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Planning for Expressive Language in Math for Multilingual Learners

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PLANNING FOR EXPRESSIVE LANGUAGE IN MATH FOR MULTILINGUAL LEARNERS

By

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CHAPTER ONE

Introduction and Background

Introduction

Throughout my career I have held many roles within education. I spent many years as an elementary classroom teacher and now find myself in the role of a teacher of multilingual learners. It is my professional opinion that teachers in the elementary setting do whatever they can to scaffold learning for students so that they may all learn to their full potential. In my time this past year as a co-teacher of third grade math, and through working with multilingual learners at varying age levels, I see these students struggle with academic language in math. Academic language is defined as formal language used in the classroom. It includes language used in instruction, textbooks, assessments, and lessons (Pompa & Scarcella, n.d.). Multilingual learners fall behind in classes that do not allow enough practice with academic language. Year after year multilingual students are fighting a constant uphill battle of trying to learn content and language simultaneously. Some are able to make it up that hill, but many are not. Are these multilingual learners (MLs) getting what they need to build academic language? Do teachers know how to best scaffold information for multilingual learners? This leads me to my driving research question, *How can planning for expressive language in math affect the academic achievement and language development of third grade multilingual students?*

It is important, especially for MLLs, to examine teaching practices and find ways to incorporate more expressive language practice. For the purpose of this capstone project, expressive language is defined as speaking and writing. Knowing that many

teachers struggle to do this, I will develop a third grade math unit that includes expressive language opportunities and then use those lessons as a model for classroom teachers to use in their everyday teaching. The lesson framework could be used in professional development for classroom teachers.

Chapter One explains my personal and professional experience that inspired me to pursue my research question. In this chapter I will first discuss my experience as a math student in grade school as well as college. I will then discuss my experience teaching math to elementary students as a classroom teacher and a MLL teacher as a co-teacher. Finally, this chapter will discuss the personal and professional significance of delving further into this research question.

My Experience as a Math Student

Throughout school, math was always my favorite subject. It came easily to me and became an area for me to excel. I graduated from high school 25 years ago. Things were different for students when I went to school. We spent time memorizing algorithms and learning when to apply them. Rarely were we asked "how" or "why" in math. We were not given the words to explain our thinking. Many of my fellow classmates struggled with the content and barely passed their classes or failed all together. If they were unable to memorize the algorithms and know where to apply them, they failed.

Math education has evolved greatly since I was young. Parents who never really learned the content are now forced to help their children with "new math". They are frustrated that those algorithms that they spent so much time learning are not valued any more. Math has changed for the better. We offer students more opportunities to cultivate the language of math. They are forced to know how and why their answers are correct.

It is a whole new world of math that, unfortunately, leaves many multilingual students behind.

When I went to college and decided to major in elementary education, I didn't want to forget about my favorite subject. I needed to choose an emphasis in order to get my middle school license. I, of course, chose math. I had to take extra math classes to fulfill those requirements. In my math classes that were aimed at teaching me how to be a math teacher, I rarely had the opportunity to use expressive language to explain my thinking. I can also not recall a time when I was taught how to elicit that expressive language from my students. We were taught how to make models and make things visual and how to "show" and not "tell", but never did we learn how to ask our students to express their understanding through speaking or writing. We were never taught how to get our students to use the academic language of math. Although this was years ago, I do not know that education for teachers has changed that much. I still see teachers struggling with how to incorporate expressive language in content classes.

My Experience as a Math Teacher

After finishing college I went on to be an elementary classroom teacher. I taught second grade for a while and then switched to fifth grade, where I spent nine years teaching all subjects in a suburban school district. I went into teaching like most teachers do, armed with all the knowledge from school and hopeful curriculum would fill in the gaps. Little did I know that teaching requires you to look outside the curriculum to meet the needs of your students. Many of the students I worked with were performing below grade level in reading and math. Professional development was given from time to time

but it always seemed like we moved from one thing to the next without giving much thought.

As I continued through my years of teaching fifth grade I noticed some things happening in math class that were upsetting. Often I would ask my students to discuss their solutions with each other. About one third of my class were multilingual learners and the other two thirds were at or below grade level. I noticed that when asked to discuss their solutions they would just tell each other what they got for an answer. If they had different answers they would just go with the one that the "smarter" student got. They never talked about how they came to their answers. I would also ask them to write a response to explain their thinking. I would get responses like, "I just knew it," or, "It popped into my head." I did not realize it at the time but I was failing them greatly. I was doing what the curriculum told me to do, but they needed more.

My students were not given the opportunity to learn how to use expressive language to explain their thinking. They did not have the scaffolding needed to be able to complete the tasks I asked of them. I made the mistake of assuming that they would just know how to perform the task. This, in turn, affected their comprehension of the math skills they were learning and did not allow connections between math concepts to form.

My Experience as a Multilingual Teacher

While teaching in an elementary school I knew that I fell in love with my MLL students. I loved the different life experiences they brought to the classroom and how hard they worked to achieve their goals. I wanted to learn more about them and how to teach them. I went back to school to get my license to teach MLL.

About three years ago I decided that I wanted to change paths and move to teaching English to multilingual students and use the license I had worked so hard to get years prior. I was so excited to embark on this new journey. I got a job in a smaller, more rural school district with a much smaller MLL population. I was stretched across multiple grades, trying to figure out how to best serve my students. I quickly realized that I would not be able to have the face to face contact with the students that I so desperately desired. I needed to find a way to serve them best in our present situation. After some trial and error and finally getting another teacher to help, I am now working in two schools instead of four. This allowed me to focus a little more. This year I worked as a co-teacher in a third grade math class. I had taken co-teaching training and Sheltered Instruction Observation Protocol (SIOP) training before so I knew a little bit about what to expect.

As I began working in the classroom I noticed many of the same things I had seen in my previous position- multilingual students had low math vocabulary and were performing low on state and local assessments. Their ACCESS (Assessing Comprehension and Communication in English State-to-State) scores continue to leave them at risk of becoming a Long Term English Learner (LTEL). They were struggling to remember content from one day to the next. They were unable to write or speak about their mathematical thinking, nor were there many opportunities. They did not have the language needed to have an academic conversation or write a response to a low stakes prompt. Their teachers spent very little time giving them practice or scaffolds on how to use their academic language. Thirty minutes in a small group with a multilingual teacher is not enough time to get the practice they truly need. They need to practice every day in

every subject in hopes of strengthening their academic language. For the purposes of my research, I will focus solely on the academic language of math.

Professional Significance of Research Question

After reflecting on my past personal and professional experiences it has become apparent to me that multilingual learners need scaffolding and practice to strengthen their academic language. This, in turn, will help these students to build their English language vocabulary and work towards becoming proficient users of the English language. It is my role to help bridge the gap between content and language.

Teachers need training and experience in the importance of academic discourse and strategies to include practice on a daily basis. In my experience I have learned that multilingual learners who do not get the practice they need with academic language are at a greater risk of becoming LTELs and therefore at a higher risk of dropping out of school. (Pompa & Scarcella, n.d.) This capstone will help me and fellow teachers gain access to reasoning and strategies to grow academic language within their math instruction.

Summary

Chapter One introduced the research question for this capstone. It also discussed my personal and professional experiences that lead me to pursue this research question. Lastly, this chapter discussed the personal and professional significance of this research, lesson, and professional development.

Chapter Two I review professional literature on the topics of historical context, learning language through content, math as a second language, and scaffolds and strategies. Chapter Three I describe the steps taken in creating an English language

curricular unit based on my knowledge from the literature review. Chapter Four I reflect on the capstone process.

CHAPTER TWO

Literature Review

Introduction

In Chapter One I described my personal and professional experience as a content and multilingual teacher that prompted me to look closer into planning for expressive language in a third grade math class. In Chapter Two I will review literature to support my research question, *How can planning for expressive language in math affect the academic achievement and language development of third grade multilingual students?* The literature review covers the topics of the historical context of English learners, learning language through content, math as a second language, and scaffold and strategies to promote academic and language growth in the classroom through academic discourse.

The first topic in this chapter provides a historical context for the importance of researching this question. This section will set the tone to help understand the current population trends of multilingual students and what is projected in the future. Additionally, this section will look at data and research of how multilingual students perform in math compared to their monolingual peers. Last, this will look at data and research pertaining to content teacher preparation to meet the needs of multilingual learners in their classes.

The second topic in Chapter Two discusses the importance of multilingual learners learning language through content. Academic language and the importance of understanding the difference between social and academic language development is described. The WIDA standards for language development in math are highlighted here. The third section focuses on math as a second language while taking a closer look at math

vocabulary and some of the difficulties it can cause for multilingual learners. The last part of this section goes into depth about the importance of including math discourse in the classroom. The final section provides scaffolds and strategies for teachers to use to prepare multilingual learners for math discourse in their classrooms.

Historical context

A multilingual learner is defined as,

> Students who come in contact with and/or interact in languages in addition to English on a regular basis. They include students who are commonly referred to as English language learners (ELLs), dual language learners (DLL), newcomers, students with interrupted formal schooling (SIFE), long-term English learners (L-TELs), English learner with disabilities, gifted and talented English learners, heritage language learners, students with English as an additional language (EAL), and students who speak varieties of English of indigenous languages. (WIDA, 2020, p. 11)

Multilingual learners are the fastest growing population in United States schools. The number of multilingual learners in schools has been steadily increasing. In 2000 the number of multilingual learners in schools accounted for 8.1% of total enrollment. By 2016 that number increased to 9.6% of total enrollment (National Center for Education Statistics [NCES], 2000, 2016). These numbers have steadily increased and in 2019 multilingual learners accounted for 10.6% of total enrollment in U.S. schools (NCES, 2020). With these growing numbers it is apparent that research into best practices for multilingual learners is crucial.

Mandates for the education of multilingual learners were put into place in 1970. The Office for Civil Rights (OCR) put out a memo stating that a student's inability to speak English should not exclude them from participation in education. Later it was reaffirmed that all students have the right to a quality education in the United States, regardless of English language ability or native language (*Race and National Origin Discrimination*, 2020). While laws remain in place to protect the rights of multilingual learners, they are still at a disadvantage when it comes to academic performance in U.S. schools.

Multilingual Learner Math Achievement

According to the U.S. Department of Education, the National Association of Educational Progress (NAEP) reports that in 2005 only 11% of fourth grade multilingual learners tested at or above proficient in national math assessments while 39% of their non-ELL counterparts scored at or above proficient. The NAEP reported a slight increase in 2019 with 16% of fourth grade multilingual learners testing at or above proficient in math compared to 44% of their non-ELL counterparts. These statistics show a vast difference in academic achievement between the two groups of students.

Researchers have tried to find the cause for the connection between math scores and English language proficiency. Henry, Nistor, and Baltes (2014) conducted a study to see if math scores could be predicted based on English proficiency. They found that at a young age, student math scores increased simultaneously with English language exposure and growth. They also found that as the student reached higher grades and the demands of academic language and literacy increased, math scores were inversely affected. The research concluded that English proficiency is a statistically significant predictor of math

scores. They ascertain that, "learning the language of instruction simultaneously with mathematics content complicates ELLs' academic learning experiences locally and nationwide" (Henry, Nistor, & Baltes, 2014, p. 24).

Another study by Powell, Berry, and Tran (2020) focused their research to measure math vocabulary performance of third grade students to see if performance differences existed amongst multilingual students and non-multilingual students. Math has domain specific vocabulary that are a prerequisite for understanding the content and concepts. The study performed multiple assessments in math specific vocabulary such as equation solving and word- problem performance, and found that while all students needed explicit instruction to learn and use the vocabulary of math, multilingual students were at a disadvantage. They require additional supports to understand and communicate using math vocabulary (Powell et al., 2020). This leads to consideration of where we are falling short.

Equity in Math Education

Taking into consideration the numbers of multilingual students increasing in schools and their lack of achievement in math, it is important to consider where we need to improve. The National Council of Teachers of Mathematics (NCTM) takes the following position when it comes to access and equity in math education:

> Creating, supporting, and sustaining a culture of access and equity require being responsive to students' backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness. Acknowledging and addressing factors that contribute to differential outcomes among groups of students is critical to

> ensuring that all students routinely have opportunities to experience high-quality mathematics instruction, learn challenging mathematics content, and receive the support necessary to be successful. Addressing equity and access includes both ensuring that all students attain mathematics proficiency and increasing the numbers of students from all racial, ethnic, linguistic, gender, and socioeconomic groups who attain the highest levels of mathematics achievement. (NCTM position, 2014, p. 1)

Students need access to math education that is equitable and accessible. With this in mind, it is important to reflect on teaching strategies and teacher preparation. Historically speaking, college and university teaching programs offer little time to support teacher preparation for linguistically diverse students. Little attention has been given to how to best serve this population of learners.

Teacher Preparation

With little preparation given in college and university teacher education programs, the responsibility lies on individual teachers and schools to provide adequate training for content teachers to learn strategies to make content accessible for multilingual learners. Unfortunately, all too often it is seen as the sole responsibility of the multilingual teacher to provide all language teaching and support. With students spending the majority of their day in content classes, this is not feasible or best practice for multilingual learners. Many teachers are left feeling ill prepared to bridge the gap between language and content (Garcia, 2012).

Assessment and research has shown that this lack of training and preparation for teachers follows them into the classroom. Even with training Cho, Lee, and

Herner-Patnode (2022) found that math lessons they observed fell short of providing necessary mathematical conceptual development. Teachers who were able to provide language supports viewed their multilingual students as having less math knowledge and held them to a lower standard. They were not allowed access to rigorous math content. Teachers struggled to fully understand the connection between math, language and culture.

All too often teachers mistake lack of language proficiency for a lack of math ability or knowledge which in turn does not allow for equity that NCTM calls for. Cho, Lee, and Herner-Patnode (2022) concluded that these misconceptions prevented students from genuine engagement opportunities in math. "Simple translations and providing native language support are not enough for ELs to improve mathematical discourse" (p. 47). Marginalized students need high expectations and quality math instruction to allow them to grow academically and linguistically.

The growing population of multilingual learners, low multilingual math achievement, lack of equity, and poor teacher preparation show that we are leaving our students behind. We are left wondering, what can be done to keep expectations high and simultaneously achieve academic language proficiency? The next section will take a closer look at how multilingual students learn language through content.

Learning Language Through Content

Content standards have shifted in recent years and place a higher demand on collaboration, communication, and text complexity. This shift proves to be especially challenging for multilingual learners (Bailey and Heritage, 2014). Content standards integrate content and language that require multilingual students to attend to both

language and content simultaneously. The dichotomy of content teachers who lack knowledge of language development and language teachers who lack content knowledge creates a scenario where multilingual learners fall behind (Bailey and Heritage, 2014).

Studies have been done over time about how multilingual learners acquire language. In order for students to learn content they need access to the language. The distinction must first be made between the types of language students learn.

Academic language

Cummins (1979) made a distinction between two types of language multilingual students learn in a multilingual setting. The first type is basic interpersonal communication skills (BICS). This is the language of survival and conversation. It is considered social language. Multilingual learners learn BICS first when they are immersed in a new language. They learn to ask for things and learn the nuances of conversation in the new language. Cummins explained that multilingual learners need two to three years to develop BICS.

Cummins distinguishes a second type of language known as cognitive academic language proficiency (CALP). This is the language of school and academic settings. CALP takes longer in which to achieve proficiency. It can take multilingual learners five to seven years or more to align with their monolingual counterparts when it comes to CALP (Cummins, 1979).

Academic language was previously defined in the first chapter as language used in school as part of curriculum and instruction. Academic language has its own vocabulary, grammar, and discourse. The rules of academic language can vary depending on content area (DiCerbo et al., 2014). All too often teachers make the mistake of

assuming that since students have achieved proficiency in BICS, they must also be proficient in CALP. Each content area has content specific vocabulary that is heavily relied upon. One of the biggest cognitive challenges to multilingual learners is the understanding of these academic concepts in the content classroom. It is impossible for a multilingual learner to comprehend a lesson without first understanding the academic vocabulary associated with the content (Garcia, 2012). This takes time and careful preparation. Some ways this can be accomplished are discussed later in this chapter.

WIDA English Language Development Standards

In an effort to provide educators with a structure to learn the language of specific content areas, the organization World-Class Instructional Design Association (WIDA) reimagined their English language development (ELD) standards in 2020. These standards are meant to assist all teachers of multilingual learners meet their needs and achieve English language proficiency and academic success. WIDA follows the commonly held belief that, "multilingual learners are best served when they learn content and language together in linguistically and culturally sustaining ways" (p. 9). WIDA holds the philosophy rooted in equity and the belief that multilingual learners are entitled to a high-quality education.

The WIDA ELD 2020 standards are broken down into five key areas and content. For the purposes of this capstone I will focus on "English Development Standard 3: English language learners communicate information, ideas and concepts necessary for academic success in the content area of Mathematics" (p. 9). This standard is broken down further into key language uses. Key language uses are prominent ways language is used in schools. There are four ways WIDA recognizes language used in school.

Language is used to narrate, argue, inform, and explain. In the area of math, academic language is most commonly used to explain and argue. Those key language uses are then made more specific by offering language expectations in the grade bands of Kindergarten, Grade 1, Grades 2-3, Grades 4-5, Grades 6-8, and Grades 9-12. Each grade band has its own set of language expectations. Those language expectations are made even more specific by deciphering between interpretive and expressive language. Since this capstone focuses on discourse in third grade math class, I will focus on language expectations for expressive language in math in the Grades 2-3 band.

The expressive language expectations in math for Grades 2-3 under the key language use of explain is as follows:

Multilingual learners will…. Construct mathematical explanations that

- Introduce concept or entity
- Describe solution steps used to solve problem with others
- State reasoning used to generate solution (WIDA, 2020, p. 92)

The expressive language expectations in math for Grades 2-3 under the key language use of argue is as follows:

Multilingual learners will… Construct mathematics arguments that

- Create conjecture using definitions
- Generalize commonalities across cases
- Justify conclusion steps and strategies in simple patterns
- Identify and respond to others' arguments (WIDA, 2020, p. 93)

These standards emphasize the importance of multilingual learners being given the skills and opportunities to cultivate academic language through discourse to ensure academic

and language success. Math, in its own right, has many specific language features and structures to consider to allow for multilingual learners to use academic discourse.

Math as a Second Language

Wakefield (2000) ascertains that mathematicians recognize math as a language that must be communicated, related, and integrated into one's life experiences. Mathematics is a language that students must understand and be able to communicate if they want to be successful in applying it. Wakefield cites that math, more than any other content area, is a language is its own right because of the following attributes where language and math intersect:

- Abstractions (verbal and written symbols representing ideas or images) are used to communicate.
- Symbols and rules are uniform and consistent.
- Expressions are linear and serial.
- Understanding increases with practice.
- Success requires memorization of symbols and rules.
- Translations and interpretations are required for novice learners.
- Meaning is influenced by symbol order.
- Communication requires encoding and decoding.
- Intuition, insightfulness, and "speaking without thinking" accompany fluency.
- Experiences from childhood supply the foundation for future development.
- The possibilities for expressions are infinite. (pp. 272-273)

Wakefield's insights into math as a second language have a great impact on learners who are already immersed in a language that is not native to them in school. He

hypothesizes that math anxiety can occur when learners are pushed to use the language of math before it is properly understood. Wakefield's comparison to the acquisition of math language to the acquisition of a second language brings to light some important concepts for educators to consider when teaching mathematics, particularly to multilingual learners.

Wakefield highlights the importance of starting young. Like any second language acquisition, starting at a young age helps start with more simplistic concepts and allows the language to grow with the child. He also contends that educators should draw similarities between math and language by doing translations and providing frequent exposure. He suggests that educators should allow for a healthy exposure to spoken math and provide opportunities for students to practice speaking math in the classroom. He believes that intuitive thinking comes when math is spoken frequently and connected to real life situations.

Using what Wakefield has said about math as a second language and what we already know about multilingual learners and the demands required of them to learn and use academic English in school, we can analyze how multilingual learners learn math.

Vocabulary of Math

Moschkovich (2009) proposes three perspectives about how multilingual learners learn math: "acquiring vocabulary, constructing meanings, and participating in discourses" (pg. 191). She believes there are shortcomings when educators tie too closely to any one of these perspectives. There is value in exploring and taking a closer look at how multilingual learners participate in each.

The vocabulary of math can be confusing for multilingual learners. Rubenstein and Thompson (2002) highlight eleven different difficulties that can cause confusion for multilingual learners.

1. Some words are shared by math and everyday English, but have different meanings in different contexts. (*Right* angle versus *right* answer)
2. Some mathematical words have shared meanings with English words but are more precise in math. (*Even* as divisible by 2 versus *even* as smooth)
3. Some math terms are only found in a math context. (*quotient, denominator)*
4. Some math words have more than one meaning in math. (*Round* as a circle versus *round* a number to the tenths place)
5. Some words shared with other content areas have two different meanings between those two content areas. (*Variable* in math is a letter that represents possible numerical values, but *variable* clouds in science are a weather condition.)
6. Some math terms are homonyms to everyday English words. (*Sum* versus *some*)
7. Some math words are related but are easy to confuse meanings. (*hundreds* and *hundredths*)
8. A single English word may translate into another language in two different ways. (In Spanish, the table we eat at is a *mesa*, but a mathematical table is a *tabla*.)
9. There are irregularities between English spelling and usage. (*Four* has a u, but *forty* does not.)
10. Some math concepts are verbalized in more than one way. (*One-quarter* versus *one-fourth*)
11. Students may adopt a more informal term as a math term. (*Diamond* for *rhombus*)

Multilingual learners struggle with understanding and interpreting the technical definitions, symbols, and diagrams that come with the language of math (Powell, Berry, & Tran, 2020). Students benefit from multiple exposures in meaningful contexts (Coggins, 2014) as well as explicit instruction and practice. The demands of math vocabulary are so high for multilingual learners that without quality instruction, it can leave them behind, causing them low performance compared to their non-multilingual learning peers (Powell, Berry, & Tran, 2020).

In order to participate in mathematical discourse, students need explicit instruction and scaffolds in place to learn academic math vocabulary. Roberts and Truxaw (2013) say that providing definitions is not enough. Educators should provide support via pre teaching, teaching and reteaching, and repetition and support of long-term retention with the use of graphic organizers and word walls as support tools. They also recommend providing frequent opportunities for students' misunderstandings to come to light and assessing their current understanding.

With this frequent practice of academic math vocabulary and explicit instruction, students will be more prepared to participate in academic discourse. The concepts must first be built and then they can express their understanding both informally, and then when ideas are solidified, formally (Rubenstein & Thompson, 2002).

Discourse in Math

New math standards have changed in a way where solving equations and word problems are not enough. New standards ask students to communicate mathematically and participate in a variety of written and oral practices (Moschkovich, 2009). Mathematical discourse asks students to use academic language to argue and explain their

mathematical thinking using the expressive languages of reading and writing. Moschkovich (1999) uses Gee's definition of discourse as: "Discourses are ways of being in the world, or forms of life which integrate words, acts, values, beliefs, attitudes, social identities, as well as gestures, glances, body positions and clothes" (Gee, 1996, p. 127, as cited in Moschkovich, 1999, p. 11). Using this definition, math discourse involves talking and acting the way a mathematically adept person would talk or act. It puts an emphasis on more than just technical language, but rather the ability to communicate mathematically (Moschkovich, 1999).

Researchers like Turner, Dominguez, Maldonado, and Empson (2013) investigated discursive positioning moves that facilitated multilingual learners' participation in math discussions. Their belief is that all students can be validated and included in mathematical discourse regardless of their English proficiency level. In an effort to position multilingual learners in an agentive participation role, they found that all learners were able to participate in a way that allowed them to grow mathematically.

Their research found that one way to position multilingual learners in discussions was through revoicing, "in which one person (often the teacher) strategically reports another person's utterance through the use of repetition, rephrasing, or expansion upon the original idea" (Turner et al., 2013, p. 204). The difference between revoicing and simple repetition is that revoicing attributes the ideas to the original speaker (often the student). This positions the student as the one who is contributing to the construction of knowledge.

Other discursive practices that Turner et al. (2013) found that allowed multilingual learners to participate in math discussions were teachers positioning students

into problem-solving roles through strategic questioning, and setting classroom norms about expected ways of participating in group discussions that encourage multilingual student participation. They also found that when students were allowed to use their first language, gestures, or objects to communicate they were better able to participate in discussions.

Moschkovich (2009) says that only focusing on vocabulary and technical terms may cause us to miss out on how a student constructs meaning for mathematical terms. Their use of gestures, objects, or everyday experiences are ways of constructing and conveying meaning that go beyond a vocabulary list. When it comes to multilingual learners they need to be allowed to use resources to show their mathematical knowledge and understanding that may not be rooted in heavy use or correct use of vocabulary. Instead of focusing on lack of vocabulary or misuse, focus instead on non language resources as a way to be a part of math discourse and grow academically.

Research by Banes, Ambrose, Bayley, Restani, and Martin (2018) adds to the discussion of using mathematical class discussion as an equitable practice for elementary students. Their research examines the relationship between student performance and discussion in third and fourth grade math classrooms. They found that "the discussion features, *variety of approaches,* and *equitable participation*" (p. 416) significantly impacted test scores "above and beyond that explained by prior mathematics performance and English proficiency" (p. 416). When multilingual learners were included in discussion equitably and given a variety of approaches they were able to participate in high-level math discussions even with low English language proficiency. Banes et al. (2018) emphasize the use of visual displays and repetition as a means of a variety of

approaches. The use of math problems that include multiple avenues to arrive at a solution and equitable participation across a classroom open up equitable participation from all students. Publicly sharing a solution to a problem, whether it be through the use of pictures, objects, or words, positions multilingual students as important contributors.

While it is apparent that discourse in a math classroom is important for academic and language development and something that can be achieved by all students, one is still left with questioning implementation. The next section will discuss strategies and scaffolds to aid the implementation of expressive language in the math classroom.

Strategies and Scaffolds

In order for multilingual learners to successfully participate in mathematical discourse, certain scaffolds must be in place for them to access the information. Coggins (2014) defines scaffolding as "a specific type of coaching in which a teacher or other knowledgeable guide gives initial support for learning, with the goal of the development of students' independent learning skills" (p. 43). Scaffolding is a way to support student autonomy and encourage learning (Walqui and Van Vier, 2010, as cited in Coggins, 2014). Scaffolding can take on many forms. Scaffolds could include questioning to help the student focus on the most important information, or it could be a reminder that helps a student draw a connection to another problem (Coggins, 2014).

Scaffolds, most importantly, allow students to engage with more challenging problems and use higher order thinking skills to develop math and related language skills. With modifications, all students with basic language skills can participate and make math gains (Coggins, 2014).

Strategies that are particularly effective for scaffolding math instruction for multilingual learners include the following (Coggins, 2014; Moschovich, 1999; Nguyen et al. 2013; Colletta and Dubetz, 2021; Banse et al., 2016; Garcia, 2012):

- Activating prior knowledge by focusing on concepts and skills that were previously learned and understood
- Allowing for student-to-student interaction frequently
- Guiding students in sorting out what is already known and what to do next
- Regularly using visuals, manipulatives, auditory aids, word walls and graphic organizers
- Questioning as means of clarifying student ideas
- Open-ended questions
- Explicit vocabulary instruction
- Using sentence stems and frames for speaking and writing

The scaffolding of a math lesson often begins with activating prior knowledge to connect known information to unknown information. Garrison and Mora (1999) saw this as the learning domain of Unknown Language, Known Concept. In this way of activating prior knowledge, students are able to use their strong conceptual base in math to help them focus on the new vocabulary, phonology, and syntax in the new language to express or explain their understanding of the familiar concepts. It provides a means to then build a place where they can learn a new concept with known language. The ability to access the vocabulary and other aspects of language allow students to participate in discourse.

Frequent student-to-student interactions provide a means for students to use the language of math while developing math skills. Multilingual learners particularly benefit

from communicating in the language of math with their peers. They are able to speak about their ideas, listen to other ideas, ask for clarification or ask questions, and build on math thinking between group members. Communication between peers, when thought out and planned appropriately, motivates multilingual learners and helps get their thinking started when they may otherwise feel stuck (Coggins, 2014). Cooperative groups should be well thought out ahead of time. Teachers often group lower language proficient students with higher language proficient students so that the higher student can aid the lower proficient student with language comprehension (Collett and Dubetz, 2021). Caution should be taken when making heterogeneous groupings. Multilingual learners should not be placed in groupings to receive "help" from their classmates, but rather the multilingual learner or lower language proficiency student should be seen as an equal contributor. In some cases it can be beneficial to group students who speak a common first language so that they may use what they know in their native language to build their math knowledge (Cho, Lee, and Herner-Patnode, 2022).

Visuals, manipulatives, auditory aids, word walls, and graphic organizers are a way for multilingual learners to access information for which they may not have the language. These scaffolds make the information visual, organized, and concrete. When students have questions or are asked to participate in math discourse they can refer to visual aids as a tool for academic language (Nguyen et al., 2013). Similarly, word walls allow access to academic vocabulary. Math word walls should include definitions, diagrams, and examples as a means to decipher the intended meaning of math words and be rid of ambiguity previously mentioned (Roberts and Truxaw, 2013; Rubenstein and Thompson, 2002). Graphic organizers as a scaffold help support and reinforce math

language. Graphic organizers like the Frayer model particularly help when math vocabulary is confusing or closely related. The use of examples and non-examples is particularly helpful when used in the Frayer model in helping to clarify and refine definitions (Roberts and Truxaw, 2013).

Questioning is an important strategy to consider when scaffolding for math discourse for multilingual learners. Questioning can be thought of in two ways. The first way teachers can use questioning is as a means to clarify or revoice student thinking. When students are struggling with language, questioning can be used as a way to probe and clarify their thinking. Questioning is also important when planning for lessons. Using open-ended questions that have a variety of ways to be answered allow multilingual learners the opportunity to justify and explain their math thinking (Bense et al., 2016).

Explicit vocabulary instruction is a very important scaffold and instructional practice for multilingual learners. As previously mentioned, the academic vocabulary of math is complex and difficult for multilingual learners. Calderon, Slavin, and Sanchez (2011) say:

> Explicit vocabulary instruction entails frequent exposure to a word in multiple forms; ensuring understanding of meaning(s); providing examples of its use in phrase, idioms, and usual contexts; ensuring proper pronunciation, spelling, and word parts; and, when possible, teaching its cognates, or a false cognate, in the child's primary language. (p. 110)

In some content areas pre-teaching vocabulary is beneficial. However, in math, pre-teaching is difficult and not best practice since math vocabulary is so content specific (Caldron et al., 2011).

In order for students to be able to accurately use academic vocabulary in discourse, sentence frames are an important scaffold. Language proficiency level needs to be considered when using sentence frames to elicit speaking and writing from multilingual learners. Sentence frames serve as a way for students to employ reasoning associated with academic language (Collett and Dubetz, 2021). They are a framework that allow students to use the academic vocabulary they have been learning to formulate and express their learning. Writing is the most advanced linguistic skill and typically takes the longest for multilingual learners to become proficient (Garrison and Mora, 1999). Sentence frames serve as a tool to allow students to begin to use academic English in their writing.

While this list is not exhaustive, there are many ways to support multilingual learners to engage in academic discourse in math. Multilingual learners need to be seen as contributors to thinking and learning in the math classroom regardless of their English language proficiency. The scaffolds and instructional practices listed will serve students well when learning and participating in math discourse.

Conclusion

Chapter Two reviewed literature that gave a historical context of multilingual learners. Literature was also reviewed on the topics of learning language through content, math as a second language, and strategies and scaffolds that support the research question, *How can planning for expressive language in math affect the academic*

achievement and language development of third grade multilingual students? The research has shown that while the population of multilingual learners is growing, students are still performing poorly and their teachers are unsure how to meet their linguistic needs. Math on its own is a complicated subject that has its own language rules and vocabulary. The vocabulary of math can be difficult for multilingual learners to understand and use. Multilingual learners must have ample opportunities to practice math discourse with appropriate scaffolds to grow linguistically and academically. Chapter Three will provide a detailed description of the capstone project, which will include detailed lesson plans for a math unit that includes intentional planning of expressive language. The unit will be used to design a two hour professional development for elementary teachers to learn how to include math discourse for their multilingual learners.

CHAPTER THREE

Project Description and Methods

Overview

As a teacher of multilingual learners, I want to provide a space where they have equal access to a high quality education, one where they can grow academically and linguistically. To support their growth, I want the needs of my students to be considered in the planning of lessons. My interest in math and how to support language and academic growth lead me to my research question, *How can planning for expressive language in math affect the academic achievement and language development of third grade multilingual students?* Chapter Three will describe my rationale and plan for completing my project to include expressive language in math.

Chapter One discussed my personal and professional experience as content and multilingual language teacher that led me to reflect on the difficulties many students, particularly multilingual learners, have with expressing their thinking in math. In Chapter Two I reviewed literature giving a historical context to multilingual learners. Chapter Two also reviewed literature pertaining to learning language through content, math as a second language, and scaffolds and strategies for using expressive language in math. Chapter Three will provide a description of this capstone project, which is to design a curricular unit incorporating expressive language in math to provide practice for growth in language and academics. The setting and intended participants will be discussed in depth, as well as details about lesson design. This chapter will include details about the curriculum framework used to design the lessons.

Description of Curricular Unit Capstone Project

In this capstone project I created a math curricular unit focusing on using the expressive languages of speaking and writing. The unit consists of ten lessons meant to be used in a sixty minute class period. The unit is designed for a co-taught math class with an average of twenty-five third grade students. Each lesson includes World- Class Instructional Design and Assessment (WIDA) 2020 English Language Development (ELD) and state content standard(s), content and language objective(s), formative assessment(s), learning activities, and materials. A summative assessment will be given at the end of the unit to assess comprehension. Learning activities in each lesson specifically target the language domains of speaking and writing and include opportunities for hands-on learning. Content specific vocabulary is taught and practiced throughout the unit with special attention to some of the pitfalls multilingual learners encounter with math vocabulary (i.e. homonyms in other content areas, false cognates, multiple meanings within math vocabulary, etc.). The format of the lessons include activating prior knowledge, direct instruction, gradual release of responsibility with partner or group work and independent practice, and lesson closing. Formative assessments take place during each lesson.

Positionality

This capstone project was designed with research targeted toward best practice for multilingual learners. I am a white, female teacher of multilingual learners in a predominantly white area. I grew up in a similar area but spent many years teaching in a diverse setting and have taken what I have learned there, along with my research to

influence my capstone design. The curriculum framework is important to executing the unit design.

Curriculum Framework

The curriculum framework that I used to ground my unit development is the Understanding by Design (UbD) by Wiggins and McTighe (2011). In this framework the end goal is determined first, followed by how students are assessed, and then finally learning activities are planned. This framework is different from other frameworks in that it begins with the end in mind. Careful consideration is given to what you want your students to know before planning exactly how they will learn it. There are three planning stages to the UbD framework: identifying desired results, determining acceptable assessment evidence, and planning learning experiences and instruction (Wiggins and McTighe, 2011).

Stage One of UbD is where desired results are identified. In this stage standards and objectives are clearly defined and well thought out. Consideration is given to what students should be able to do or know by the end of the lesson (Wiggins and McTighe, 2011). For this stage in my unit plan I used content standards alongside language development standards and formed lesson specific objectives for both. Each lesson addresses a math content standard specific to third grade along with an ELD standard for math as identified in Chapter Two.

Stage Two of UbD is where the designer determines acceptable evidence as related to the objectives chosen in stage one. In this stage assessment is identified to show evidence of meaning making and transfer of knowledge (Wiggins and McTighe, 2011). For this stage in my unit plan I designed formative assessments for each lesson

that focus on the language production of speaking and/or writing. Students are asked to produce language related to the content standard and objective. A summative assessment at the end of the unit checks for transfer and evidence of meaning making from all content objectives in each lesson.

Stage Three of UbD is the final planning stage for this curriculum framework. Now that all goals and assessments have been decided, it is time to plan for lesson activities and learning experiences. In this stage it is important that activities appeal to learning differences and the teacher serves as a facilitator to learning. Wiggins and McTighe (2011) also suggest using cycles of model-try-feedback-refine to anchor learning. This was done in my ten lesson unit. For this stage my learning activities take into account many of the scaffolds and strategies mentioned in Chapter Two for multilingual learners. There are also many opportunities for cooperative learning and hands-on learning.

Setting and Participants

The intended setting is a third grade elementary math classroom. In my school there are 617 students in third through fifth grades. My building employs forty-four teachers, eleven paraprofessionals, two administrators and many other support staff. The student demographics are seventy-nine percent White, eight percent Hispanic, seven percent two or more races, five percent Black, two percent Asian, and less than one percent American Native (Minnesota Report Card, 2020). Less than four percent of students are labeled as English learners, which equates to twenty-one students in this building. The languages spoken by the multilingual students include Spanish, Russian, Hmong, Karen, Arabic and English Creole. There are two teachers for multilingual

learners in the entire district, serving four schools and thirteen grade levels. I spend my time between two schools serving multilingual learners in third through eighth grade.

I spend four days a week at the intermediate school (grades three through five). During my time there I pull a few small groups out of class, but spend the majority of my time co-teaching in each grade level. This unit was designed for a third grade math class where the multilingual learners in that grade level have been clustered. There are six students in the third grade class who are labeled English learners. The rest of the class consists of students who are not multilingual learners. There are a total of about twenty-five students in the class. The classroom teacher and I use many co-teaching protocols to teach the class together on a daily basis. We are both considered teachers of the class and share responsibility for all students in class. All activities for this unit was designed for all students, with special considerations given to scaffolds and strategies that are best practice for multilingual learners.

The lessons take place in the regular third grade classroom. I go into the room for their math period. I have my own space in the classroom where I can meet with students as needed. The classroom is stocked with math manipulatives with access to other resources in the school. There is a television connected to an AppleTV and each teacher has access to their own iPad and Apple Pencil. The classroom is set up with a small meeting rug in the front of the room and tables with a seat for each student towards the back of the room. Students have one-to-one devices so have access to Chromebooks daily.

Although the capstone project is designed for a co-taught classroom, it can be used by any content or language teacher. The project highlights ways to incorporate expressive language in math and can be translated to any grade level or content area.

Timeline

The timeline for the completion of this capstone project is Spring of 2023 with implementation taking place the following school year. In order to complete the project by May 2023, I set small goals for myself to be able to keep myself on track. I started first by researching lesson ideas and deciding on the content standards to focus on.

I completed stage one of UbD by the end of January 2023. After deciding on the area of focus, I decided which specific third grade math standards my lessons will be designed around. I also choose the WIDA ELD standards to focus on in my lessons. I finished stage two by the end of February and made sure I had all formative assessments and a summative assessment prepared for the unit. I finished phase three by mid-April and made sure I had plenty of time to incorporate scaffolds and strategies for multilingual learners and have high quality experiences that led to student learning. When the unit was finished, I submitted it to my content reviewer, by the end of April, and took time to make revisions as necessary.

In order to implement the unit I will have to wait until the following school year. The unit will be implemented as it fits into the curriculum in the 2023-24 school year. The unit will take about two weeks to fully implement with time for assessments.

Summary

Chapter Three gave an overview of the capstone project and the curriculum framework driving the design of the curriculum unit. The chapter also gave an overview of who I am as a curriculum as well as the intended participants and setting. A timeline of completion ended this chapter. Chapter Four will detail a reflective conclusion of the capstone project.

CHAPTER FOUR

Conclusion

Introduction

The purpose of this project was to answer the question, *How can planning for expressive language in math affect the academic achievement and language development of third grade multilingual students?* Chapter One discussed my personal and professional experience as a content and multilingual language teacher that led me to reflect on the difficulties many students, particularly multilingual learners, have with expressing their thinking in math. In Chapter Two I reviewed literature that gave historical context to multilingual learners. Chapter Two also reviewed literature pertaining to learning language through content, math as a second language, and scaffolds and strategies for using expressive language in math. Chapter Three provided a description of this capstone project, which was to design a curricular unit incorporating expressive language in math to provide practice for growth in language and academics. The setting and intended participants were discussed in depth, as well as details about lesson design. The chapter also included details about the curriculum framework used to design the lessons. Chapter Four will cover major project learnings, a review of literature, implications and limitations of the project, future recommendations, and my reflections on the project.

Major Learnings

Through this capstone writing process I have learned the importance of planning for expressive language in content areas outside of language arts. Speaking and writing often get overlooked in many content areas. Multilingual learners are not getting what

they need to progress linguistically and academically. This process taught me that no matter the area, there have been many people who have come before me and thought about the same things. My work taught me that there is a world of knowledge out there to access and synthesize to meet the needs of students.

Through the writing of my project, a math curricular unit, I found that it was a lot easier to incorporate speaking and writing opportunities than I had originally thought. There are many opportunities in math lessons where expressive language fits very naturally. While some curriculums are getting better with adding this type of practice, many of them do not consider the needs of multilingual learners in lessons outside of a small side note here and there.

One of the easiest ways I found to add speaking practice was at the beginning of each lesson. It was helpful to review what was taught the day before and ground the group for new learning. There are so many fun ways to practice speaking that do not have to be formal and stressful. I wanted the students to have practice using the vocabulary and explaining their thinking or justifying their thoughts, but I wanted to do it in a way that didn't make them feel like they were being judged or needed to be perfect. Speaking and writing for multilingual learners should be considered low-stakes most of the time. Planning for expressive language in math allows multilingual learners to practice language and helps them to engage in lessons. They are able to be an active and contributing member of class where they may otherwise have sat silently.

Review of Literature

The literature review was paramount in confirming my beliefs that using expressive language in math is vitally important for students. It also strengthened my knowledge of best practices for teaching multilingual students. Academic language is important for all students to develop, but it can present challenges for multilingual learners if not taught explicitly and with scaffolds. The vocabulary of math presents a lot of confusion for students since there are many things that overlap or have varied meanings (Rubenstein and Thompson, 2002). Students need a lot of practice discussing and using the language of math repeatedly to be able to understand and add the concepts to their lexicon and knowledge base (Coggins, 2014; Moschkovich, 2009). The process of practicing the academic language of math for multilingual learners requires many different scaffolds and strategies. The strategies that work well for multilingual learners are explicit vocabulary instruction, repeated practice, student interaction, and the use of visuals and manipulatives to name a few (Coggins, 2014; Moschovich, 1999; Nguyen et al. 2013; Colletta and Dubetz, 2021; Banse et al., 2016; Garcia, 2012). All teachers are language teachers and therefore need to make sure they are providing these experiences to their students so they may grow linguistically and mathematically.

While the concepts discussed in the literature review are specific to math, the ideas can be translated into other curricular areas. The need for academic language instruction and practice transcends all content areas.

Implications

Based on this project, I have made it my goal to include expressive language in every math lesson I teach with my co-teacher. My next step is to create expressive

language objectives for the entire year of the third grade math curriculum. I will use all of the Minnesota third grade math standards along with the third grade math WIDA standards to make sure expressive language is a part of every lesson. I will continue to use the scaffolds and strategies discussed in my research throughout the entirety of the curriculum.

I will use planning time with my co-teacher to discuss the best ways we envision working expressive language into our daily routine. Although we only have thirty minutes of collaborative planning time during the week, we will make time to prioritize expressive language. I will also use what I have learned to educate and assist other teachers to plan for expressive language in all content areas to benefit multilingual students and all students.

In a greater scope, this research and project provides solid evidence that expressive language is an integral part of helping multilingual students learn and comprehend subject matter. It is my hope that the information could be used to impact a change with curriculum writers to prioritize expressive language practice in lessons.

Limitations of Project

At this time, there are a few clear limitations for this capstone project, such as that the lessons have not yet been taught, the lessons require teacher preparation, and the lessons are written for a very specific context. The first limitation is that the lessons have not been field tested as of this writing. Therefore, the outcomes of the curricular unit are not guaranteed. The lessons may need to be modified in a way that is not apparent without actually teaching them. Additionally, there is no way to guarantee the quality of instruction based on different teaching environments and styles.

Other limitations are that there are time, planning, and financial constraints such as access to the ability to reproduce the activities, access to technology, and funds to purchase any materials. Teachers may choose to change some of the lessons or the sequence of the lessons which would take additional time. Although this capstone project was written for a very specific context, it could easily be adapted for students in different grade levels. Ideas from the lessons could also be applied to other content areas. This would take time and resources as well.

Future Recommendations

First of all, I strongly recommend that teachers look at their curriculum through the lens of a multilingual learner. Are they provided explicit instruction of vocabulary? Are the lessons being scaffolded in a way that makes them accessible? Are students provided opportunities to practice that academic language and content through expressive language?

I would like to see teachers planning for expressive language in all curricular areas across all stages of education. There are ways to adapt the same principles used in my unit for kindergarteners up to high school. The more teachers are able to pull the language from the content and use it to help students practice expressive language, the better all students will be able to succeed.

As stated earlier, I would also love to see curriculum designers to put the needs of multilingual students in the forefront. With the numbers of multilingual learners on the rise, it is vital to consider their needs when designing for schools. Expressive language opportunities should be considered for all content areas and ages of learners.

As far as next steps in research, I have a few suggestions. One suggestion is to create formative language assessments to measure language proficiency growth when implementing expressive language in math. I would also suggest researching more specific benefits to using expressive language, such as collecting academic data growth and conducting interviews with students.

Summary and Conclusion

Expressive language is important to the linguistic and academic development of multilingual learners. Multilingual learners need teachers to plan for expressive language practice every day. They need explicit instruction of academic language and vocabulary with educators spending extra time and care to make sure they are thinking about where misinterpretations may occur. The research and project presented in this capstone have a large impact on teaching as a profession. The needs of multilingual students cannot be overlooked. Teaching professionals need to make sure they are making language and content accessible to all students.

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