and expand on what students already know.

Moving into the instructional aspects of this project, the methods chosen to make these connections include a wide array of options, because no student is alike. The project proposes using methods such as discussion, explicit vocabulary instruction, and contextual language learning through informational texts and trade books, as wells as many other methods which can be utilized in the kindergarten classroom to aid in the expansion of kindergarten L2 vocabulary. Participants in this professional development are exposed to national science standards, and learn how these standards can work together to heighten engagement and improve comprehension in the classroom. Participants are also exposed to research around the utilization of inquiry-based learning (IBL), a philosophy of learning which is student-centered and seeks to led the students lead their learning through question and experimentation, emphasizing hands-on learning.

When the aspects of this project-linguistic acquisition theory, national science standards, and inquiry-based learning-come together, scientific learning that is deep, enduring, and expands a students L2 vocabulary can happen. Utilizing these methods in conjunction with one another

can create lessons that are engaging-always a positive feature-as well as lessons that expand L2 vocabulary, the true aim of this project.

With so much information, it is important to use methods of instruction that are valuable to adult learners. The next section will look at the rationale behind the structure of the project. It will also look at the underlying theories of adult education in this project, and consider research in adult educator science education.

Frameworks and Theories

Lawson (1997) tells us that every major area of thoughtful endeavors are created with underlying infrastructure in place that defines it, such as beliefs, rules, and important tasks. These areas of thoughtful endeavor are the paradigms we use to explain and define the various ways of thinking. In planning this professional development, I chose to follow the paradigm laid out by Rhoton, Rhoton, and Shane in their 2001 text, "Professional Development: Planning and Design." I used this as a mentor text because it concerns itself with the development of professional development for science instruction, which is the core of my project. The paradigm in this text focuses on identifying common vision across science standards and reflects both the belief that all children can learn science, and best practices in teaching both students and adults.

This paradigm also identifies the need for teaching practices to adults to reflect the practices that will be used for the students, giving teachers something to model and build from. Their belief is that professional development should build on what teachers already know, what their practice in science currently are, and that teachers should be introduced to new information and strategies in ways that allow them to deepen what they already know in the content area (Rhoton et al., 2001). Based on this design, then, the professional learning I am development

must be aware of what instructors may already know on the topic and allow them to deepen both their content and pedagogical knowledge.

Finally, the paradigm outlined in by Rhoton et al. requires the learning taking place to be created in accordance with target science standards as well as linked to other aspects of professional/academic learning. This requirement makes sure that while the professional development is useful for giving educators the tools to teach using best practices in science instruction, they are also given tools to integrate instruction and connect lessons with other concepts.

When developing a professional learning for adults, the work of Malcolm Knowles cannot be forgotten. Knowles' andragogy forms the basis for many contemporary theories of adult learning that are in use today. His assumptions of adult learners inform this professional development; learners in this professional development cannot be taught as one would teach a child because they are in a developmentally different place in life, they have a wealth of experience to draw on, and they need to utilize the information from this learning in their practice almost immediately, rather than slowly building learning the way one would for a younger student (Knowles, 1984). These assumptions must be kept in mind when creating and teaching a professional development meant for adults. In the next section, the selection of these theories will be considered.

Choice of Method

I chose to base my work off of the mentor text "Professional Development: Planning and Design" because it looks crically at the purpose of a professional development and utilizes designs that support lasting learning in participants. Rhoton et al. look at critical issues in the design of professional development, such as how the professional development is structured,

how the professional development can meet the needs of many individual teachers, and how professional developments can implement systematic reform (Rhoton et al., 2001).

I chose to use the work of Malcolm Knowles because he was a pioneer in the field of adult learning. His research and principles form the basis of much of what adult learning theory is based on, and his work has an enduring usefulness that aids the clarity of this project.

These theories were selected because of the intended audience of the project: professional adult educators. In the next section, this audience will be considered in detail. The students, school, and educators will be examined, as well as the city in which this learning is intended to take place.

Setting and Audience

The district this professional development this will take place in is located in a set of second-tier suburbs around a major metropolitan area. The district serves three cities, and hosts 5800 students from elementary to high school age. The student body is comprised of 39% minority students (Latino and African-American), and 59% Caucasian, with the remaining percentage representing students of Asian descent (Claar, 2018).

The setting for this professional development is a Spanish immersion school that has been operational for the past fourteen years. The school has 544 students in grades K-4, and has grown by 21% over the past five years. The school employs over 40 teachers and specialists, many of them completely fluent in both Spanish and English. Minority enrollment in this school is 43% of the school body, higher than the Minnesota average of 32%. Twenty-seven percent of the school body is eligible for free and reduced lunch. There are currently six kindergarten classes, each containing between 20-23 students, and six kindergarten teachers. The intended

audience for this learning are the teachers and academic specialists of the school, particularly the kindergarten teachers (Claar, 2018).

Having looked at the intended audience, the next section of this work is concerned with a full and accurate description of the project itself. This section includes a description of materials, and a timeline for the work. Also included are details on expectations of participants, as well as some description of the lessons themselves.

Project Description

This project is a series of materials for five professional development sessions.The materials include a presentation as well as speaker notes to assist the delivery of the speaker. Handouts of information that coincides with each session's lesson is also included, and also a pre- and post-learning assessment to assess participant learning. These pre- and post-learning assessments assist the facilitator in understanding participant knowledge as they enter the PD and as they are complete it.

Within the session, participants are asked to be active participant in their learning. Participants are asked to bring to each session a notebook in which they can take notes and respond to journal questions that ask them to consider their own practice in light of the information they are learning. Malcolm Knowles' andragogy purports that adult learning should be immediately applicable for the participants, thus, these sessions are designed to tie into the individual participant's classroom practice. Participants are also expected to take part in group discussions concerning aspects of that session's learning and participate in educational exercises such as acting out lessons and creating lessons for their own classrooms. This is an effort to create a dialogue between the speaker and the participants, recognizing them as experts and turning what could be a passive learning experience into an active one (Knowles, 1992).

The five sessions offered in this professional development are each an hour long, and each session focuses on a specific theme surrounding this topic. This class is designed to meet weekly to give participants the opportunity to put what they have learned each week into practice in their own classrooms so they can report on their progress at the next week's class. Learners are asked to do educational exercises that build skills they can bring into their classroom science lessons. The final session is dedicated to utilizing all of the material covered in the course to create a lesson that reflects the participant's learning.

Summary

The goal of this professional learning is simple: to show educators-specifically Kindergarten teachers-the opportunity they have the in classroom to make marked gains in language through a subject that is often ignored in the Kindergarten classroom. Science is both simple and difficult in Kindergarten, and amid the important discussions of reading, writing, and math that happen in Kindergarten, science often gets overlooked or tacked on as a second thought. The importance of science education in the Kindergarten classroom cannot be overstated, and more than that, Kindergarten teachers can use science as another way to encourage language growth in meaningful and authentic ways.

The research question behind this project is *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives,*and it is the goal of this professional learning to help educators see what the answer to that question might be, and how they could implement this kind of learning and instruction in their classrooms. What the complete answer to that question might be, and my reflection how the project overall, will be addressed in the next chapter.

In the next chapter, I will consider the overall effect my work has had on me and may have on the professional educational community. I will reflect on my work and where I have grown and developed as a writer and researcher, as well as considering areas where I have learned new information or techniques. I will critically examine my work, looking for perceived weaknesses in my work. In the next chapter I will also consider what further areas of study connected to this topic might be, as well as some final reflections.

CHAPTER FOUR

Reflection

In this final chapter, I will be exploring my professional growth as a researcher/writer, as well as areas of strength and weakness in my project and its possible contributions to the field. The guiding question of my research, *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives,* has led me down a path that has caused me to grow in my knowledge around various theories, principles, and practices in education and language. This guiding question also led me to create a project that will help to educate other teachers and instructors in these important aspects of language immersion and science education.

Chapter Four of this capstone begins by looking at areas of personal growth in researching, writing, and learning. I also consider which aspects of the literature review turned out to have the greatest overall impact on the capstone and project, and where I was able to make new connections. The chapter looks at what some future projects connected to this one might consider, as well as any policy implications inherent in the current project. I also consider some of the limitations of the project I created, the benefits of my project, and how this project might best be communicated with other educators or interested parties. I close with some conclusions around my work on this project and its overall impact on my professional views on the subjects of both science and language immersion education.

Beginning this project was a challenge for me; while I had a topic I thought I wanted to learn about, I was unsure how to begin the research or if I could even write a literature review. The next section explores my growth in academic writing and research at the graduate level.

Growth as a Writer/Researcher

When I first began working on this capstone, I did not know much about research or academic writing. I had no background in the sciences; I had never even really used APA format. This capstone has been a constant challenge for me as a writer, because I have had to learn new ways of framing my thoughts. I've been asks to write in ways that are different from what I had learned previously, and I have had to learn a new way of formatting.

During the writing process, I found that I enjoy researching and learning about topics in education. While the literature review was a challenge for me, it cannot be denied that I now have a wealth of knowledge on the topic of language acquisition, inquiry-based learning, and national science standards to draw on. This knowledge has informed and improved my practice as a language-immersion teacher, and I find that I like that. An ongoing challenge for me will be to continue to improve my practice by keeping up with research topics that can positively influence my teaching.

Throughout this process, I learned how to be discriminating in my sources as a researcher. When I initially began the process of looking at the literature around my topic, it was completely overwhelming. There was so much information, and there seemed to be no clear way to sort through it all. However, the work that was done to refine my research question and to consider what topics might inform it was priceless in knowing what information to look at and what information to move past. This process has made me a better researcher because it has given me the tools to make informed decision on what information informs my topic, and what does not.

Researching and writing the literature review was one of the most challenging aspects of my capstone, and also one of the most beneficial. In the next section, I will examine the parts of the literature review that proved to be the most important for my work.

Reflections on the Literature Review

Grøver et al.'s 2016 study had a tremendous impact on most of my capstone. Their research on language-immersion preschoolers and their L2 development was instrumental in aiding my understanding of what my kindergarten students experience in language immersion education. The implications of their research can be found numerous times in my capstone, because they are so fundamental to my project. Their work on language transfer is key to my project, as it concerns how L1 knowledge informs L2 vocabulary development. This research is key to my understanding of how kindergarten L2 vocabulary can be expanded: through the use of their existing L1 vocabulary. Through this research I was able to understand that my role as a language immersion educator is not to generate new learning in vocabulary, it is to connect existing L1 vocabulary to its new L2 counterpart.

Walter and Tedick (2000) and Cammarata and Tedick (2012) also contributed greatly to my understanding of the role of the immersion educator, as well as the need for balanced instruction in the classroom. Their work with immersion students' overall linguistic knowledge raises important red flags in the area of immersion education. The goal of immersion education is for students to gain fluency in the target language, not for them to be able to understand perfectly and speak haltingly. Their research challenges accepted norms in immersion education and pushes for explicit grammar instruction, reminding us that students do not learn through osmosis.This is an important topic for my research to consider, as it informs some of the underlying assumptions around the role of the immersion educator.

An understanding of the national science standards was one of the more important aspects of my capstone. By fully understanding what the CCSS and NGSS are for kindergarten, readers are able to see the need for literacy promotion and time for science education in the

kindergarten classroom (NGA, 2010). They are able to see the value of the three aspects of NGSS as kindergarteners begin to look critically at their world and ask questions (NGSS Lead States, 2013). By fully explaining the value of the national science standards, readers are able to understand that not only is science education valuable in the lower primary grades, it is a necessary tool to help young students understand the world they live in.

While the literature review was a challenge for me, it gave me the information I needed to be informed in this topic. Through the review, I was able to learn critical information, such as listed in the previous section, as well as make new connections and understandings. These new connections and understandings helped me to deeper understand the material around this topic.

New Connections and Understandings

Through the literature review, I was able to learn about what inquiry-based learning (IBL) looks like in an immersion education context. While I knew a little about IBL when I began this process of writing this capstone, I was not sure if it had been done at an immersion level. It seemed to me a good fit for immersion education: students are allowed to lead learning, students are encouraged to ask questions and find the answers, and they learn as a community in the classroom. Studies I read such as those done by Samarapungavan et al. (2011) and Van Uum et al. (2017) reported positive results: students were learning, students were engaged. These studies gave me a deeper understanding of the positive aspects of IBL when done right in the classroom.

However, I wasn't fully convince that it was a good fit for the immersion classroom until I came across the study done in Bulgaria by Pavlova et al. (2015). Their work with emerging bilinguals helped me to understand how best to support IBL in an immersion classroom, and why it worked well for students who might not fully understand what the instructor is saying. It was

through the literature review that I was able to begin to understand more fully what IBL was and how it might work in my classroom.

These new connections, as well as the more important points of the literature review, deepened my understanding of the material around my capstone project and allowed me to see what some possible implications of my research might be.

Possible Implications for the Future

One of the possible implications of this project, and a subject that came up again and again, was the need for more time and resources dedicated to science education in the kindergarten (and primary) classroom. Since kindergarteners are learning so many crucial academic skills, such as reading, writing, and early mathematics, science education can get pushed to the side or completely left out of the daily classroom routine. However, science education is a crucial part of primary education, and, as shown throughout this project, can make for positive gains in L2 acquisition. There are many ways science can be taught that integrate with and enrich skills taught in reading, writing, and mathematics instruction, and science should not and cannot be ignored in the primary classroom.

Walter and Tedick (2000) and Cammarata and Tedick (2012) both call for balanced instruction in the classroom. They call for specialized education of immersion educators and a change in the way the immersion school prepares their instructors. They cite research into the effectiveness of immersion education and strategize ways to improve areas of perceived weaknesses. This research is valuable and should result in a policy change in immersion schools. As an immersion educator, no specialized training was asked of me to teach in the classroom. While I am a licensed K-6 teacher, I was licensed in English, to teach English materials in an English speaking classroom. As an immersion educator, most of what I've learned about best

practices in immersion education has come from this capstone project, not from my school or district. A policy change in the training of immersion educators could be a possible implication of this project.

The policy changes that came up in this project are based on the literature that was reviewed and the conclusions I made. However, no project is perfect, and in the course of my research there were some areas in which I did not delve as deeply as I might have. The upcoming section considers some of these areas and how they might be included in a future draft.

Limitations

One of the limitations of this project is that it is very narrow in its focus. My project is specifically for kindergarten teachers, although others may benefit from it. The project specifically looks at CCSS and NGSS, and does not consider other science standards that may benefit students. Also, this project only looks at one philosophy of education - inquiry-based learning - and does not consider other philosophies, even other constructivist philosophies, that might benefit immersion education students. While the project itself is sound, it is hyper-focused on one grade, one country's standards, and one way of doing things, and this limits its overall usefulness.

A more well-rounded version of this project might include global science standards, instead of using United States science standards. Other philosophies of education that mesh well with language immersion might also be considered. Expanding either of these sections would lead to a project that might be better suited for use in more than one area of the world, especially useful since immersion education is not unique to the United States.

Another limitation of this project is that it does not consider the implications of special education at all. While immersion education is not tailored to special education, there are still

students in special education that may require modifications in the classroom. One section of this project looks at, for example, explicit language instruction and encouraging students to speak in L2 in the classroom. However, the same section fails to consider what modifications might need to be made for a student with special needs in the area of speech. Another section of this project considers IBL and hands-on learning, but fails to consider what modifications might be necessary for students with motor-control concerns. It is a definite limitation of this project that special education is not considered at all. A version of this project that considered special education would include more adaptation options within the suggested teaching methods.

The limitations of this project remind me that no work is every truly finished; nothing is ever completely perfect. While I continue to consider how the current project could be improved, I also have considered what some future projects might be. Through the course of my research, there were many avenues of study I was not able to pursue, and the next section looks at a few of them.

Future Related Projects

In the future, I would like to explore research around best practices in immersion education, and prepare another profession development around that theme. I feel that in order for immersion education to be deep and truly meaningful, educators need to be equipped with all the tools they can, and this includes being knowledgeable in best practices of immersion education. A future professional development could include theory on immersion language acquisition, and explore topics such as using visuals in the classroom, explicit language instruction strategies, and using songs and poems as memory aids. I think that this would be a much-needed contribution to the field of immersion education.

I would also like to explore research in the area of balanced instruction. This is an area that really struck me as necessary to investigate more, since it seems from the research I read that the intent of immersion education and the outcome of immersion education are not lining up. This made me wonder extensively what I could do as a teacher to change this in my instruction. I want to know what instructors can do to change their practice in order to facilitate immersion students speaking as well as they can understand the target language. I am very interested and personally invested in this question through my students, and I would like to know more.

Having the opportunity to complete this capstone and project has shown me the value of in-depth research around a topic. What I've learned on this subject has informed my practice, changing both what I teach and how I teach it. The next section details how I plan to share this valuable information with other educational professionals.

Sharing my Project

Since this project is a professional development, my first action will be to present it to my principal and curriculum coach, with the hope that it can be used as a tool for incoming kindergarten teachers in the future. While my school does not have any formal trainings available for immersion instructors, I think this project would be a good first step in that direction, and would help new kindergarten teachers at my school to keep science in mind and not get so overwhelmed by reading, writing, and mathematics.

I also hope to present this professional development to my kindergarten team, as well, and discuss the learning with them. I want to see how this information affects their classroom practice through discussion and the pre- and post-learning surveys. I think that this information

would have a positive impact on my kindergarten team as a whole, since this is information that is specifically tailored to their school and student population.

The information I learned in the pursuit of answering my guiding question has turned out to be quite valuable to me as a language-immersion kindergarten teacher, and feel it is important to share it with those around me. The information is of great benefit to other teachers in this field, as well as for administrators and specialist working in immersion education. The next section will detail what some of those benefits are, and some positive impacts of this project on language-immersion education.

Benefits to the Profession

My project benefits educators because it can give them a fuller understanding of what second language acquisition is like for their students. This capstone and project gives information on how students learn second languages, as well as strategies for better language instruction in the classroom. Knowing this information helps teachers be more deliberate in how they choose to give language instruction, and a better understanding of how students learn language can lend to a change in the way educators choose to teach it.

This project also exposes the need for more science time in the lower primary classroom. With so much emphasis on mathematics, reading, and writing, many times science and social studies do not get the time they should in the kindergarten classroom. However, it is my hope that this project shows the benefits of science instruction in the classroom, when taught in meaningful, hands-on ways, both to academic instruction and language acquisition.

The direct connection between science and language is an example of one such benefit. When science is taught using the highest standards, students are exposed to high-quality literature that increases student comprehension and academic vocabulary skills. Language

acquisition theory tells us that what students learn in one language transfers to the other, so another benefit of this project is, when taught sustainably, that students are able to increase academic language skills and reading comprehension in kindergarten, setting the foundation for continued academic success.

Conclusion

I began this project with a simple goal. It was the beginning of a new school school year, and the idea that my brand-new kindergarteners would ever understand me, let alone speak in Spanish by the end of the year, seemed inconceivable. I wanted to know how I could help them learn Spanish in a real, lasting way that tied to their academic goals. I wanted to know, *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives.*

However, this project turned out to be a lot bigger than my original question. Since beginning this project, I've learned valuable information on language acquisition theory and balanced instruction in immersion education. I've learned about the importance of science education, the strengths and weaknesses of national science standards, and the various ways science and literacy education connect and interconnect with one another. I've learned how inquiry-based learning can be used in the immersion classroom to give students an active way to learn about the topic at hand.

Although research is not something that comes naturally to me, I've seen the value of digging into a topic through this capstone process. Because I drew information from so many different areas, I was able to see trends and make connections I could not before beginning this project. My research led me to conclusions that have affected not only my level of knowledge

around topics such as elementary science education or language acquisition theory, but have also impacted the way I teach in my language-immersion classroom.

Through the creation of my project, I was able to expand my understanding of adult education. It was very important to me to create a resource that other educators could use to learn the same information, tools, and strategies that had become so valuable to me and my practice. Creating this project was an opportunity to share with others what I had learned, and I hope that the professional development piece that I created has the same effect on others that learning the information had on me.

At the heart of this capstone and project, at the heart of my guiding question, is one simple desire: to be a better teacher. I feel it is my responsibility to my students to never stop trying to improve my skills as a learner and educator, and that's what this project was all about. At the beginning of the year, I saw the vast majority of my kindergarteners struggling with a foreign language and I wondered, how can I improve this experience for them? My guiding question, *how to enrich and expand the vocabulary of kindergarteners in a Spanish immersion program through science lessons and science-focused learning objectives,* stems from the simple ambition to help them communicate. This capstone and its subsequent project are my contributions to answering this question, and are the fruit of my desire to never stop trying to be a better educator.

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