

Hamline University

DigitalCommons@Hamline

School of Education Student Capstone Projects

School of Education

Fall 2020

Writing In the Math Classroom In Order to Increase the Academic Proficiency In English Language Learners

Daniel Bahnaman

Follow this and additional works at: https://digitalcommons.hamline.edu/hse_cp



Part of the [Education Commons](#)

WRITING IN THE MATH CLASSROOM IN ORDER TO INCREASE THE
ACADEMIC PROFICIENCY IN ENGLISH LANGUAGE LEARNERS

by

Daniel R Bahnaman

A capstone project submitted in partial fulfillment of the requirements for the degree of
Master of Arts in Teaching.

Hamline University

St. Paul, Minnesota

December 2020

Primary Advisor: Trish Harvey

Content Expert: Jacob Olson

ABSTRACT

A common problem in today's schools is how to best serve our English language learners. These students specifically struggle with mathematics, as it relies heavily on specific academic language that is constantly being scaffolded. Research has shown that writing in the mathematics classroom can assist English language learners develop academic vocabulary and therefore increase proficiency. This capstone project focuses on the research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?* The project gives an introduction into implementing writing in the middle school math classroom by providing a one-week introduction to journaling, a two-week eighth-grade curriculum with added writing pieces, and information for implementing writing into sixth and seventh-grade units. The project uses journal prompts as well as writing-based assessments to observe students' growth in math academic vocabulary.

ACKNOWLEDGEMENTS

To my wife Sheila, who has given me all of the love and support that I have needed during this process. Thank you for always being there.

TABLE OF CONTENTS

CHAPTER ONE: Introduction	7
Overview:	8
Background:	8
Benefits:	10
Rationale:	11
Conclusion:	12
CHAPTER TWO: Literature Review	14
Introduction	14
English Language Learners and Their Challenges in the Classroom	14
Who are English Language learners?	15
Myths	16
Challenges for ELL students in the classroom	17
Challenges for ELL students in the math classroom	18
Importance of Academic Language and Vocabulary in the Classroom	20
What is academic language?	20
Academic vocabulary	21
Strategies for Working with ELL Students	21
Collaboration	22

Teacher knowledge and professional development	22
Academic Language in the Mathematics Classroom	24
Strategies to build academic language in the mathematics classroom	24
Assessing and analyzing prior knowledge	25
Culturally responsive questions	26
Writing in the Math Classroom to Build Proficiency and Academic Language	27
Challenges to writing in the math classroom	27
Why write in the math classroom?	28
Journaling	29
Explaining mathematical concepts	31
Conclusion	32
CHAPTER THREE: Project Description	34
Introduction	34
Project Description and Rationale	35
Research Framework	37
Project Format	38
Relevant Standards	40
Outcomes and Evidence	41
Setting and Audience	42
Materials	43

Timeline and Learning Plan	44
Conclusion	45
CHAPTER FOUR: Conclusion	46
Introduction	46
What I Have Learned	47
Revisiting Literature Review	49
Implications and Limitations	51
Future Projects	52
Communicating Results	52
Benefits to the Profession	53
Conclusion	54
REFERENCES	55

CHAPTER ONE

Introduction

In my five-year teaching career and eleven years working in education, I have been working with students that need extra support and help. I have worked with many different student populations in different communities. Although I have found myself to be a math teacher and specialist, I never would have thought I would go down this path. From my background as working in reading and writing, to working with students that need extra support in math, the students I have worked with have one important thing in common: the majority have been ELL students from immigrant families. These students deserve and require well thought out and developed curriculum in order to better assist them. These students come into the classroom behind their native English speaking peers at no fault of their own. Most of the ELL students I work with and have worked with do not speak English at home. They speak English and another language at school and return home to speak in their parent's native language while working on homework that is in English. That is quite a task for young and developing minds.

As I worked in education, my focus has shifted from reading and writing to math. I never forgot my roots in reading and writing, and I understand the value and importance of its place in the mathematics classroom. Academic language and vocabulary plays a major role in students' understanding of mathematical concepts, and, therefore, reading and writing in math is essential to build conceptual understanding for all students. The importance of academic language plays an even larger role for English language learners in the classroom. Many students are trying to decode words in another language or make

the complicated switch between languages in order to show their understanding to their teacher and classmates. This struggle for ELL students has prompted me to develop the research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?* From this research question, I developed a curriculum in order to facilitate writing in mathematics classrooms in which the majority of students are English language learners.

Overview

This chapter discusses the path that led me from working from a language and English background to becoming a math teacher. I reflect on the students I have worked with and currently work with that have shaped my philosophy of teaching. I also discuss my rationale for choosing the research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?*

Background

I never thought I would end up a math teacher. When I was growing up, math was by far my worst and least favorite subject. My parents would always say, “we’re not a math and science family, we’re a reading and social studies family” when I would need help on my homework and they could not help me. I remember my dislike for math when I was in 6th grade. It was the time in my life, when I realized I was not as good at math as everyone else. I was in the low track for math while most of my friends had tested into the advanced track. I remember feeling sad, left out, and not good enough. It was in that moment that I decided I wanted nothing to do with math for the rest of my life.

I went through the rest of my school years getting by with C's in my math classes, while excelling in my social studies and English coursework, taking advanced placement courses. I got to college and took one more math class and sighed in relief as it was the last math course ever. I went on to graduate with a degree in public relations, a degree not known for its mathematical content. But something had stayed with me during all of my high school and college years: I always enjoyed working with kids and students. Throughout college, I worked as a literacy tutor in under-served schools with high ELL populations. Towards the end of college I realized I wanted to be a teacher, something that I did not expect to happen. I went on to take coursework while working in schools as a paraprofessional, specializing in working with struggling ELL readers. However, while taking my coursework I took a "how to teach math" course for elementary teachers. It changed me. I realized that I had a desire to teach math in order to encourage those students who felt how I did when I was young. I wanted to be there for them when they wanted to give up and disregard math forever.

As I started working my first few teaching jobs, again at high ELL population schools, I became a math teacher only. I taught in 5th grade, then in middle school, then as a specialist working with all grades. I started to understand that I could combine my desire to teach struggling math students with my background knowledge in reading and writing. I began to experiment by having my ELL students write down some of their thoughts about the content we were learning. Nothing too complicated, but ideas about things we had covered using some specific language stems. I was amazed to see that when they sat down and focused on their writing, the conversations we were having truly blossomed. Writing gave the students the confidence to share thoughts and ideas with

their classmates and with me as well. As I continued to work with ELL students, I started to have them participate in journaling about their thoughts and ideas about math. Not only about what we were currently learning in class, but their thoughts and perceptions about math in general. I was amazed to see that when these students started to write about their beliefs on math, there was a sense of relief among them. They could feel comfortable sharing that they thought math was hard for them because they couldn't understand the word problems or only knew how to say that word in Spanish but not in English.

I do not have a writing-based curriculum in my school, but I do incorporate writing into my math classes in order to improve the academic language and proficiency of my students and to also give them an outlet in order to share their thoughts and opinions in a non-threatening way. They know that I will not call out their writing for grammar, but more in order to create meaningful discussions in the math classroom. I have found writing and journaling in the math classroom to be an invaluable tool. It is a complement to my teaching style and has shown to ease the minds of my ELL students. When these students feel comfortable, they can truly soar and show their full potential. I am hopeful that by exploring my research question and creating a curriculum that other teachers in my school can use, I can serve every ELL student in my current and previous schools by teaching them how to incorporate writing into the mathematics classroom.

Benefits

The benefits of my research question and my curriculum can be seen in different ways. The students will be the first to benefit. The students will become very good and efficient at the mathematical fluency required for their grade level. They can solve

equations, perform the order of operations, balance algebraic equations, etc. However, if there is a word problem or a question that asks them to justify their answer, many of them will skip over the problem. They do this because they already know in their heads that they will not be able to solve it since they do not understand what the question is asking or saying. These students need the support in order to use the complex academic language of mathematics. They need to be able to practice justifying and explaining a math concept without the fear of getting something wrong in front of their teachers or classmates. If students can be comfortable in writing and using academic language on a daily basis, they can truly discover their full potential.

The teachers will also benefit from this research and project. The teachers will receive a well laid-out and thoughtful curriculum designed by a teacher who knows what they are going through. It took much trial and error in order to successfully integrate writing into my math classroom, and this curriculum will take the guessing out of it. Teachers will get a curriculum in order to serve their students who need the most help. I look forward to sharing the curriculum with the teachers and seeing how they and their students react and enjoy the writing process together.

Rationale

Although this school year I have changed schools and positions, this research question and project focuses on the school in which I was working for four years before taking a new position. It is a small school, with around 350 students kindergarten through 8th grade. Many of the families are related in some way. In fact, many of the families come from the same small town in Ecuador. The teachers in my school come from various backgrounds. Some have teaching licenses and some do not. Some are native

English speakers and some are not. The teachers in the school need more support. They were handed a new math curriculum at the beginning of the year and are trying to grasp the complexities, as would any teacher in their position.

The curriculum, although nationally known and able to be delivered completely in Spanish, is leveled in a way that many of our ELL students cannot grasp. The language the curriculum uses is far too complex for a small child to understand what is happening. Many teachers decide to skip most or all of the word problems altogether, as they feel like the problems are not scaffolded in a way that their ELL students can comprehend. The teachers are faced with a difficult challenge on a daily basis: teach the standards on which they will be assessed while adhering to the curriculum set in place by the school. This balancing act proves to be very stressful for teachers and challenging for their students. Their students must learn to be proficient in the math concepts but also be able to identify and use complex academic language. Students that have a lower level of English are at a disadvantage in the classroom, but need the tools to succeed. (Hoffert, 2009) This is where my research question and project come in to fill the gap.

By implementing my curriculum in tandem with the curriculum already in place, the teachers will be able to have the resources needed to scaffold with their students in order to comprehend and answer the complex questions from the curriculum in place. My curriculum will serve the ELL students by giving them an opportunity to practice writing and using the new language they are learning from their teachers via the curriculum.

Conclusion

In this chapter, I discussed my background for my project. I detailed the path that has led me to develop my research question: I have also given the rationale for the

research question and project and who are the intended beneficiaries for both the curriculum and the research that I complete.

In chapter two, I lay out the groundwork in my research for this project. I discuss the challenges that English language learners face in the math classroom and strategies that have proven to be effective in teaching. I also discuss academic language and vocabulary and its vital place in the mathematics classroom. Finally, I discuss the two main strategies that will be implemented in my curriculum. Chapter three gives the background knowledge in order to better understand the ELL population as well as strategies that teachers can employ in order to better serve them. Finally, in chapter four I share my main learnings and reflections from the capstone project. I share implications and benefits of the project I created as well as final thoughts on the process.

CHAPTER TWO

Literature Review

Introduction

The National Council of Teachers of English defined an English language learner (ELL) as an active learner of the English language who may benefit from various types of language support programs (National Council of Teachers of English, 2008). In order to better serve this growing population, teachers must develop and implement strategies in order to give these students the best chance of success. My research question is: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?*

In my first section, I explore the dynamics of English language learners (ELLs). In my second section, I focus on academic language and vocabulary in the classroom. My final section focuses on writing in the mathematics classroom and the positive effects that it has on improving academic language and building mathematical proficiency in ELL students. This literature review serves as the foundation of my project and guides me as I attempt to answer my research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?*

English Language Learners and Their Challenges in the Classroom

In this subsection, I introduce who ELL students are and where they are located in our country as well as introduce some common myths associated with teaching ELL students. I also address the misinformation that surrounds this student population.

Teachers must have correct information in order to better serve them. Finally in this section, I address the many challenges ELL students face every day in the classroom as well as specific challenges they face in the math classroom. These students are challenged with hurdles that teachers, administrators, and parents can work to solve in order to make school much more equitable.

The prevalence and increase in English language learner students in U.S. schools has created a shift in the ways of teaching and learning in the modern classroom. Approximately one in seven students speak another language at home other than English (Hoffert, 2009).

Who are English language learners?

The United States Department of Education describes an English language learner as a student who is limited-English-proficient (Our Nation's English Learners, n.d). ELL students are the fastest growing segment of the student population, with a 70 percent increase between the years 1992 and 2002. Between the 2000-2001 and 2016-2017 school year, ELL students grew by 28.1%. Forty-three states saw an increase in the number of ELL students (Digest of Education Statistics, 2018). They make up 10.5 percent of the entire nation's enrollment in K-12 schools (National Council of Teachers of English, 2008). There are over 4,800,000 English language learners enrolled in schools. The majority of ELL students are Hispanic or Latino, and are more likely to be migrants, Title I and homeless (Our Nation's English Learners, n.d). The top three states for percentages of ELL students are California, Texas and Nevada, with 20.2%, 17.2%, and 15.9% respectively (Digest of Education Statistics, 2018). These students, a vital part

of our schooling system, face challenges to our schooling system but with good teachers and strategies, can be a resource to our schools.

Myths

As with any student population, there are common myths and beliefs about ELL students (National Council of Teachers, 2008). It is important to address these as I go forward in my research topic. The National Council of Teachers (2008) laid out some common myths associated with ELL students. One such myth is that many ELL students have disabilities, which is the reason for their over-representation in special education programs. The National Council of Teachers continue to say that due to current testing, this can lead to a misdiagnosis of special education. Gil and Bardack (2010) also discussed that this over-representation is due to the lack of support given to these students. Another myth is that children learn a second language quickly. ELL students face many challenges, a topic I cover in another section. Teachers must focus on strategies to help their students acquire language in a relevant way.

Another myth is that teaching ELL students means only focusing on vocabulary. While vocabulary is important, students need to learn and use academic language in different forms. This is the main focus of my research question and project. Gil and Bardack (2010) also laid out a few common myths as well. One myth that was intriguing to me was that most ELL students have learned English by middle and high school. Secondary school ELL students have more challenges due to the increase of rigor and academic language. These students are at high risk to not complete high school. The last myth I will highlight is that parents of ELL students do not want to be involved in their children's education. Parent involvement is crucial to developing the skills of ELL

students, and communication must highlight the importance of parental roles as well as the skills that the parents bring in helping the education of their student.

Challenges for ELL students in the classroom

English language learners have a tough road ahead of them in schools, especially as they grow up. Teachers may not be able to link the students' native language in order to give support to that student. This can be both challenging for the teacher and students, as it makes creating a bridge between languages challenging (Hoffert, 2009). No Child Left Behind (NCLB) has disproportionately affected ELL students. In her article *NCLB and English Language Learners: Challenges and Consequences*, Menken (2010) argued that ELL students may be the group that has suffered the most from NCLB, due to high-stakes testing that leads to retention and placement into remedial classes. These high-stakes consequences do not set up these students for success. Menken also went on to say that ELL students are at a disadvantage to NCLB because the single assessment is itself a language barrier which can cause retention and limit their access to schools. One high-stakes assessment can determine the entire school year and at times school career of an ELL student.

As students grow up and progress through the school system, they may be at a disadvantage and be placed on a lower track due to ELL status. They can be placed on this track due to prior academic achievement, institutional constraints (such as a lack of teacher training), English proficiency, and the fact that they are classified as English language learners (Umansky, 2016). These kinds of exclusions do not only affect English and other language focused classes, but also math and science. ELL students have low academic language proficiency, sometimes multiple grade levels behind (Brown, 2005,

pp. 240-242). These low levels can cause stress in their teachers who can be unprepared for such situations. Certain districts emphasize training their teachers to work with ELL students, while others lack the training to ensure the success of these students with specific language needs (Hoffert, 2009). ELL students face significant challenges, and school districts must do everything they can to give them a fair chance.

Challenges for ELL students in the math classroom

ELL students come with particular disadvantages for the math classroom. They are learning a language that they are not fluent in, and also take a test that requires communicating in a mathematical language, usually in writing (Brown, 2005).

Brown identified eight different reasons why math is particularly difficult for English language learners.

1. Math is a third language that is filtered through their first language through their first language.
2. Math is continuously scaffolding, which can provide a challenge to students who lack the academic language of mathematics. As students grow up, the gap widens as the material grows more challenging.
3. Math vocabulary is not used in everyday life, making it harder to learn because the students are not using it in other situations.
4. The language structure of math is very specific and complex that most students find difficult, proving more challenging in a second language.
5. The reading skills of a student impacts the math skills of a student. If a student cannot read or understand a word problem, they will not be able to perform the correct mathematical operation.

6. Different countries and cultures approach mathematical problems in different ways and might use different symbols. Some countries replace a comma for a period in numbers larger than 999.
7. The way that math problems are understood are also culturally bound.
8. ELL students may not understand cultural references in a word problem and therefore not understand the problem. (pp. 340-342)

These students face significant disadvantages, especially when it comes to taking ever-important standardized tests. They are required to take the same mathematics tests as native English speakers, with no support on the tests. Many ELL students are also placed in the wrong math class. Students with a lower level of English appear to have a lower level of math ability in many teachers' eyes (Hoffert, 2009). This placement into a remedial class sets up these students for failure. Many times, they are not given the opportunity to show the teachers their mathematics skills, and they may prove it when it is too late in the year.

In this subsection of chapter two, I laid out the foundations for the students that I will be putting my focus on for my project: English language learners. This almost 11% of our school age population (National Council of Teachers of English, 2008) come with many challenges in and out of the classroom. They face an uphill battle with their education for many different reasons, as highlighted in this section. In my project, I focus on mathematics, a subject that is complicated for many students, and even more so if English is not their first language. In my next section, I focus on academic language and strategies to help the ELL students in our classrooms.

Importance of Academic Language and Vocabulary in the Classroom

In this subsection, I define and explore both academic language and academic vocabulary and the impacts that they have in the classroom. I then explore ways to achieve academic language and vocabulary proficiency with ELL students. I discuss some common and proven academic language strategies that work for ELL students, collaboration and teacher training and professional development. I end section two by discussing specific strategies using academic language that can be used in the mathematics classroom. I go into detail about assessing and analyzing prior mathematical knowledge as well as using culturally responsive questions on assignments and tests.

Academic language is the specified language, both written and oral, of academic settings that facilitates communication and thinking about academic content (Nagy & Townsend, 2012).

What is academic language?

Academic language is the language that students and people use in the classroom and the work environment. It relates to context, discourse, text, and assessment (Cardullo et al., 2017). When children are small, they learn basic structures of communication, words and phrases to interact socially. As they grow up and mature around upper elementary school, the language changes. ELL students have a hard time keeping up, as the academic language is much more specialized and rigorous (Bielenberg & Fillmore, 2005). ELL students may still be at the social level of language, while their native English speaking peers are using academic language comfortably. As Cardullo et al. (2017) explained, there are three characteristics of academic language:

- Morphologically complex words-words that contain prefixes or suffixes, multi-part words, and compound words
- General high frequency academic words
- Words that are discipline specific

It is also important to note that academic language is both oral and written language. They are mutually supportive and equally important in the development of academic language (Nagy & Townsend, 2012). In order for students to be successful in the classroom, students must be proficient in both oral and written academic language.

Academic vocabulary

Academic vocabulary is a key component of academic language. Baumann and Graves (2010) defined academic vocabulary in two parts: domain-specific vocabulary for content areas like algebra, chemistry, etc. and general academic vocabulary, which may appear across content areas but may have specific meanings based on the content area. Students understanding vocabulary is key in being able to understand and comprehend what words mean in context. Academic vocabulary also helps a student understand the language being used and apply it in turn on work and assessments (Cardullo et al.,2017). Teachers must be willing and ready to help their students learn and master academic vocabulary in order to help them succeed in their academic language skills, which in turn will guide them through the content of the course and material.

Strategies for Working with ELL Students

In this subsection, I discuss some common and popular techniques and strategies for working with ELL students. These strategies have a focus in building academic language and vocabulary. Although these strategies are geared towards ELL students,

they are useful for all students, as all students must also acquire skills in academic language and vocabulary. The common-core standards are demanding for language. Students are required to make claims based on evidence, challenge and respond to others' work and thinking, and make and defend your own arguments (Kelly, 2016). Even native English speakers will have a challenging time with such demands, let alone an ELL student.

Collaboration

Collaborative and cooperative groupings help all students learn, especially ELL students (Hoffert, 2009). Group work is an effective method for ELL students to practice their academic language for many different reasons. One way is to allow them to synthesize material and content through verbal communication (Hoffert, 2009). This non-threatening method is a way for them to be able to show their knowledge using language and practice with that academic language and vocabulary. This is particularly effective when there is one discipline strong and one language strong student paired with one or multiple ELL students in order for the group to be effective and share ideas and discipline specific concepts. Small collaborative groups are also particularly effective for ELL students because it gives a safe and welcoming context to speak freely without fear of their classmates as a whole. Small groups allow for practice and taking chances using academic language, whereas a large group setting can be intimidating for any student, especially if their primary language is not English (Calderon et al., 2011).

Teacher knowledge and professional development

States that have adopted the common core curriculum need their students to be ready to use academic language in all disciplines. Schools need to be ready to serve their

students by training their teachers in how to teach their students to use proper academic language effectively (Calderon, et al., 2011). Many teachers, especially new teachers, do not have concepts of how best to support their students. They might not even know there is an ELL teacher or specialist in their district. This teacher or specialist has access to language scores and resources for teachers.

Carter et al., (2016) developed a study based on professional learning based on academic language in the classroom. They wanted to see if a year of professional learning would change their beliefs about academic language in the classroom. This study showed a great increase in knowledge and confidence in secondary teachers' use and teaching of academic language in the classroom. They began to see the importance of using academic language and how it would improve the students' knowledge of the subject. They also learned and had a better understanding that academic language is interdisciplinary, but also discipline specific. Using exit surveys and responses, the teachers' knowledge of academic language went from a simple definition to a thought-out response of the importance of this teaching to their students.

Teachers need to be the role models for their students in all ways; academically, behaviorally, and linguistically. It is up to the teachers to show their students the best ways to learn by modeling academic language in their own discipline. Nagy and Townsend (2012) lay out some examples of guiding questions that can lead to students using more academic language in the classroom. I have highlighted some examples.

- Do we see some phrases that we don't often use when we speak? Why are they here?

- What clue words and pieces of information did the author give us so we can follow where this paragraph is going?
- Does the way this is written tell us anything about who the author is or what he or she believes? Why or why not?
- Do you see any words that represent a process or something happening?

Nagy and Townsend's (2012) article concluded that although interventions of a student's academic language are important, understanding teacher knowledge of academic language generally and discipline specific are more important.

Academic Language in the Mathematics Classroom

Academic language in the mathematics classroom presents many challenges.

Teachers want to create a space that is conducive to learning the challenging content that is being taught, but must be aware of all of their students' specific language needs. Math teachers need to still be math teachers, but also language teachers (Leith et al., 2016). As students are pressed to pass high-stakes assessments based on state standards, teachers can at times dismiss the need for academic language to focus solely on content (Leith et al., 2016). Teachers must create an environment for students to grow both mathematically and linguistically in order to set them up for future success.

Strategies to build academic language in the mathematics classroom

Many teachers that are trained to be math teachers are trained to teach to a group of students that speak English as their first language. Therefore, it poses a challenge for teachers to work with ELL students (Zhao & Lapuk, 2019). Working with ELL students poses a challenge for teachers to meet their specific needs, including social needs, in the classroom. (Dong, 2016) Vocabulary acquisition poses a significant challenge to ELL

students. Words that students might know in everyday context, like foot or volume, mean completely different things when in the math classroom. Students must switch their meaning depending on their location and the class they are in, which is no easy task (Barrow, 2014). In this subsection, I discuss some common strategies used in the mathematics classroom in order to overcome the many challenges faced around building academic language in students, especially ELL students.

Assessing and analyzing prior knowledge

It is a common myth and misunderstanding that students who are English language learners are deficient in their math abilities (Leith et al., 2016). In order for teachers to know where their students are both mathematically and linguistically, a test for prior knowledge is a good place to start for school districts and teachers. Many times, these tests do not contain word problems to synthesize but problems on conceptual understanding, such as adding fractions or simplifying an algebraic expression (Leith et al., 2016). In the secondary and high school years, a test can also make sure that a student is placed appropriately in the proper math class. Again, students can be tracked due to their lack of English proficiency when in fact they are adept in math and should be placed in a higher level math class (Hoffert, 2009).

It is also important to understand that mathematics looks different in different parts of the world. ELL students need to have a firm understanding of mathematical notation, which could be different than where they grew up or how their parents taught them (Dong, 2016). Teachers need to understand different methods of solving mathematical problems, not just the “American” way of solving problems. Understanding how other cultures solve mathematical problems will lead to a better understanding of the

student's mathematical knowledge and avoid placing them in the wrong math class or mis-assessing their understanding (Zhao & Lapuk, 2019). When teachers have this kind of knowledge about other cultures' methods of solving mathematical problems, they can anticipate areas of confusion as well as communicate the differences and issues with the families (Leith et al., 2016).

Culturally responsive questions

For many ELL students, accommodations are given on tests in order to offset the language complexity (Robinson, 2010). Instead of giving extra time on tests, teachers should work to make sure that the assessments they give and the work they do in class is explained in culturally relevant questions (Leith et al., 2016). Leith et al. (2016) described a mathematics word problem (an already difficult task for any students) that references a gymnastics meet. For many students this problem is already done. They do not know what gymnastics is and have already given up on the problem. Teachers can rewrite the problem in language and context that the students will understand in order to assess their mathematical knowledge. As students progress, teachers can slowly introduce academic and English specific words so that the students do not get overwhelmed. Teachers need to make sure the word problems are engaging to the students, so they will not drift off. One way to do this is to relate the problems directly to the students by using activities in which they participate or by using their names (Zhao & Lapuk, 2019). Another way to make sure that students' word problems are culturally appropriate is to let them make their own word problems. This will keep them engaged and give them language to work with. (Dong, 2016) Barwell (2005) outlines a few ways to make word problems more accessible in language to ELL students: use a narrative structure to have

the students relate to the character in the story, have the students relate the word problem to their own lives, and to work together in order to understand and solve a word problem.

In this subsection, I discussed academic language and its context in the classroom. I explained what academic language and academic vocabulary are and how they relate to ELL students. Next I talked about why academic language is important and challenging for ELL students. I also discussed the strategies of using collaboration in the classroom to aid ELL students as well as how professional development for teachers can assist student knowledge and understanding, especially when it comes to academic language. Lastly, I laid out why academic language is important and challenging specifically in the math classroom and two strategies that can assist ELL students, analyzing and assessing prior knowledge and making culturally responsive questions. All of these points in this subsection are related to how teachers can assist their ELL students by understanding and being proactive.

Writing in the Math Classroom to Build Proficiency and Academic Language

In the year 2000, the National Council of Teachers of Mathematics (NCTM) identified writing as an essential part of learning and teaching math (Wilcox & Monroe 2011). Teachers have seen the impact of writing in their classroom, specifically in math. In a subject full of complex words and meanings, writing has been seen as a way to build academic language and proficiency in all students.

Challenges to writing in the math classroom

Writing provides students an opportunity to construct and develop their critical thinking as well as create meaning of mathematical tasks and concepts (McCarthy, 2008). But why is this well-believed practice not always implemented? Quinn and Wilson

(1997) conducted research on teachers' beliefs and practices on writing in the mathematics classroom. They selected a mix of schools to discover what the teachers thought about integrating writing in the math classroom, and how often they implemented the skills. The majority of teachers (a mix of 2nd, 7th, and 11th grade teachers) understood that writing in math, and in general, was a great opportunity for students to think critically and organize thoughts. However, many of the teachers did not use writing in their own classroom, even though they believed it to be best practice. Their reasoning for not using writing were as follows: the students had little to no writing ability (especially in ELL students), that they did not want to integrate writing because the English teachers were not integrating math, and there just was not enough time in a class period (and the required teacher time) to fit all of the extra work. Although many teachers struggled with the idea of implementing writing, they still saw the benefit to the students in general.

Why write in the math classroom?

Dacey, Hopping, and Salemi's 2018 book *Why Write in Math Class?* serves as a resource for guidance for teachers who have a desire to implement writing in their mathematics curriculum. They list the following reasons and benefits for implementing writing into the math classroom. (p. 4)

- Help students prepare for a discussion
- Brainstorm what they notice and wonder
- Make connections among multiple representations of ideas
- Explain their thinking
- Clarify their understanding of ideas

- Develop their reasoning skills
- Learn from their mistakes
- Note changes in their thinking over time
- Explore ideas creatively
- Reflect on their thinking

Writing is a way to extend the time given to students about their thinking. It is a way for students who show an interest in literacy skills to link that skill with their knowledge of mathematics (Carter, 2009). So many times in math, students just find their answer and move on. Writing lets students think critically about their answers and allows them to explore other ways to solve them. In today's age of high standards and high stakes standardized assessments, writing gives the students an opportunity to express their understanding of mathematical knowledge, language and understanding. It gives them the tools to justify and argue their reasoning and rationale, an important skill in mathematics (Bixby, 2018). This ability to express mathematical language and knowledge is a critical skill for ELL students.

Journaling

Journaling is one specific strategy that I highlighted for my project. Journals that are not corrected for grammar are a way that students can write and share their ideas in a non-threatening way where they can use that new academic language to express their ideas. As students are writing in their journals, ideas might come to them and they might realize that their mathematical ideas are coming to them in ways that they had not noticed before. This key structural element of writing in journals serves as a main advantage.

In this section, I discuss the work from Marilyn Burns's book, *Writing in Math Class* (1995). She laid the groundwork and reasoning behind using journals in the mathematics classroom. Burns laid out three general guidelines for students to write:

- Write about what you did
- Write about what you learned
- Write about what you are not sure about or wondering about

She made sure to lay out these guidelines early in the year with her students so that they know that this will be something that they will be participating in for the whole year. She also gives students the following prompts in order to get them thinking about what or how to write in a math journal. (p. 51)

- Today I _____
- I learned _____
- I'm not sure about _____
- I'm wondering about _____

At times she gives specific prompts about what was taught or learned for the day, but generally she keeps with these prompts. This type of consistent writing allows for students to build in the routine of the math journal. Burns highlighted the effectiveness of using journaling on a daily basis. She described that students are willing to share their journals with their classmates and their teacher. They are not afraid to share their ideas because they know that it is not graded, but more of an exploration of thoughts and ideas. This journaling gives all students a chance to practice using language in class and practice with their teacher or a partner. It is important to note that Burns modeled the writing and language for the students, so they can get used to what is expected and the

language that was used in class. Burns used a think aloud and writing as if she were a student in the class. This allows the students to be comfortable with their own writing and sharing their ideas with her and other students.

Explaining mathematical concepts

The second strategy that is explored is having students explain their understanding of mathematical concepts through writing. This strategy can be used at the start of a unit and be revised as the students go along throughout the year or unit. Baxter et al. (2002) described this strategy as something as simple as having a student explaining what subtraction means to them. This lets students explain to their teacher and classmates about what this seemingly simple concept means to them. This lets students practice the academic language that they are practicing in class and helps them make sense of the ideas in their heads (Baxter et al., 2002). This process also allows for students to think about and learn about metacognition, and explain to their teachers and classmates why certain words are important in their thinking and writing (Baxter, et al., 2002).

Dacey et al., (2018) explained another way to teach writing in this way. They have students explain something as simple and complicated as the equals sign. They have students participate in these writing activities across multiple grade levels, and notice the change in academic vocabulary that is taking place. Words like balances and equivalent start being used as the students grow in their academic vocabulary. They also go on to describe that a particular way to pair this with ELL students is to pre-teach some of the vocabulary, as then those students would be able to incorporate the new language in one

of these writing prompts. They suggest leading the students down the path, but not giving them the most complicated of academic language until the very end of the unit.

This strategy allows for teachers to see where the students are strong or weak in their understanding of critical concepts (Firmender et al., 2017). It also allows for them to pinpoint which academic language their students are comfortable using (Firmender et al., 2017). Teachers can use the writing as a tool for the students to reflect on their understanding and academic language they are using (Bostiga et al., 2016). This strategy allows for ELL students to grow in their academic language but also in mathematical understanding. It allows them to share thoughts and ideas with their classmates and teachers alike.

Conclusion

In this chapter I have outlined literature in order to guide my research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?* This literature has served as a base for my understanding of the topic but also as reinforcement for the necessity to bring more writing into the math classroom.

In chapter three, I outline my project in order to discover more about my research question. I discuss the project in length and discuss the rationale behind the style of curriculum I create. I discuss the setting and the audience for the curriculum as well as the timeline in which it takes place. Lastly, I outline the framework for the project, both of the pieces that I placed in the curriculum, as well as the design that my curriculum used.

Academic language is an important and challenging element of a mathematics class for ELL students. However, ELL students can use writing to improve academic language and proficiency. Therefore, in chapter three I lay out my project to create a writing in mathematics curriculum in order to increase the use of academic language in ELL students.

CHAPTER THREE

Project Description

Introduction

From my experiences being a math teacher in majority ELL schools, I have struggled with my students understanding the complicated language associated with mathematics. ELL students come into a math classroom with severe disadvantages, so anything we can do in order to help them be successful is a step in the right direction. I have found that writing in the math classroom has increased academic language, proficiency, and confidence in ELL students' math ability. Based on this background knowledge, I decided to use the research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?* Using my chapter two literature review as a guide, I reaffirmed my belief that writing in the math classroom is a strategy that sets these students on the path to success.

In this chapter three, I focus on the project that I created for ELL students in the math classroom or during their designated daily math period. First, I give a description and rationale of my project. Next, I give the rationale behind the framework chosen for the curriculum in my project. I also mention the relevant standards that are used in the project. Lastly, I explain the setting, audience, outcomes and evidence, learning plan, materials and timeline of the project that I created.

Project Description and Rationale

For my project, I made an introductory writing in mathematics curriculum for the middle school math teachers and students in my previous school. This curriculum can also be used for any middle school math teacher. It is a starting place for many of the teachers and students, as writing is not used other than writing prompts from the required math textbook. The curriculum is based on my research from my chapter two literature review. It serves as the foundation of the project to have ELL students start to use academic language in the classroom. The curriculum for the teachers and students is meant to ease-in to writing in the math classroom. As writing is not something that the students are used to doing in the math classroom, the curriculum is designed so that students can view it as something that will expand their abilities in a non-threatening way. This includes basic writing prompts in the beginning of the year sharing thoughts and opinions on math and math concepts. The curriculum that I have designed comes in three different parts.

The first part of the curriculum is a week long introduction to writing in the math classroom. It includes a get to know you assignment that allows students to share their experiences with math with their teacher. It also includes introductory explanations of math journals. The prompts that are highlighted in the curriculum are non-threatening to students and eases them into the next weeks of using their writing and math notebooks in class.

The second part of the curriculum is a ten day unit for eighth grade students. The unit focuses on defining and understanding rational and irrational numbers. It is the first unit that I typically do with every eighth grade class. The unit which I created, is a typical

unit that I have hand-made. The unit places a higher focus on academic language and vocabulary in order to better serve the ELL students in the classroom. Extras included in the lessons are the WIDA standard that guided the lessons for the ELL students, extra questions that make sure to highlight the academic language and vocabulary for the unit, and journal prompts for each lesson. There are three journal assessments for the students in order to assess their understanding of the language in context. All three journal prompts are the same, so that teachers and students can visibly see the growth that they made during the course of the unit. The first journal assessment is at the end of lesson one, the second at the end of lesson five, and the third and final assessment at the end of day ten, the end of the unit.

The third and final part of the project consists of resources for the other two grade levels of middle school math. My project was developed for teachers teaching all three grades, but could be used by a math teacher that only teaches one grade. I created and adapted journal prompts for the first unit of both sixth and seventh grades. This will give the teacher a place to start with their first unit of the year so they can see how they might want to incorporate writing into their units and curriculum.

The rationale for my project is three-fold. First, the project is based on my own experiences of using math in my own classroom as described in chapter one. My experiences with trial and error of using writing in the math classroom and the general classroom has shaped who I am as an educator. The vast majority of my teaching and education career has been focused on working with ELL students. Implementing writing in the classroom has shaped the thinking and academics of the students who I have worked with. Second, the research and discussion in my chapter two shaped my project. I

took away much from the writing process in my literature review, and affirmed my beliefs about academic language and writing. Third, and most important, is the lack of belief and use of writing in the math classroom at the school in which I work and have worked. I want to show the teachers and students how useful writing in math can be. For most, writing can be seen as unnecessary or cumbersome, especially for ELL students. I would like for the students and teachers to have something that will build a foundation for their math future

Research Framework

For my project, I follow the guidance and practice of the two books that I highlighted in my literature review: Burns's *Writing in Math Class* and Dacey, Hopping, and Salemi's *Why Write in Math Class?* (Burns, 1995) (Dacey et al., 2018) One of the biggest takeaways I took from the texts was to make sure that the teacher instills a community of learners that are comfortable communicating in math and making mistakes with the rest of their learning community. Teachers must facilitate this type of community because writing can appear to many students as a risky activity in a math class (Dacey et. al., 2018). This community also helps students communicate with their teacher. Students can communicate to their teacher their thoughts or ideas orally, and then can translate those communication skills to writing (Burns, 1995). I focus on building those foundations in the curriculum for those ELL students who already struggle with writing and are hesitant to start.

Another key focus of the curriculum is building the foundations of academic language using collaboration. As mentioned in chapter two, collaboration is key for helping ELL students. Small groups help that collaboration and allow students to make

mistakes with each other and offer that safe space to use and practice academic language (Calderon et al., 2011). I employ strategies to help facilitate academic language by using small group strategies as highlighted from *Why Write in Math Class?*. The book highlights how using small groups can help facilitate a conversation and comparison between the academic vocabulary that was used in writing.

The last key focus of the curriculum I implement for my project is having students and teachers understand the growth over time. Having students reflect on their opinions over time can help them create meaning and make sense of why something was put into place (Dacey et al., 2018). This is also important for teachers to embrace as well. If teachers are learning something new and are excited about it, that energy will flow into the students and let them know that it is okay to be excited and learn something new (Dacey et al., 2018). A journal prompt detailing a change in beliefs about a certain topic or thoughts about the importance of writing in math class can help the students and the teachers see how opinions are changing and why something is important (Burns, 1995).

Project Format

My project focuses on and builds a curriculum that is based on the backwards design model discussed in Wiggins and McTighe's 2011 book. This framework ensures that students will understand the big ideas behind writing in the classroom and come out of the unit better writers and mathematicians (Wiggins & McTighe, 2011). One of the key concepts of Understanding by Design is the concept of student understanding. The authors stated that "Understanding is revealed when students autonomously make sense of and transfer their learning through authentic performance" (p. 3). It is my goal for this project that the students participating in the curriculum build their own understanding

using the writing prompts and will turn to writing in order to build understanding. It is also a goal of the project for students to be able to correctly use the academic language they are learning in their math class into writing in order to build proficiency and build their own understanding of the concepts.

In order to plan the curriculum, I must first think about the end of the unit and the understanding and transfer I would like to accomplish, a key part of the backwards design process (Wiggins & McTighe, 2011). Stage one of the backwards design process is about the understanding the students will achieve. It will also have students coming back to the same essential questions throughout the curriculum and unit (Wiggins, McTighe, 2011). For my unit, I am working to achieve an understanding from the students that basic writing in the math classroom will help them learn and apply new academic language and explain their thinking. I want the students to be able to use academic language comfortably in order to increase their proficiency in math,

During the second phase of backwards design, it is essential to define the assessments that make sure that the learning goals are being met. It is important to make sure that all of your assessments are in line with the results that you desire from your stage one goals (Wiggins & McTighe, 2011). Stage two of backwards design also makes sure the designer of the curriculum includes products and performances that assess whether or not the stage one outcomes are met (Wiggins & McTighe, 2011). For my process of designing my curriculum, I must make sure that students are producing work that emphasizes academic language in order to increase proficiency. I also need to ensure that the students have prompts that will guide them to understand how they can apply their academic knowledge and apply it in context.

In the third and final phase of backwards design, the creator of the curriculum goes into the nuts and bolts of the curriculum, what kinds of activities will the students and teachers be doing in order to assess and ensure that phase one goals are being met. The goals and activities must be created so that learners will gain independence as they progress through as well as create meaning and understanding for themselves (Wiggins & McTighe, 2011). The creator of curriculum must also make sure that all learners have the opportunity to achieve understanding by differentiating the lessons and activities (Wiggins & McTighe, 2011). In phase three of my curriculum, I design specific lessons that help the students achieve the stage one desired transfer. I provide lessons that are scaffolding so that they may develop their own understanding about math concepts and build academic language. In turn, their teachers will see the meaning that their students are creating for themselves.

Relevant Standards

The project that I created is meant to be useful for both students and teachers. Therefore, the alignment of standards is crucial for students' understanding and for teachers to make sure that their students are meeting the rigorous standards set for them. I use the Minnesota state standards for mathematics for all three grades. The standards are listed in part two and part three of the project. I also add a standard that applies to English language learners from World-class Instructional Design and Assessment (WIDA). The WIDA standard that I highlight in my curriculum is English language development standard three which reads, "English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics." (English Language Developmental Standards, 2020) This standard is the most important

for students that truly encapsulates my project. The students should be able to communicate their mathematical ideas in order to be successful in the content area.

The Minnesota state standards along with the main WIDA standard will ensure that students are completing grade level standards, which in turn will help students increase their academic language and math proficiency.

Outcomes and Evidence

The outcomes I hope to achieve for the project and curriculum are for students to correctly use academic language in context using prompts given by the teacher. Given a list of five words, I hope that students will be able to use four out of five correctly in context. This is the evidence that students provide in order to show that they are improving in their academic language use and math proficiency. The prompt is:

Use the following five words in context (explain what that means to the students) to describe what you know about rational and irrational numbers.

-ratio

-repeating decimal

-terminating decimal

-pattern

-square root

The students will complete the same writing prompt three times. The first time will be after lesson one of content, the second will be after lesson five, and the third will be after lesson ten. I am planning on having the same prompt so that the teachers can see the increase in academic language and mathematical proficiency in their ELL students. Teachers will be able to see the growth in their students in a clear and concise way through the use of academic language in writing prompts.

Setting and Audience

The setting for the project is the school that I used to work at, a small Catholic school in the middle of an urban area with a student population of 340 students in kindergarten through eighth grade. The school is currently in year six of implementing a school-wide dual-immersion program, which has reached sixth grade. The school is 89% hispanic and 5% African American. The rest of the student population is a mix of other races and cultures. Eighty-six percent of the students qualify for free and reduced priced lunches. Almost 99% of students are on tuition assistance. 87 percent are classified as English language learners and 93% report that a language other than English is spoken at home.

Due to the nature of the structure of the dual-immersion program, the students roughly spend 50% of their day speaking in English and the other 50% in Spanish. The classes are split by language and content area except for literacy, which is taught in both languages throughout the day. Math is currently taught in English in middle school and will be taught in English for the foreseeable future of the school. The dual-immersion program in the school has reached sixth grade, but does not affect the math instruction.

The audience for my project are the students in middle school, with a specific emphasis on the eighth graders. The eighth grade students will be the ones that will be assessed on their writing and academic language. The math teachers are also a small part of my audience, due to the fact that they will have to deliver the curriculum. The math teachers at my school are the teachers that teach math to their respective students (roughly 20 students per class section). There is one male math teacher and one female math teacher in the middle school. There are two Title I math tutors in the school but are not included in this study, as they are not the primary math instructors. Both teachers identify as white. The teachers come from various backgrounds due to the nature of a Catholic school with different levels of education and teacher training. The school has implemented a new bilingual curriculum across all grades, which does provide an additional online math component for support. The teachers generally receive very little professional development on teaching math, with most of the focus on building literacy in the school.

Materials

The materials used in my project are very few. This is on purpose, so that teachers and students will be able to see how easy it is to incorporate writing into the math curriculum. Students will need a specific math notebook that will serve as their journal and to host their writing prompts for the lessons. The only other materials that will be used is the curriculum itself. The curriculum provides all of the writing prompts that teachers and students will need in order to be successful in this project.

These lessons were created to support students online (the lessons were created for students participating in distance learning due to Covid-19) but can be easily translated to students in person if the students have access to technology.

Timeline and Learning Plan

The timeline for this project is intended to be three weeks of writing during the first part of the school year. This will give students and teachers a foundation of writing in the math classroom and how it can improve academic language for the ELL students. The project is broken up into three different week sections. The first week will be an introduction to the two main forms of writing that will take place over the four weeks: journaling and explaining mathematical concepts. These will be fun and easy prompts to get the students used to writing and sharing their ideas with the teacher and the other students. The next two weeks will focus on building academic knowledge into their writing using prompts. The academic language and vocabulary assessments will take place after day one, day five, and day ten. The last lesson will also have the students reflect on the process.

These lessons are focused around the learning and discussions that are already taking place within the classroom. The first week's lesson is centered around the discussions in the beginning of the school year. Students are already thinking about their feelings as they approach the beginning of a new year. Teacher led discussions will lead to student writing and discussions. The same format guides the other two weeks worth of lessons. Teacher led teaching and discussions lead to student writing and discussion. One other format that the lessons will take is student writing which leads to class discussion. The learning plan for this project is aimed to be fluid, allowing for natural discussion to

take place. The three levels of teaching, writing and discussion are meant to work together and in any form, occurring naturally and allowing teachers to use their judgement about when to move on to the next piece of the activity.

Conclusion

In this section I have discussed the audience and setting for my project. This gives the reader a look into my previous school and why I chose this specific type of project. I also described the timeline in which it will take place and how the assessments fit into this timeline. I also described the learning plan of the project and the outcomes and evidence that will be shown by the students participating in the project.

The chapter as a whole laid out the foundation and groundwork for my project, a curriculum designed for ELL students in order to implement writing into their mathematics classroom in order to gain skills in academic language and build their math proficiency. I discussed the nuts and bolts of the project that will give me the information in order to produce a curriculum that serves a student population that deserves the best from the educators in their lives.

As I approach my next chapter, I reflect on the chapter as a whole. Having a well designed and thought-out project will ensure that the students will achieve the results that I desire. In my next chapter, I discuss, in length, the curriculum I designed. I discuss the process and rationale behind the design as well as conclusions I make after finishing my project.

CHAPTER FOUR

CONCLUSION

Introduction

My educational journey has been long and winding, but after years of trying out different grade levels and student populations, I have found my home teaching middle school math, specifically to English language learners. However, after spending years working with English language learners in math class, I knew that I had to conduct my research on how to best serve them. ELL students have many barriers in their educational journey, especially in math class. They truly have three languages that they are focusing on and developing all at once (Brown, 2005). This understanding of my purpose for this capstone project led me to my research question: *How can writing in the math classroom increase the academic language and proficiency in a classroom of 80% English language learners?*

Chapter four consists of the following subsections: what I have learned from this capstone project process as a researcher, writer and learner, a revisiting of my literature review to look at influential pieces of research, the implications of my capstone project in my school and other locations, limitations that occurred in this process, future research and projects that could stem from my work, the communication of my results to my current and previous school and beyond, the benefits of my research to the profession, and closing thoughts.

What I Have Learned

The capstone process has been a challenging one, but I have come away with so much more learning than I could have ever thought possible. I have discovered that I am a stronger researcher, writer, and learner because of this process.

From a researching perspective, I learned quickly that it is important to find a narrow topic, and that it was not always so easy to do so. I started the process of writing with an extremely broad topic, writing in math class. I honestly thought it was narrow enough to write my capstone paper. I started researching and quickly found out that the amount of research was overwhelming and would need to narrow my topic more. I then worked to get my topic more narrow, so that I could find quality research but not at an overwhelming quantity.

Something important I learned about researching was the importance of finding where my research fits within the subject area. Could I find a topic with enough existing research but unique enough to find a place where I could fill in a gap in the field? I will learn from this new understanding throughout my career as I look for new research in order to make myself a better educator. If I want to find research that is relevant to me, I need to make sure that the questions that I am asking are narrow enough to find meaningful sources and information.

I have learned and taken much from this capstone as a writer. One of the more challenging parts of this writing has been keeping a clear path on such a long process. When working on a project for so many months, it is easy to get lost in the research and also to get excited about something new you have learned through a new find for the day. This presents itself to be challenging because you have to remember where you have

been and where you are going in your project. If you find that new exciting piece of research you have to fit it into your research project, or you might just have to save it for a different form of research paper or project. I felt that once I found my path for this capstone, it became easier to say no to certain sources and pieces of research. This learning of finding and maintaining a clear path is invaluable as a teacher to make sure that I am not veering too far from where I have been with my students and where we need to go collectively.

I have become a better learner through this process. One of the biggest takeaways from this capstone has been the realization that the information that I am looking for is out there, I just need to find it. Having been a teacher for a number of years I have at times fallen into the same ruts of finding information for my students and classes. After working on this capstone, I have re-discovered the invaluable information that is readily accessible through journals and articles. I found that using the library databases proved to be very user friendly and I plan on using these resources next time I am looking for some solutions to better serve my students.

Overall, working on this capstone has made me more willing to reach out to other people in my field and in my classes. I usually like to work in a little bubble but I have found that people are willing to help with anything I might need as long as I ask. I have found that I saved so much more time asking someone who might have experience in a topic or in writing research papers versus figuring out the answer for myself. That kind of learning is something that I will be able to take with me in any future endeavor.

Revisiting Literature Review

Looking back on my literature review, I see how the research truly shaped what my project would become. As I wrote more, my topic and research became more narrow, which led me to discover what I wanted my project to look like. One of the cornerstones of my research was Baxter, Woodward, Olson, and Robyns' (2002) research of students explaining mathematical concepts in order to show their thinking and knowledge of academic vocabulary. The reason this piece of research was so important to my project was their focus on having students think critically of a topic and making sure that their words mattered (Baxter et al., 2002). I tied this into my project by having my assessments tied to the words that the students would use and be assessed. Students' words are selected for a reason, and I wanted to make sure that I included this in my assessments.

The other main pieces of research that helped form my project were those sources that highlighted the importance of journaling in math class and also how to achieve this goal. Dacy, Hopping, and Salemi's (2018) book *Why Write in Math Class* reaffirmed all of the findings that I had already found in my research. Their well laid out reasons for why it is important to write in math class gave me more ideas of different ways I could make journal prompts, so that students could develop their reasoning skills, make connections between other concepts, and note changes in their thinking. These skills are skills that I kept in mind while crafting my journal prompts. In my project, I used two different types of prompts. One of the prompts I used was based on the research from this book. I wanted to create prompts that guided students' learning and make those connections that are critical in the math classroom.

Dacey, Hopping, and Salemis's (2018) research was also used for creating my assessments. From that research, I used the idea of pre-selecting words to better assist ELL students focus their attention on which words are the most important. This guided my assessments and also my journal prompts that I crafted. I made sure to include the most important words for the assessments but also create my journal prompts around these words in order to create the repetition for the students. This repetition throughout the lessons and the journal prompts will hopefully stress the importance of the academic vocabulary to the students.

The other piece of research that I used to craft my journal prompts is Marilyn Burns's 1995 book, *Writing in Math Class*. I took much from this book and formed my project around the ideas and themes from the book. One of the main ideas that I used from the book was the implementation of journaling and writing in math class early in the school year. Burns's thoughts on making sure that a teacher is laying out the rules, guidelines, and procedures for writing during the first week helped my decision to have my project be focused on the beginning of the year. I found it important for students to know very early on in the school year to understand that this will be something that they will be working with all school year. The other main pieces I took from Burns are her basic math journal prompts. Basic journal prompts about how the student felt about the day's learning or what they still have questions about lay the foundation for students to be comfortable in writing and talking about math in a daily setting.

Looking back on my literature review helped me to understand the pieces of research that truly shaped my project. It was interesting to see how influential certain pieces of research could meld with my own thoughts.

Implications and Limitations

The implications of my project on the community will hopefully drive new professional development for math teachers and how they can use writing to better serve their English language learners. My license is not based on teaching ELL students, so my research for this capstone and my previous experience guided me throughout this journey. The project I created was based on my best judgment for what is best for the types of schools I have worked in. My hope is that leaders of schools will look at the project and see how they can push it even further. There are so many wonderful professional development opportunities for teachers to learn to better serve their ELL students.

I also hope that another implication from my project is that there needs to be support in place from an ELL teacher or staff in order to assist the teachers of the school. I have not had the opportunity to work with many fully trained ELL teachers. I had to use what I knew in order to come up with strategies and resources for my students. My project gives a quick guide for how math teachers can use writing in their classrooms with ELL students. An ELL teacher could take this even further and give even more advice and resources to other math teachers.

The other implication of my project is that administrators and teachers could share this project and see how valuable writing is in order to increase the use of academic language and vocabulary in their schools. They could shift resources and invest more money into curricula that focuses on writing in all content areas. This shift could be beneficial not only to ELL students, but to all the students in the school.

I did not have any limitations in the creation of the final project.

Future Projects

Future work on this project could expand on the work that was done for this capstone. I would enjoy continuing to work on this project and expand the writing curriculum to all three grade levels and for the entire calendar school year. It would be interesting to see how my thoughts and ideas would evolve throughout the school year and how students would react and grow with the writing process. By working on and making the writing curriculum, I have been able to reflect on the writing and reflection process in middle school as a whole. I would enjoy expanding the writing curriculum to other parts of the school day, such as advisory. I think that students being in the habit of writing and reflecting could be a huge factor in their emotional development.

I also plan on sharing my project with the other content teachers in the middle school for possible implementation into their subject areas. I would be willing to work with them and share my basic structure of the writing curriculum. I believe that this would be a positive factor for the education of our students as it would create set expectations and routines for each of their classes. They would be so used to writing and reflecting in each of their classes that it would be second nature for them.

Communicating Results

I plan on communicating results directly with my previous and current schools. As I originally planned, my first audience I would share my project with is my previous school, as they are the audience I had in mind when creating this project. I plan on sharing my project and results with them so that we can start to work together to implement some form of the writing process this school year, and then start fresh with the

project for next year. After sharing and working with my previous school, I plan to share the results with my current school. I am the only middle school math teacher, but I will communicate my results with the elementary school teachers who teach math to their students. I will also share my results with the other content teachers in the middle school to spark their interest in implementing some kind of writing process in the rest of the middle school.

After sharing my project with my previous and current schools, I plan to implement the program and see how the students react to the writing process and prompts. If they respond positively, I would love to communicate my project and results to other schools with high ELL populations. I think the more schools that want to provide their ELL students with the necessary support, the more equitable our schools will be.

Benefits to the Profession

I believe that my project benefits the profession because it gives students and teachers an entryway into writing in the middle school mathematics classroom in a way that is non-threatening and gradual in nature. The project can be used as is for the specific units highlighted or as a guide to what writing in the middle school math classroom could look like and the results that could take place. I also believe that this writing curriculum could be modeled in other content areas in middle school as well. Many of the journal prompts are general in nature and the assessments can be adapted for the vocabulary that is being taught for that specific content area and unit.

Most importantly, this project benefits those teachers who do not have the benefits of having an ELL teacher or staff on site. This is true for many small schools, like the one meant for this project and my current school as well. The teachers need

something that is ready to go on the first day because their time is stretched in many different ways. I hope that this project can alleviate some of those hardships.

Conclusion

In this chapter, I have shared my learnings through this capstone process and how it has shaped me as a researcher, writer, and learner. This process has shaped me in all three ways and am grateful for the experiences that it has granted me in all three areas. I have reflected on my process through the literature review and how the journals and books have guided me throughout the capstone process. I discussed the implications of my project and how I think that the project could offer some changes into how middle school math teachers use writing to instruct their ELL students. I wrote on how this project could lead to future projects such as branching out and having other middle school content areas use this project as a guide. I also wrote about the people and schools I plan to share my project and results and how they might benefit from this capstone. Finally, I discussed the project's benefits to the profession and how this project could alleviate some of the pressure and work from teachers and schools that do not have an ELL staff member on site.

As I conclude this capstone process I am grateful for the learning and growth that I have experienced. I have taken much from the process and am glad and excited to share my project and finding with others in the profession. I look forward to implementing the project and having former colleagues also implement it as well. I am eager to see how students and teachers' thoughts on writing in math can change and what kind of feedback I will receive. In conclusion, I am grateful for what I have learned and what lies ahead for this project and my career in working with ELL students.

REFERENCES

- Barrow, M.A. Even math requires learning academic language. *Phi Delta Kappan*, 95 (6), 2014, pp. 35–38., <https://doi.org/10.1177/003172171409500608.ck>
- Barwell, R. Working on arithmetic word problems when English is an additional language. (2005) *British Educational Research Journal*, 31 (3), pp. 329–348., <https://doi.org/10.1080/01411920500082177>.
- Baumann, J.F. & Graves, M.F. What is academic language? (Sept. 2010) *Journal of Adolescent & Adult Literacy*, 54 (1), pp. 4–12. [10.1598/JAAL.54.1.1](https://doi.org/10.1598/JAAL.54.1.1), <https://doi.org/10.1598/JAAL.54.1.1>.
- Baxter, J., Woodward, J., Olson, D, & Robyns, J. (Sept. 2002) Blueprint for writing in middle school. *Mathematics Teaching in the Middle School*, 8 (1), pp. 52–56., www.jstor.org/stable/41181228.
- Bixby, M.M. Effective and efficient use of math writing tasks. (2018) *The Mathematics Teacher*, 112 (2), p. 143., <https://doi.org/10.5951/mathteacher.112.2.0143>.
- Bostiga, S.E., Cantin, M., Fontana, C. & Casa, T.M. (2016) Moving math in the write direction: reflect and discuss. *Teaching Children Mathematics*, 22 (9), p. 546., <https://doi.org/10.5951/teachmath.22.9.0546>.
- Brielenberg, B. & Fillmore, L.W. (2005) The English they need for the test. *Educational Leadership*, 62 (4), pp. 45–49.

- Brown, C.L. (2005) Equity of literacy-based math performance assessments for English language learners. *Bilingual Research Journal*, 29 (2), pp. 337–363., <https://doi.org/10.1080/15235882.2005.10162839>.
- Burns, M. (1995) *Writing in Math Class a Resource for Grades 2-8*. Math Solutions Publications
- Calderón, M., Slavin, R., & Sancha, M. (2011) Effective instruction for English learners. *The Future of Children*, 21 (1), pp. 103–127., <https://doi.org/10.1353/foc.2011.0007>.
- Cardullo, V, Finley, S., Burton, M., & Tripp, L.O. (2017) Attitudes, perceptions, and knowledge - academic language and academic vocabulary of pre-service teachers. *Journal of Higher Education Theory and Practice*, 17 (9) <https://doi.org/10.33423/jhetp.v17i9.1418>.
- Carter, H., Crowley, K., Townsend, D.R., & Barone, D. (2016). Secondary teachers' reflections from a year of professional learning related to academic language. *Journal of Adolescent & Adult Literacy*, 60(3), 325–334. doi: <https://doi.org/10.1002/jaal.554>
- Carter, S. (2009) Connecting mathematics and writing workshop: it's kind of like ice skating. *The Reading Teacher*, 62 (7), pp. 606–610., <https://doi.org/10.1598/rt.62.7.7>.
- Dacey, L.S., O'Connell Hopping, K. & Salemi, R.E. (2018) *Why Write in Math Class?: K-5*. Stenhouse Publishers
- Digest of Education Statistics*, 2018. Oct. 2018, nces.ed.gov/programs/digest/d18/tables/dt18_204.20.asp?current=yes.

- Dong, Y.R. (2016) Create a responsive learning community for ELLs. *The Mathematics Teacher*, 109 (7), p. 534.,
<https://doi.org/10.5951/mathteacher.109.7.0534>.
- English language learners: a policy research brief produced by the national council of teachers of English. *The James R. Squire Office for Policy Research*, 2008, pp. 1–8., Accessed 4 May 2020.
- Firmender, J.M., Casa, C.M., & Colonnese M.W. (Oct 2017) Write on. *Teaching Children Mathematics*, 24 (2), pp. 84–92.,
<https://doi.org/10.5951/teachmath.24.2.0084>.
- Gil, L. & Bardack, S. (2010) Common assumptions vs. the evidence: English language learners in the United States: a reference guide. *PsycEXTRA Dataset*,
<https://doi.org/10.1037/e537552012-001>.
- Hoffert, S.B. (2009) Mathematics: the universal language? *The Mathematics Teacher*, 103 (2), pp. 130–139., Accessed 4 May 2020.
- Kelly, L.B. (2016) Supporting academic language. *Science and Children*, 54 (3),
https://doi.org/10.2505/4/sc16_054_03_52.
- Leith, C., Rose, E., & King, T. (May 2016) Teaching mathematics and language to English learners.” *The Mathematics Teacher*, 109 (9), pp. 670–678.,
<https://doi.org/10.5951/mathteacher.109.9.0670>.
- Mccarthy, D.S. (2008) Communication in mathematics: preparing preservice teachers to include writing in mathematics teaching and learning. *School Science and Mathematics*, 108 (7), pp. 334–340.,
<https://doi.org/10.1111/j.1949-8594.2008.tb17846.x>.

- Menken, K. (2010) NCLB and English language learners: challenges and consequences. *Theory Into Practice*, 49 (2), pp. 121–128.,
<https://doi.org/10.1080/00405841003626619>.
- Nagy, W., & Townsend, D. (2012) Words as tools: learning academic vocabulary as language acquisition. *Reading Research Quarterly*, 47 (1), pp. 91–108.,
<https://doi.org/10.1002/rrq.011>.
- Our Nation's English Learners*.
www2.ed.gov/datastory/el-characteristics/index.html#four.
- Quinn, R.J, & Wilson, M.M. (1997) Writing in the mathematics classroom: teacher beliefs and practices. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, 71 (1), pp. 14–20., <https://doi.org/10.1080/00098659709599316>.
- Robinson, J.P. (2010) The effects of test translation on young English learners' mathematics performance. *Educational Researcher*, 39 (8), pp. 582–590.,
<https://doi.org/10.3102/0013189x10389811>.
- Umansky, I.M. (2016) Leveled and exclusionary tracking: English learners' access to academic content in middle school. *American Educational Research Journal*, 53 (6), pp. 1792–1833., <https://doi.org/10.3102/0002831216675404>.
- English Language Developmental Standards. (2020). WIDA.
<https://wida.wisc.edu/teach/standards/eld>
- Wiggins, G.P. & McTighe, J. (2011) *The Understanding by Design Guide to Creating High-Quality Units*. ASCD

Wilcox, B. & Monroe, E.E. (2011) Integrating writing and mathematics. *The Reading Teacher*, 64 (7), pp. 521–529., <https://doi.org/10.1598/rt.64.7.6>.

Zhao, M. & Lapuk, K. (2019) Supporting English learners in the math classroom: five useful tools. *The Mathematics Teacher*, 112 (4), p. 288., <https://doi.org/10.5951/mathteacher.112.4.0288>.