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A Teacher and Her Language Minoritized Students in a Translanguaging Mathematics Classroom: Activating and Suppressing Our Full Linguistic Repertoires for Increased Mathematical Reasoning and Sense-Making

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A Teacher and Her Language Minoritized Students in a Translanguaging Mathematics Classroom: Activating and Suppressing Our Full Linguistic Repertoires for Increased Mathematical Reasoning and Sense-Making

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ABSTRACT OF DISSERTATION

A Teacher and Her Language Minoritized Students in a Translanguaging Mathematics Classroom: Activating and Suppressing Our Full Linguistic Repertoires for Increased Mathematical Reasoning and Sense-Making

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Kutztown University of Pennsylvania, 2024

Kutztown, Pennsylvania

Directed by Mark Wolfmeyer, PhD

This study delves into translanguaging practices within a mathematics classroom led by a bilingual teacher and attended by language minoritized students. Grounded in translanguaging theory and practices, it investigates the dynamic language interactions between teacher and students, shedding light on the activation and suppression of linguistic features within purported "named languages." Utilizing diverse data sources, such as audio-recorded lessons and student interviews, the study uncovers patterns in classroom language use. Results highlight the prevalent utilization of the full linguistic repertoire by both teacher and students, especially in elucidating mathematical concepts and fostering conceptual understanding. Furthermore, the study examines how translanguaging facilitates communication, fosters inclusivity, and enhances students' sense-making. Through student interviews, six key themes emerge, including comfort and perceived benefits, language support, preference for mixed-language instruction, challenges

with English pronunciation, strategies for understanding, and impacts on participation and confidence. Ultimately, the study advocates for cultivating supportive learning environments that embrace linguistic diversity and promote sense-making, aligning with the essence of translanguaging and the standards set by the National Council of Teachers of Mathematics, alongside recommendations from reform math pedagogy.

Keywords: Translanguaging, Mathematics Education, Language Minoritized Students, Conceptual Understanding, Mathematical Sense-Making, Reform Math Pedagogy.

Signature of Investigator Ana Bogotá Date 04/17/2024

Dedication

A mi querido esposo:

A lo largo de este viaje académico, has sido mi mayor apoyo. Gracias por creer en mí incluso cuando dudaba de mí misma. Gracias por estar a mi lado en cada paso del camino. Tu amor incondicional y tu constante aliento han sido la fuerza que me ha impulsado a alcanzar este logro.

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Gracias por inculcar en mí el deseo de siempre dar mi mejor esfuerzo en todo momento sin importar las circunstancias. Con ustedes, aprendí que nunca debo dejar de aprender y nunca debo dejar de crecer. Ustedes han sacrificado sus vidas para que con mis hermanos pudiéramos tener mejores futuros. Además, siempre me han animado y apoyado a seguir mis sueños, lo que me ha permitido tener una vida estupenda y enriquecedora.

To My Students:

Thank you for lighting the fire of my passion for teaching. You each have unique talents and offer incredible value to our classroom community. It is for you that I continue to improve my craft each day. After all, it is my responsibility to ensure that you receive an outstanding education, and that is a responsibility that I hold dear to my heart. Thank you for being my shining stars.

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CHAPTER I- INTRODUCTION

This study delves into translanguaging practices within a mathematics classroom led by a bilingual teacher and attended by language minoritized students. I am the teacher-researcher who enacted these lessons and studied their impact with a methodology I designed. In this chapter, I will situate the research project by outlining my positionality as a teacher, particularly as a foreign-born English language learner educator, and how this intersects with the diverse backgrounds of my students. Additionally, I will explore the challenges that immigrants encounter upon their arrival in the United States and how these challenges can impact their educational journey. Furthermore, I will argue for the importance of translanguaging as a pedagogical approach to support language minoritized students in developing both their linguistic repertoire and mathematical abilities. This discussion will be contextualized within the framework of reform mathematics teaching, emphasizing the significance of translanguaging in addressing the unique needs of language minoritized students in mathematics education. I conclude the chapter with the research questions and definitions of key concepts relevant to the project.

Researcher Positionality

In this section, I will begin by discussing my positionality as a researcher. It is crucial for me to acknowledge the significance of my own lived experiences, as they have profoundly influenced my academic journey and upbringing. These experiences have shaped my perspective in a way that resonates with the individuals who are my research's focus. Positionality, as defined by Sensoy and DiAngelo (2017), “is the concept that our perspectives are based on our place in society, and where you stand in relation to others shapes what you can see and understand” (p. 15). With this concept in mind, I start by describing my

background, and I will offer the reader a view inside the mindset of bilingual immigrant and explain what led me to my study. Furthermore, I will delve into the context of this research, as it is intricately intertwined with the experiences of my students as immigrants to the United States.

In action research, researchers often occupy dual roles as both insiders to their professional setting and as practitioners (Herr & Anderson, 2015, p. 2). Herr and Anderson assert that researchers' positionality involves navigating various forms of border crossing as they embark on their studies, leading to a central dilemma unique to action researchers regarding their relationship to the setting and participants (p. 4, 37). They aim to scrutinize where researchers fall on the continuum of positions in relation to the study's context and participants.

My personal journey reflects elements of this insider-outsider dynamic in research. Originating from Bogotá, Colombia, I obtained a high school diploma and a bachelor's degree in industrial engineering. Raised in a middle-class family with a teacher mother and engineer father, I had a privileged upbringing, attending a prestigious all-girls Catholic private high school and earning a college scholarship for academic excellence. However, at twenty-two, I immigrated to the United States, where my engineering degree from Colombia faced challenges of recognition in a new environment. Despite my qualifications, I encountered skepticism due to my immigrant status and limited professional experience, prompting me to navigate the complexities of establishing myself anew in a different cultural and professional landscape.

Undoubtedly, this perception was disheartening, leaving me feeling undervalued compared to those with domestically attained degrees. Faced with limited job prospects, I felt compelled to pursue further education. In my opinion, returning to school not only allowed me

to enhance my skills but also served as a means to validate my academic background in this unfamiliar terrain. My decision to pursue a career in education was influenced by a personal irony. Born to a family of educators, I had initially earned a degree in engineering, only to find myself drawn to the field of education since my youth. Witnessing the fulfillment teaching brought to my then-fiancé, I resolved to follow a similar path. After residing in the United States for several years, I earned a master's degree in education. Resilience and determination marked my journey. Furthermore, I held a determination to establish my place and affirm my value in a foreign yet promising land.

Upon graduation, I obtained employment at a suburban school district in southeastern Pennsylvania, where I have been employed since 2016. Initially, I was hired to be an elementary Spanish teacher. However, since the second half of the 2018 –2019 school year, I have taught students who are in the school's so-called "English language learners (ELL)" program. As listed in my definition of terms, I will refer to students who are emergent bilinguals and multilinguals, typically speaking languages other than English in their homes and communities, as "language minoritized students." As a foreign-born Hispanic teacher whose primary language is Spanish, many of my students naturally feel drawn to me. They see me as someone who understands their immigration journey and can relate to their experiences.

A significant portion of language minoritized students in my school district are immigrants who were born in foreign countries. In my case in particular, all of the students in my care are immigrants. I empathize with my students because I also immigrated to this country with strong Spanish language and beginning English language proficiencies. After all, it was not that long ago when I first arrived in the United States. Towards that end, many of my students look to me as an example. Certainly, the majority of their teachers are white, as our

faculty is not very diverse. Furthermore, I am among the few bilingual teachers that my students have who are also immigrants, just like they are. For this reason, I believe that I can forge deep, meaningful relationships with them that would perhaps be difficult for other teachers to attain. Hence, my goal is to form relationships with all my students that transcend just the day-to-day interactions that are typical in a student-teacher relationship. Surely, I know first-hand the struggles that newly arrived immigrants to the United States face; I am a living example of this. At times even the most ordinary of tasks in the United States, such as shopping at a grocery store, can become overwhelming when one does not have a full grasp of the English language. That experience helped me to forge empathy for my students. Not only are these students having to contend with learning English, but they must also do so while simultaneously mastering content in classes that is taught in English. Part of what led me to translanguaging is that I know that it would have been beneficial to me if I were to engage in translanguaging at the onset of my arrival to the United States. One could say that I learned from my lived experience in that regard.

Research Context: Immigrant Math Learners in a U.S. Public School

In the following section, I provide the background for my study in conjunction with relevant data from the US Department of education and the Migration Policy Institute about immigrant students in the United States - their demographics. Additionally, I will explore some of the conundrums and difficulties of the immigration process and factors or fears that immigrants face in the United States. Finally, I will describe what some of my immigrant students experience as they are navigating the education system of the United States. These particular circumstances are important to consider as they provide a more complete picture of the full range of lived experiences my students face.

Currently, I am an employee at a suburban school district in southeastern Pennsylvania. My teacher certificate is as an ELD teacher, in addition to my secondary mathematics certificate. I also hold a PK-12 Spanish certificate. I teach newly arriving students to the country who have arrived within the last six months with a dominant language other than English. My assignment is split between the middle school and the high school. In fact, I am the only "ELL teacher" for language minoritized students in my district who is split between the middle school and high school. In the high school setting, the course I teach is entitled, "Foundations of Mathematics." This course is designed for immigrant students, and as the name refers, the content taught is intended to cover and review basic yet fundamental math concepts. It sets the mathematical foundations that they will need as they complete higher levels of mathematics.

Being that the United States is a unique country in that it represents a plethora of cultures from around the world, American culture is not homogenous. Immigrants make up 14.4% of the population (Migration Policy Institute, 2021). It represents a blend of individuals and varied experiences stemming from diverse backgrounds. According to the US Department of education, "Schools in the United States have always welcomed new immigrant children to their classrooms – according to the most recent data, there were more than 840,000 immigrant students in the United States, and more than 4.6 million English learners". While this is valuable data, the sheer scale of the statistics underscores the ongoing importance of addressing the unique needs and challenges faced by these student populations. However, it is crucial to recognize that mere enrollment figures do not fully capture the complexities of immigrant students' experiences, including linguistic, cultural, and socioeconomic factors that can impact their educational outcomes. It prompts further critical examination of the policies and practices

necessary to ensure equitable access to education and support for all students, regardless of their background or language proficiency.

The following figures are based on the Migration Policy Institute regarding immigrant students in the United States in 2019:

- Race/Ethnicity: About 72% of immigrant students were Hispanic, 11% were Asian, 5% were Black, and 9% were white.
- Socioeconomic Status: Immigrant families are more likely to live in poverty than non- immigrant families. In 2019, about 23% of children in immigrant families lived in poverty, compared to 14% of children in non-immigrant families.
- English Language Learners (ELLs): About 21% of immigrant students were identified as ELLs in 2018-19. Among ELLs, Spanish was the most common language, followed by Arabic, Chinese, and Vietnamese.
- Educational Attainment: While many immigrant students face obstacles to academic success, some groups of immigrant students actually outperform their non-immigrant peers. For example, immigrant students from East Asia tend to perform very well academically (Migration Policy Institute, 2021).

The school district in which I work is a microcosm of these diverse backgrounds. As such, more immigrants arrive in the United States in search of a better life for themselves and their families. Those immigrants who are of the appropriate age attend school; however, many of them do not speak English. These students are classified as English Language Learners. Often, these students arrive in the United States and are immediately placed into content classes without having had adequate practice with English. Also unique to this situation is the socioeconomic status of the community in which I work. Many students

come from families who earn far more than the median family income. However, almost thirty percent of the students are categorized as economically disadvantaged. The students I serve constitute a large portion of those economically disadvantaged. Simply put, their parents, if they even have any, are for the most part not college educated. Many work two or three jobs just to make ends meet for their children. Regarding its history, a time existed in which it had a somewhat dubious reputation. Nevertheless, with a great deal of investment in small businesses, it has become very attractive for families. Certainly, it has experienced a bit of a renaissance.

My district is also diverse. According to the PA Future Ready Index for the 2022-2023 academic school year, 65.7% of students are white. Hispanic students make up 20.1% of the student population, and African- American students represent 5.4 % of the student population. Socio-economically, my school district is diverse. Furthermore, according to the PA Future Ready Index, 32.4% of students are economically disadvantaged, and English Learners constitute 12.1% of students across the district. Additionally, many of my students are undocumented immigrants. This fact makes it exceedingly difficult, if not impossible, for them to achieve legal status. In fact, “Immigration to the United States on a temporary or permanent basis is generally limited to three different routes: employment, family reunification, or humanitarian protection. Each of these legal avenues is highly regulated and subject to numerical limitations and eligibility requirements” (Why don’t immigrants apply for citizenship?). Unfortunately, most of my students do not fall under any of these categories. Thus, their legal immigration status is left in perpetual limbo.

From personal experience, I know this is both expensive and extremely stressful. For example, I arrived in the United States on a visa. Then, I obtained my permanent residency.

After five years of permanent residency, I was finally able to apply for citizenship. Each step of this process requires numerous steps that must be followed meticulously, otherwise the case status of the petitioner could be delayed. In certain instances, it could also be disqualified. Therefore, I hired an immigration lawyer to help me navigate through the proceedings. During this process, there were times in which I felt as though my immigration status was in jeopardy, mainly due to the amount of time it takes to process each case. That is to say, before I became a citizen of the United States, instances existed in which I had the legitimate fear that I would fall out of status due to delays in processing.

Why is this important? Having walked the path of an immigrant gives me an inside look of the intricacies and hardships of the immigration process. Perhaps even more difficult than my experience, the majority of my students are undocumented immigrants. Thus, they live with the constant stress of deportation. If they or their family members commit even a minor infraction such as a summary offense, then they run the risk of being deported. Currently, "More than 4.7 million immigrants in the United States were facing deportation proceedings in fiscal 2022, according to a federal report released Friday, a 29 percent jump from the same period the year before" (Sacchetti, 2023). Even those children who are United States citizens with undocumented parents are not immune to the stress of deportation. In fact,

> While citizen-children who suffer parental deportation experience the most severe consequences associated with immigration enforcement, our findings also suggest that the burden of mental health issues extends to those children concomitantly affected by immigration enforcement policies that target their undocumented parents. (Gulbas, et. al., 2015).

As stated by Asad (2020) "Deportation has become more commonplace in the United

States since the mid-2000s. Latin American noncitizens—encompassing undocumented and documented immigrants—are targeted for deportation. Deportation's threat also reaches naturalized and US-born citizens of Latino descent who are largely immune to deportation but whose loved ones or communities are deportable."

In fact, I have witnessed families who are too terrified to go to community centers to pick up food or other necessities for fear of running afoul of the authorities. Therefore, it becomes much clearer to see why school is not always the number one priority for all of my students. They have real and legitimate fears of being forced to leave the United States. Furthermore, once they are here with an undocumented immigration status, it becomes very difficult, if not impossible, to attain legal immigration status. It is incumbent upon me as their teacher to advocate for them in any way I can. Truly, they have worries that their peers born into the dominant culture will never have to experience.

Language minoritized students and Translanguaging

This section delves into a multifaceted approach aimed at better serving language minoritized students, introducing the literature in the field of translanguaging. This field provides mindsets and pedagogic innovations to support language minoritized students, also referred to in this field as emergent bilinguals and multilinguals (Cummins, 2001; García et al., 2017; Ji- Yeong, and Martinez, 2020; Valdés, Moll, & Amanti, 2002). As I work with the literature from this field, I will use the terms language minoritized and emergent bilinguals interchangeably. Highlighting the positive aspects of bilingualism, the use of translanguaging emerges as a pivotal strategy. Translanguaging, defined as the dynamic use of language without rigid boundaries, offers a platform for emergent bilinguals to navigate language learning. By fostering a non-judgmental environment that celebrates linguistic diversity, translanguaging not

only facilitates language development but also nurtures students' cultural and linguistic identities. Thus, this section emphasizes the importance of embracing translanguaging approaches to create inclusive and supportive learning environments that empower emergent bilinguals to succeed academically and beyond (Ji-Yeong, and Martinez, 2020).

In the perspective of translanguaging, named languages are specific languages with recognized names, such as English, Spanish, or any other language that has a designated title within a linguistic community. Named languages are conceptualized as political constructs representing specific linguistic codes associated with distinct cultural and social identities. However, rather than viewing named languages as separate and rigid entities, translanguaging recognizes them as dynamic components of individuals' linguistic repertoires. In this view, named languages serve as resources for communication and meaning making. Translanguaging emphasizes the fluid and flexible use of linguistic resources, allowing individuals to draw from their entire repertoire, including named languages, to effectively express themselves and negotiate meaning in diverse contexts. Thus, named languages are understood not as fixed categories, but as dynamic elements that interact and intersect with other linguistic and cultural influences within individuals' communicative practices.

Another important consideration is the concept of dynamic bilingualism, in which language use is characterized by its adaptability and responsiveness to changing communicative demands, allowing individuals to seamlessly transition between languages or linguistic varieties depending on the situational, social, and cultural context (Wei, 2011). This concept emphasizes the dynamic nature of bilingual language use, highlighting the active negotiation and integration of linguistic resources to navigate multilingual environments effectively (García & Li Wei, 2014). In other words, dynamic bilingualism reflects a holistic

understanding of language proficiency that goes beyond mere linguistic competence, encompassing communicative strategies, cultural knowledge, and identity negotiation in multilingual settings.

Translanguaging advocates for a holistic approach to language use, where individuals actively draw upon and integrate features from their entire linguistic repertoire to facilitate communication and meaning making in multilingual contexts (García, 2009). From this perspective, the activation and suppression of features within the linguistic repertoire represent essential strategies for navigating diverse communicative situations effectively.

As will be further explained in Chapter IV, in the context of named languages, the students and the teacher engage in a dynamic process of activating and suppressing features of their linguistic repertoire as communicators. This process is closely linked to the concept of translanguaging, where individuals fluidly draw upon multiple languages or linguistic varieties to communicate effectively. In translanguaging, language activation involves intentionally bringing specific linguistic elements into use from one's repertoire to enhance communication and convey nuanced meanings. Individuals may choose to suppress features that are not relevant or appropriate in a given context or to prioritize the use of a specific language or linguistic variety to achieve communicative goals effectively (García & Li Wei, 2014). Additionally, language suppression entails selectively inhibiting certain linguistic features that may not be relevant or appropriate in a given context. This dynamic interplay between activation and suppression allows individuals to navigate diverse communicative situations with agility and adaptability.

Also, it is important to distinguish translanguaging from code-switching. While both involve the use of multiple languages, code-switching typically involves a more rigid and

compartmentalized approach to language use. In code-switching, languages are viewed as distinct entities that operate separately, with speakers transitioning directly from one language to another. This often involves direct translation or alternation between languages within a conversation, resulting in a more structured and segmented linguistic practice. In contrast, translanguaging emphasizes the fluid and seamless integration of linguistic resources, where languages are not compartmentalized but rather flow together naturally to create meaning (García, 2009; Wei, 2011). Translanguaging allows for a more dynamic and holistic approach to language use, where linguistic boundaries are blurred, and communication is enhanced through the creative blending of linguistic elements from diverse sources.

To assist these students in language development journey, but also in content area classes, it is important for them to get up to speed as quickly as possible. One such manner is through translanguaging. At its core, translanguaging is, "the use of language as a dynamic repertoire and not as a system with socially and politically defined boundaries" (García & Li, 2018). It allows the simultaneous use of different features of language as displayed in an "emergent network of meaning making" (Sánchez, M., & García, O. 2022).

For language minoritized students, it creates a zone of non-judgment for languaging while expanding their full linguistic repertoires by implementing all language features.

Furthermore, translanguaging approaches do not reduce language demand but provide a richer and safer language environment so that EBs do not feel overwhelmed by the language demand. By valuing and enacting translanguaging, teachers can value not only students' culture and language but also their identities as bilinguals (or multilinguals) (Ji-Yeong, Martinez, R., 2020).

Puzzle of Practice: Translanguaging in the Math Classroom

In my exploration as both a researcher and practitioner, I have come to embrace the imperative of expanding my students' content knowledge within an environment that not only values but actively integrates their linguistic and cultural backgrounds (González, Moll, & Amanti, 2005). This journey has led me to the concept of translanguaging, which extends far beyond a mere scaffold for language development. While initially conceived as a means to facilitate English language learning by leveraging students' linguistic repertoires in the classroom (García and Wei, 2014), translanguaging transcends this notion. It becomes apparent that if students can expand their linguistic repertoire using all their linguistic features, it can serve as a vital tool in aiding language minoritized students in their language development journey, as well as their learning across the content areas. Thus, I am eager to explore the translanguaging practices within the mathematics classes I teach for language minoritized students. The decision to explore how to integrate translanguaging into my teaching practice stems from a recognition of the scarcity of research in education that explores this approach in the context of mathematics, particularly its connection to Emergent Bilinguals (EB). Among the few advocates for this approach is Armando Garza, whose work has delved into the potential of translanguaging to support the learning and engagement of multilingual students within the mathematics classroom (Garza, 2017).

Garza (2017) highlights that “As the Latino student population increases, teachers in classrooms that serve such student population play a crucial role in creating ideal educational spaces where the teaching and learning process is leveraged by linguistic and cultural resources that students bring to their classrooms”. Furthermore, as Garza (2017) argues:

> “Scholarly work on Latino/a bilingual students has increased over time. However,

> the corpus of research that involves Latino/a adolescent students, their dynamic linguistic resources, and academic literacies is scarce (Martin-Beltrán, 2014). In addition, research that addresses Latino/a students' mathematics literacy and their linguistic practices is not abundant (Moschkovich, 2015)".

Second, in my experience as an ELL teacher, I have found that most of my students are Spanish speakers. Personally, I am a Spanish speaker by birth. Hence, I thought it was worth a try to include Spanish in my mathematics classes, as most of my students speak it. Then, upon starting this doctoral program, I came across the concept of translanguaging. I realized that this concept could open new opportunities for my students. If my students can feel less intimidated by English through the use of their full linguistic repertoire, then I believe that translanguaging has the potential to be an invaluable asset in a language minoritized classroom. However, some of my fellow ELL teachers are quite reluctant to accept translanguaging as a method by which the students can expand and develop their language journey. This push-back comes from teachers who have a great deal of teaching experience, but they are very rigid in terms of their teaching methods. To them, the only thing that matters is that the students are immersed in English. In other words, it is inconsequential that the students' linguistic capabilities can be a great asset in their language development journey. These teachers steadfastly believe that all classes should be taught in English so that the students will receive the maximum amount of exposure to English. On one hand, one can understand that it is imperative for the minoritized language students to expand their linguistic repertoire with English features. On the other hand, these students already have a linguistic repertoire from which they can incorporate and expand in the "named language" of English with translanguaging. It is my desire that through the research in translanguaging that I perform, I

will be able to sway the opinions of my colleagues. After all, if we can implement methods that are most beneficial to our students, then everyone wins.

By alleviating the intimidation factor associated with English through the utilization of their full linguistic repertoire, translanguaging emerged as a valuable tool in the language minoritized students' classroom. Yet, despite its potential benefits, I encountered resistance from some fellow coworkers who remained steadfast in their adherence to traditional teaching methods. Their reluctance to embrace translanguaging stems from a deeply ingrained belief that English should be the sole medium of instruction to maximize students' exposure to the language. While I recognize the importance of leveraging students' language development, I believe that dismissing the value of students' linguistic repertoires overlooks a significant resource for English language learning. Through my research on translanguaging, I aim to challenge these entrenched ideologies and foster a more receptive attitude among my colleagues. By advocating for methods that prioritize the holistic needs of our students, I believe we can collectively create a transformative way, more inclusive and effective learning environment where everyone stands to benefit.

The translanguaging literature, more fully explored in chapter II, reveals the benefits for this method and especially in developing multilingual growth for language minoritized students. Additionally, my project hopes to reveal the possibilities that translanguaging approaches can enhance goals in mathematics education. As is examined by Wolfmeyer (2023), when a teacher fully embraces translanguaging in his teaching, and is using the full linguistic repertoire of his students, meaning-making and reasoning are enhanced – which are the cornerstones of reform mathematics teaching. At its core, the curricula of reform mathematics, "emphasize the application of mathematics in real-life contexts and include such

practices as collaborative, group problem solving and student-generated algorithms" (Sayeski K.L. & Paulsen, K.J., 2010). Thus, it increases the opportunities for student learning beyond the low-level mathematical procedural (as if they were only being taught in English) and maximizing the potential of higher-level thinking.

It is important to notice that in traditional rote mathematics learning, students often memorize the times tables as a means to perform arithmetic operations efficiently. For example, they may recite the multiplication facts from 1 to 10 repetitively until they can recall them quickly from memory. Similarly, students learn the standard algorithm for two-digit multiplication, where the teacher demonstrates the step-by-step process of multiplying each digit and carrying over the tens place, and students practice this method repeatedly until mastery is achieved.

In contrast, conceptual understanding in mathematics focuses on making sense of mathematical concepts and applying them in real-world contexts. Reform math teaching takes this approach, which encourages students to develop their own strategies and methods for solving mathematical problems. For instance, instead of relying solely on memorization, students may understand multiplication as repeated addition and use mental math strategies to solve two-digit multiplication problems. They may decompose numbers, use place value understanding, or employ other flexible strategies to arrive at the correct answer.

> As Muller et al. state: The National Council of Teachers of Mathematics (NCTM, 2000) describes a vision for mathematics education focusing on conceptual understanding. This vision includes students engaged in hands-on activities that incorporate problem solving, reasoning and proof, real-world connections, multiple representations, and mathematical communication. NCTM and others have prepared

> multiple documents and resources (e.g., Chambers, 2002; Germain-McCarthy, 2001; NCTM, 2000; Stiff & Curcio, 1999) to support teachers in achieving this vision and putting the standards into practice. However, differences in age, gender, ethnicity, and school culture often impede the implementation of successful teaching practice in mathematics classrooms and prevent students from taking ownership of mathematical ideas in the ways that have been envisioned (2011).

In their study, Muller et al. described a profound approach to fostering mathematical understanding among students. Through engaging and challenging tasks, students were given the autonomy to explore their own solution strategies. By allowing the students to collaborate and utilize mathematical tools, the result was an environment in which students could grapple with concepts independently and then refine their understanding through peer interaction.

The National Council of Teachers of Mathematics (NCTM) Standards, first published in 1989, marked a significant shift in mathematics education by emphasizing conceptual understanding, problem-solving, and real-world applications. These standards advocate for a more student-centered approach to learning, where students are actively engaged in making connections between mathematical concepts and their everyday experiences. This approach aimed to foster a deeper understanding of mathematics and equip students with the critical thinking skills necessary for success in an increasingly complex world.

Furthermore, according to Wolfmeyer (2023), Moschkovich's research on emergent bilinguals in mathematics classrooms aligns strongly with reform mathematics teaching because it emphasizes the need for higher-level thinking in mathematics instruction for emergent bilinguals. If ELL students can see the relevance of reform mathematics in their everyday lives, then translanguaging and reform mathematics can form a symbiotic relationship with

each enhancing the other.

However, this leads me to think: What is the connection between reform mathematics and translanguaging? Certainly, this is a question that requires a detailed look. To put it best, the intersection between reform mathematics pedagogy and translanguaging lies in their shared emphasis on student-centered learning and the utilization of diverse linguistic resources to enhance understanding and engagement in the mathematics classroom. On one hand, reform mathematics pedagogy prioritizes active student participation, problem-solving, and conceptual understanding over rote memorization and procedural fluency. Similarly, translanguaging promotes the fluid and flexible use of multiple languages, including students' full linguistic repertoires, to scaffold learning and facilitate communication in the classroom. When integrated effectively, translanguaging within the context of reform mathematics pedagogy can create inclusive learning environments where students can draw upon their linguistic repertoires to deepen their mathematical understanding and engage in meaningful mathematical discourse. Surely, this intersection underscores the importance of recognizing and leveraging students' linguistic diversity as a valuable asset in mathematics education.

Research Questions

My research endeavors to investigate the dynamic utilization of translanguaging within the mathematics classroom, focusing on my strategic integration of my complete linguistic repertoire during verbal communication with students. For a year or so, I have been deepening my practice of translanguaging in the Foundations of Mathematics class with my language minoritized students. I have wondered about the ways in which I activate and suppress from among my full linguistic repertoire and also how this relates to the goals of teaching mathematics for meaning and sense-making. My project set out to design, enact, and analyze a

week's worth of instruction in which I prioritized lesson planning for meaning-making and conceptual understanding. I was excited by the opportunity to record the lessons and through analysis, thus understand more fully the translanguaging mathematics classroom I enact. The first research question delves into the intricate ways in which I harness translanguaging techniques to facilitate mathematical instruction, emphasizing the fluid and versatile use of multiple languages to enhance students' understanding and engagement. Additionally, my study seeks to illuminate the multifaceted experiences of students within a translanguaging mathematics environment, encompassing not only their mathematical behaviors but also their broader academic and social interactions. With the exploration of both my pedagogical practices and students' lived experiences, my research aims to provide valuable insights into the effectiveness and implications of translanguaging in the mathematics classroom.

Therefore, my research questions are as follows:

1. How does a teacher use translanguaging in the teaching of mathematics, utilizing her full linguistic repertoire when communicating verbally with students?
2. What are students' experiences in the translanguaging mathematics classroom, including their behaviors mathematical and otherwise?

Study Significance: Why It Matters

In this section, I discuss the fact that translanguaging represents uncharted territory for many educators and school districts. That is to say, as a new concept, translanguaging is still unknown in many respects. After all, the ultimate goal of translanguaging is to have language minoritized students achieve the best possible outcomes.

Each teacher maintains his or her own philosophy of education. Personally, I believe that all students are capable of learning. Each student brings his or her own unique talents to the

classroom, and they can all contribute to learning. With that said, language minoritized students have the disadvantage in that they must attend classes which are taught in English, a language with which many have little to no experience. Nevertheless, these students do possess their full linguistic repertoires, which can help them in their language learning journey. This is where translanguaging can play a critical role in the development of English.

According to Joana Duarte, "In the context of multilingual education, translanguaging has been put forward as a means of including several languages in education" (2020). Translanguaging encourages the use of multiple languages simultaneously, which has been shown to help students expand their language practices. In part, this is because the students receive exposure to both languages. According to Jasone Cenoz, "Spontaneous translanguaging is considered the more universal form of translanguaging because it can take place inside and outside the classroom. It refers to the reality of bi/multilingual usage in naturally occurring contexts where boundaries between languages are fluid and constantly shifting" (2017). Moreover, "According to Wei and García 'adopting a translanguaging lens means that there can be no way of educating children inclusively without recognizing their diverse language and meaning-making practices as a resource to learn'" (2022).

In the school district in which I work, no policies exist regarding the use of translanguaging for ELL students. No professional development has addressed the concept of translanguaging, and my fellow ELL teachers have not mentioned including it in professional development either. The typical ELL instructional approach is to simply place newly arrived, foreign-born students into content area classes. Surely, this can lead to a litany of issues for these students, as they are constantly trying to learn English while simultaneously receiving instruction in content area classes in English. Granted, they do receive classes designed for

them to learn English. Nevertheless, many of my colleagues do not condone the use of the students' full linguistic repertoires during English classes. Therefore, it is incumbent upon me to help shed light on translanguaging. Certainly, translanguaging can help ELL students achieve better outcomes. If equity is one of the goals of education, then translanguaging can help provide better outcomes for language minoritized students.

Definition of Terms

Throughout the dissertation process, some relevant terms are important to understand the context of this research. I divide these terms into two categories: Language Education and Mathematica Education. They are presented in the subsequent section.

Language Educations Terms

Code-switching, when viewed from an outsider perspective, entails the observation of bilingual language use with a focus on the alternation between two or more languages within a single discourse. Makoni and Pennycook (2006) emphasize this external viewpoint, which tunes into the languages named by speakers as they switch between them. This perspective often examines code-switching as a phenomenon occurring between distinct linguistic systems, highlighting the surface-level alternation between languages.

Conversely, an insider perspective on code-switching involves understanding bilingual language use from the viewpoint of the speakers themselves. According to Otheguy et al. (2015), this internal perspective perceives code-switching as a manifestation of a unified linguistic system utilized by bilingual individuals. In this view, bilingual speakers draw from a shared linguistic repertoire, assembling linguistic features categorized as belonging to different named languages (Otheguy et al., 2015). This perspective emphasizes the interconnectedness and fluidity of language use, recognizing code-switching as a natural

aspect of bilingual communication rather than a distinct phenomenon between separate language systems. This project emphasized the translanguaging theories as opposed to code switching.

Emergent Bilingual - A student who continues to develop his or her full linguistic repertoire while also learning another "named language". The term Emergent Bilingual is suggested since these students are becoming bilinguals. The word "bilingual/multilingual" implies a positive and intellectual asset and it focuses on what students can do even before they become fluent in English (Ji-Yeong, and Martinez, 2020).

Full Linguistic repertoire is the set of skills and knowledge a person has of one or more languages. It includes linguistic features (words, sounds, structures, etc.) and multimodal features (such as gestures, images, sounds, etc.) (García & Li, 2018).

Language minoritized students, as defined by Seltzer (2019), are students whose language practices face marginalization within educational institutions and broader societal contexts. These students may not necessarily represent a numerical minority within their school or community, yet their ways of languaging are systematically relegated to the periphery. They encounter challenges where their linguistic expressions are depicted as deviations from an established norm, leading to their marginalization and association with discourses of minoritization (Seltzer, 2019). In essence, language minoritized students contend with the marginalization of their linguistic identities within educational landscapes, wherein their language practices are stigmatized and positioned as inferior or deviant in relation to imposed standards.

Named languages, as described in scholarly literature, refer to specific languages that are designated and recognized within linguistic discourse. They are often associated with

social, political, and cultural identities within a given community. For instance, in the context of bilingualism studies, "named languages" are languages like English, Spanish, Mandarin, or any other language with a distinct name and recognized status within a linguistic community.

In the context of translanguaging theory, named languages are mentioned in contrast to the integrated linguistic repertoire of bilingual speakers. Otheguy et al. (2015) elucidate that translanguaging involves the deployment of a speaker's full linguistic repertoire without rigid adherence to the socially and politically defined boundaries of named languages. This implies that speakers draw from their integrated linguistic repertoire, which transcends the limitations imposed by individual named languages, thereby enabling fluid communication across linguistic boundaries.

Proficiency Level Descriptors are a detailed articulation of multilingual learners' growth in interpretive and expressive language across levels of English language proficiency. They describe typical ways multilingual learners might develop across six levels of English proficiency, as outlined by WIDA (World-Class Instructional Design and Assessment) (2020). However, it's essential to note that while these descriptors provide valuable insights into students' English language proficiency, they represent only one way of assessing language abilities and may not fully capture the richness and complexity of a student's full linguistic repertoire.

Translanguaging - The act of using multiple languages simultaneously to enhance each other. Translanguaging is a theoretical lens that offers a different view of bilingualism and multilingualism. The theory posits that rather than possessing two or more autonomous language systems, as has been traditionally thought, bilinguals, multilinguals, and indeed, all users of language, select and deploy particular features from a unitary linguistic repertoire to

make meaning and to negotiate particular communicative contexts. Translanguaging also represents an approach to language pedagogy that affirms and leverages students' diverse and dynamic language practices in teaching and learning (Vogel, S., & García, O. 2017).

In translanguaging, "**activating**" refers to the process by which bilingual speakers draw upon their entire linguistic repertoire to express meaning and communicate effectively. This involves the intentional use of linguistic features from multiple languages without strict adherence to the boundaries of named languages. García (2009) highlights that activating linguistic resources allows speakers to access a broader range of linguistic tools, enabling them to convey nuanced meanings and negotiate identity in diverse communicative contexts.

Conversely, "**suppressing**" in translanguaging refers to the conscious or unconscious inhibition of certain linguistic features or language norms within a bilingual speaker's repertoire. This may occur when speakers perceive societal pressures or stigmatization associated with specific language varieties or when navigating contexts where language boundaries are more rigidly enforced. Otheguy et al. (2015) suggest that while some linguistic features may be temporarily suppressed in certain contexts, they remain part of the speaker's integrated linguistic repertoire and can be activated as needed in other communicative situations.

Mathematical Education Terms

Conceptual understanding in mathematics entails a multifaceted comprehension of mathematical concepts and processes, deeply rooted in meaningful engagement and active reasoning. It involves grasping the underlying meaning and connections within mathematical ideas. Through engagement in problem-solving, reasoning, and real-world connections, students develop the ability to apply mathematical concepts flexibly across contexts,

reflecting a deeper comprehension beyond mere procedural knowledge (NCTM, 2000). Conceptual understanding is nurtured in an environment where students' ideas are valued and respected, fostering intrinsic motivation and positive dispositions towards mathematics (Mueller, et al., 2011).

Mathematical sense-making, as elucidated by Mueller et al. (2011), refers to the process by which individuals actively construct meaning and understanding in mathematical contexts. It involves engaging with mathematical concepts, problems, and tasks in a way that leads to a deeper comprehension and insight. Sense-making in mathematics entails more than rote memorization or following prescribed procedures; it involves reasoning, problem-solving, and making connections between mathematical ideas. This process is inherently motivated by the desire to understand and solve mathematical problems, driving individuals to explore, question, and critically analyze mathematical concepts. Through sense-making, individuals develop a coherent understanding of mathematical principles, which enables them to apply their knowledge flexibly and effectively in various situations.

Reform mathematics pedagogy is a teaching approach based on student-centered learning with the aim of understanding and making meaning of the process of mathematics. According to Wolfmeyer, “the research-based practices from reform mathematics research require classroom mathematics teachers to thoughtfully consider every classroom lesson as a social experience from which each student makes meaning for mathematical content” (2023).

CHAPTER II – REVIEW OF THE LITERATURE

The content of this chapter takes into consideration translanguaging as a theoretical framework and also includes the related concepts of culture, dynamic approaches, and raciolinguistic ideologies. These concepts provide a critical perspective for studies focusing on language minoritized students, as they are relevant to leveraging opportunities and equity. After these are detailed, the chapter delves into the literature that specifically examines translanguaging for the mathematics classroom. Complementing the translanguaging literature review, I include a review of reform mathematics pedagogy for both its contribution to helping underprivileged students to achieve more success in mathematics classes and for its emphasis on conceptual understanding and sense-making in the mathematics classroom.

The following section aims to explore various aspects of translanguaging, examining its development, integration, and implications in language learning. Drawing from personal experiences as both a language learner and educator, the concept of utilizing one's complete linguistic repertoire to foster knowledge acquisition resonates deeply. Within the language learners' classroom, translanguaging facilitates natural exchanges among activated and suppressed linguistic features, prompting inquiries into its recognition and validation. Additionally, the chapter explores how translanguaging broadens the educational landscape, promoting a holistic approach to language acquisition. Moreover, it addresses challenges faced by students of color, emphasizing the value of recognizing and fostering existing knowledge while embracing translanguaging. Ultimately, the literature highlights translanguaging's benefits in expanding students' linguistic repertoires.

Translanguaging as Theoretical Framework

Translanguaging is the foundation of my study. The theory of translanguaging centers

on the premise of the flexible and continuous use of one's full linguistic resources to make meaning of experiences and the world around them (Celic, C. & Seltzer, K., 2013). In its broadest sense,

> Translanguaging theory engages with language and bilingualism not as simple boxes of L1s and L2s, as one named language or another, as oral/written/signed language and other modes, but as an *emergent network* of meaning that is constructed as speakers and signers assemble and orchestrate different features and resources to do language (Sánchez, M. T., & García, O., p. 30-31).

Understanding that language development does not happen "only" in one named language or in isolation as a discrete system, rather language experiences influence through social interactions and context. That said, this section connects the literature regarding translanguaging to the very fabric of this project. The continuous process of borrowing and amalgamating from the linguistic abilities that a person already possesses is at the heart of translanguaging.

As stated by García (2014,) language is "a series of social practices and actions embedded in a web of social relations that orient and manipulate social domains of interaction" (p. 4). Translanguaging braids together all the linguistic resources and linguistic practices into a flowing and fluid learning process. As such, "the bilingual speaker selects which language features to employ and suppress, based on the social context of their interactions" (Kleyn and García, 2019). In the classroom, for construing meaning and social interaction, it is imperative to allow students to use all of their linguistic resources. The literature surrounding translanguaging has shown access to students' full linguistic and semiotic repertoire in instruction.

By understanding that the elements or factors that are part of an individual linguistic repertoire are not a fixed or prearranged set, translanguaging opens the door to a more inclusive approach to teach and leverage learning practices for multilingual learners. Regarding the term "translanguaging," the prefix "trans" implies that when bilingual speakers translanguage, they transcend named languages by going beyond them (García & Li Wei, 2014; Li Wei, 2011). This suggests a fluid and dynamic interaction between languages, where speakers draw from their entire linguistic repertoire to communicate effectively in diverse contexts, thereby enriching their learning experiences and promoting linguistic diversity in educational settings.

As a parallel to the application of translanguaging, it is the examination of expanding and pushing limits or barriers that have kept undermining students from among minoritized populations as an underperforming population (e.g. those who are racially, linguistically, or culturally minoritized). "When students are marginalized, excluded, negatively labeled, and do not fit what is considered to be normative, they may experience social injustice because of the ways in which oppression have been institutionalized within the education system" (Mirci et al., 2011, p. 58). The goal, therefore, is to recognize and amplify the existing knowledge and potential growth of students, which necessitates a shift in teachers' and researchers' approaches to re-seeing and re-hearing students for their linguistic assets and expertise (Seltzer, 2019).

Part of the issue at hand is that most perspectives on language hail from a monolingual perspective. As mentioned by Seltzer, (2019) there must be a shift in conventional perspectives on language categorization, particularly regarding named languages and the understanding of students' linguistic practices. Through the lens of translanguaging theory (García, 2009; García & Wei, 2014), Seltzer aims to disrupt the labels and terms often imposed on language minoritized

students, particularly those related to "home" and "school" language. Furthermore, Seltzer states, “It is this dual focus—destabilizing oppressive language ideologies and unpacking the real effects of those ideologies on language minoritized people—that is at the heart of a critical translingual approach in the classroom” (2019, p. 990). This underscores the necessity of challenging entrenched language norms and advocating for a more inclusive and equitable approach to language education.

More importantly, translanguaging does not invalidate the resources and skills already innate in my students; it enhances their bilingual identities. Moreover, translanguaging considers the holistic approach to language development, and it gives leverage to spontaneous interactions as it reflects on the natural way of using language. (Li, S., & Luo, W., 2017). This theory's approach is conducive to language use and the development of languages as a natural, dynamic and organic process and can help academically.

Related Concepts: Culture, Dynamic Approach, and Raciolinguistic Ideologies

Culture also plays an important role in the classroom and in language development. Each student brings his or her own unique cultural experiences into the classroom, and these can further enhance their development of English. Teachers of foreign-born students must always be cognizant of the cultural backgrounds of their students. In this vein, the use of a sociocultural perspective is an important accompaniment to enriching translanguaging. For example, “Using a sociocultural perspective allows teacher educators to positively see the rich cultural and linguistic resources that Latino students bring into their classrooms” (Garza, 2017, p.151). Rather than becoming an impediment to the students’ learning, their culture should be an invaluable resource from which they can draw when engaging in the translanguaging process.

In language education, the concept of an additive approach versus a subtractive approach holds significant implications. While a subtractive approach (Valenzuela, 1999), discourages the use of students' full linguistic repertoires, an additive approach emphasizes the value of embracing and respecting linguistic diversity. However, as Flores critiques, additive approaches are not without their challenges. For example, they may fail to address deeply ingrained systemic inequalities and may inadvertently perpetuate deficit views of bilingualism and multiculturalism (Flores & Rosa, 2015). Such perspectives overlook the complex interplay between language, identity, and power dynamics. Additionally, Flores advocates for a more dynamic and transformative approach that empowers students to navigate diverse linguistic and cultural landscapes, rather than merely supplementing their existing knowledge (Flores & Rosa, 2015). This concept of a dynamic and transformative approach was not born with Flores. Surely, "García (2009) proposed dynamic bilingualism as an alternative to additive bilingualism. Additive bilingualism, through its adoption of monoglossic language ideologies typically frames languages as bonded and distinct language learning as the process of adding one bounded language to another" (Flores, 2019, p.50).

The term translanguaging, as expanded by scholars like Ofelia García, offers a lens through which to challenge traditional notions of bilingualism and multiculturalism (García, 2009). By embracing translanguaging, educators can better understand and dismantle deficit perspectives, as evidenced by personal experiences within the US Latinx community. This shift towards a raciolinguistic awareness ultimately informs a more inclusive and equitable approach to language education, one that recognizes the multifaceted nature of linguistic and cultural identities (García, 2009; Flores & Rosa, 2015). Additionally, English language development is not immune to the prejudices that some people hold. Raciolinguistic ideologies

are a common, if not realized, reality of teaching students whose heritage language is not English. At its essence, “raciolinguistic ideologies produce racialized speaking subjects who are constructed as linguistically deviant even when engaging in linguistic practices positioned as normative or innovative when produced by privileged white subjects” (Flores & Rosa, 2015, p.150). Also, “This raciolinguistic perspective builds on the critique of the white gaze—a perspective that privileges dominant white perspectives on the linguistic and cultural practices of racialized communities—that is central to calls for enacting culturally sustaining pedagogy” (Flores & Rosa, 2015, p.151). As a foreign-born educator with Spanish as my dominant language, I have encountered firsthand the challenges of facing judgments based on my appearance and linguistic abilities. These experiences have allowed me to empathize with students who undergo similar scrutiny. It is often apparent that individuals from diverse backgrounds are compelled to adhere to the standards and conventions dictated by the prevailing culture, thereby leading to the marginalization of their full linguistic repertoires and communication styles. Witnessing students encounter these obstacles is deeply disheartening, particularly considering that their linguistic diversity ought to be recognized, celebrated, and esteemed within the educational landscape.

Raciolinguistic ideologies are pertinent to my research because they profoundly influence language practices within educational settings, particularly for linguistically diverse students (Flores & Rosa, 2015). As Flores and Rosa (2015) assert, "Raciolinguistic ideologies shape language practices in educational contexts, influencing both the opportunities available to students and the ways in which their linguistic resources are recognized and valued" (p. 149). Certainly, these ideologies intersect with translanguaging, impacting attitudes towards multilingualism and shaping the acceptance and implementation of translanguaging practices

(García et al., 2008).

Understanding raciolinguistic ideologies is essential in recognizing the social, cultural, and linguistic identities of my students, especially emergent bilinguals (Flores, Kleyn, & Menken, 2016). According to Flores, Kleyn, and Menken (2016), "Emergent bilingual students occupy complex social positions that shape their experiences, identities, and academic trajectories within educational contexts" (p. 113). Of course, these ideologies may perpetuate linguistic hierarchies and biases, affecting students' self-perception, sense of belonging, and academic success (Otheguy, García, & Reid, 2015). Otheguy, García, and Reid (2015) argue that "Raciolinguistic ideologies contribute to the marginalization of certain linguistic practices and the valorization of others, thereby shaping social hierarchies and identities within educational contexts" (p. 281).

Exploring the intersection of raciolinguistic ideologies with translanguaging allows for a deeper understanding of how power dynamics, language ideologies, and societal structures influence language practices in educational settings (Flores & Rosa, 2015). Moreover, Flores and Rosa (2015) emphasize that these ideologies not only impact linguistic resources but also influence educational policies and practices. Through the examinations of these intersections, my research aims to contribute to a more inclusive and equitable learning environment that honors students' diverse linguistic backgrounds and advocates for more inclusive language policies and practices in education (García et al., 2008).

To further delve into the intersection of raciolinguistic ideologies and translanguaging, the concept of dynamic bilingualism plays an important role. Dynamic bilingualism represents a shift in how society conceptualizes bilingualism, moving away from static, fixed notions of language proficiency towards a more fluid and adaptable understanding. At its core dynamic

bilingualism, “refers to the development of different language practices to varying degrees in order to interact with increasingly multilingual communities” (García, Flores, et al., 2011). Certainly, this framework recognizes that bilingual individuals constantly navigate and negotiate between their languages depending on the context, audience, and purpose of communication. Moreover, it acknowledges that language use is not binary but exists along a continuum, with individuals drawing from their linguistic repertoires flexibly.

How does translanguaging come into play regarding dynamic bilingualism? Surely, translanguaging emerges as the embodiment of dynamic bilingualism in practice. It refers to the seamless blending and alternating between languages by bilingual speakers to communicate effectively. Rather than treating languages as separate entities, translanguaging acknowledges the interconnectedness and interdependence of linguistic systems within an individual's repertoire. This approach highlights the fluidity and creativity inherent in bilingual communication, as speakers strategically mix languages to convey meaning, express identity, and build social connections.

In essence, dynamic bilingualism redefines bilingual proficiency as a dynamic and evolving process rather than a static state, while translanguaging exemplifies the enactment of this fluidity in real-world language use. Together, they provide a more nuanced and inclusive framework for understanding the complexities of bilingualism and multilingualism in today's globalized world.

Translanguaging in the Mathematics Classroom

With these core concepts of translanguaging, raciolinguistic ideologies, and dynamic approaches in hand, I turn to the review of emerging literature that relates translanguaging to the mathematics classroom. Armando Garza’s article (2017), “A Translanguaging

Mathematical Space" represents a qualitative case study that explores how a seventh-grade mathematics teacher made use of translanguaging practices in his classroom to support the learning of English language learners (ELLs) and bilingual students. Garza's study found that the teacher made deliberate and strategic use of translanguaging practices in his instruction, such as providing a multilingual classroom that provides scaffolding in both English and Spanish. The use of translanguaging practices was found to enhance students' comprehension of mathematical concepts and improve their participation in class discussions. The study also found that the teacher's use of translanguaging practices fostered a positive classroom culture and a sense of community among the students. Moreover, Garza suggests that, "Translanguaging practices can be a valuable tool for supporting bilingual and multilingual students' learning and promoting equity and inclusivity in mathematics education" (Garza, 2017).

Garza's research provides a strong theoretical foundation for my study, emphasizing the significance of translanguaging practices in mathematics education and highlighting their potential to promote equity and inclusivity. By building upon Garza's findings, my research aims to further investigate the role of translanguaging in the teaching and learning of mathematics, with a focus on teacher-student communication and student experiences within the classroom context.

A second study conducted by Tai and Wei (2020) explored the use of translanguaging as a pedagogical tool in Hong Kong English medium instruction mathematics secondary classrooms that utilized co-learning practices. The study aimed to investigate how teachers and students used translanguaging to support comprehension of mathematical concepts and facilitate communication in co-learning classrooms. In this study, data were collected from

two co-learning classrooms, and the study found that teachers utilized various translanguaging practices, such as code-switching, transliterating, and parallel talk, to support students' understanding of mathematical concepts and enhance communication between the teacher and students. Students also used translanguaging practices to express their ideas and negotiate meaning with their peers.

Traditionally, teachers are the center of instruction. That is to say, much of the interaction that occurs in the classroom is based on that which the teacher decides. He or she decides who, if anyone, is allowed to speak. However, this could be detrimental to the students' development of English. Towards that end, co-learning can be an invaluable tool when used in conjunction with translanguaging. Essentially, "co-learning challenges the power relationship between the so-called expert (teacher) and the novice (students) and denies the privileging of one knowledge over another" (Tai & Wei, 2020, p. 242). As such, one can see the importance of co- learning as it relates to translanguaging. Translanguaging stresses the importance of incorporating a student's full linguistic repertoire into instruction. In order for this to happen, the teacher must be willing to acquiesce to the fact that it is imperative for students to use their full linguistic repertoires as they integrate new features into their repertoires After all, "As a pedagogical principle, translanguaging promotes flexible use of all named languages as well as other meaning-making resources in learning." (Tai & Wei, 2020, p. 245). Additionally,

> We consider translanguaging as an enabling and empowering strategy in bilingual and multilingual education where all participants, learners and teachers, are encouraged and supported to make use and share their funds of knowledge, including but not limited to the knowledge of different languages, in collective and collaborative

> learning. In other words, translanguaging creates a space for co-learning (Tai & Wei, 2020, p. 245).

In theory, translanguaging should provide both students and teachers the opportunity for growth. Certainly, students are not the only participants in this process. It is incumbent upon the teachers to do all that is necessary to facilitate the development of the English language. In fact, in Tai and Wei's study, they point to the fact that the teacher embarked upon as much learning as the students did. Relevant to my research, this occurred in a mathematics class, just as my research does. Hence, this only strengthens my hypothesis that translanguaging can prove to be a great benefit for the ESL students in my mathematics classes. With that in mind, "Co-learning promotes equity in knowledge construction. It exhorts the teacher and students to learn from each other and engage in the joint construction of knowledge. The teacher is no longer the sole possessor of knowledge in the class" (Tai & Wei, 2020, p. 264).

Another relevant aspect of translanguaging, regardless of which content area class in which it is utilized, is its potential positive effects on pedagogy. Through learning something that he or she does not know, such as a student's full linguistic repertoire, a teacher can help to expand upon any lapses in knowledge that he or she may have. Teachers of those students whose heritage language is not English must be respectful of any differences in culture. This can help students to reach higher levels of learning. Enhancing the students' English language development will help from a pedagogical standpoint as well. Becoming familiar with a students' full linguistic repertoire, even if not fluent, can help teachers empathize with their students. The effort that teachers put forth in this regard is beneficial. After all, "This highlights that co-learning does not only afford teacher's learning of new information or

provide a frame for equalizing power relations. It can potentially serve as an opportunity for teachers to accomplish a range of pedagogical goals for promoting students' learning in the EMI classrooms" (Tai & Wei, 2020, p. 264). In this sense, a teacher must demonstrate his or her vulnerability. To be willing to engage in the translanguaging process with students speaks volumes about a teacher's desire to be the best teacher possible for his or her students.

The study by Tai and Wei (2020) sheds light on how translanguaging and co-learning practices are utilized in mathematics classrooms. Their findings directly inform my research questions regarding teachers' use of translanguaging and students' experiences in these settings. The study highlights the effectiveness of translanguaging in enhancing communication and understanding of mathematical concepts. Additionally, it emphasizes the importance of collaborative learning environments where all participants, including teachers and students, contribute their linguistic resources. This research underscores the potential benefits of translanguaging for ESL students in mathematics education and emphasizes the significance of creating inclusive and supportive learning environments.

Translanguaging as a concept is inclusive rather than narrowing. At its core, it seeks to incorporate multiple languages into the same setting to foster an inclusive, engaging environment. Being that the United States has such a large foreign-born population, it is imperative to not only acknowledge language and cultural differences, but to also embrace them. Teachers, especially those of language minoritized students, can use these various languages as a tool to facilitate learning in the classroom. In the case of a fifth grade Texas classroom, researchers analyzed the use of translanguaging amongst the teacher and her students. Regarding its background, this school has a large Latino, foreign-born population. These students are Spanish speakers, and they receive placement in fifth grade

classrooms with English-speaking peers. The researchers found that, "translanguaging allows multilingual teachers to keep the appropriate fluidity of the communication in the classroom and provides a frame to create an awareness of the cultural and linguistic capital that Latin@ students bring to their schools" (Garza & Langman, 2014, p. 46). Personally, I find that this statement resonates with me. As a Colombian-born Spanish speaker, I can relate to the teacher that was part and parcel of this research. I imagine that she must have experienced many of the same emotions that I do when I teach students whose heritage language is Spanish. This tool that I have available to me, translanguaging, provides me with a great resource from which I can draw. The majority of the teachers with whom I work are monolingual, and it can be difficult for them to communicate with students who speak a different language. However, my bilingualism has afforded me numerous opportunities to enhance my teaching, and by extension, the amount of content that my students acquire.

In addition to creating fluidity, Garza and Langman contend that, "translanguaging can be used as a pragmatic tool for bounding pedagogical mediations among the members of a bilingual learning community when they actively engage in the process of constructing or co-constructing meaning" (2014, p. 46). Meaning, in my opinion, can often become misconstrued when engaging in two different languages at the same time. What certain words convey in one language may have a different connotation in another language. Translanguaging can help to bridge the gap between students who speak languages other than English and their English- speaking teachers and peers. On a personal level, I have experienced miscommunication when speaking in English simply because that which I am saying in Spanish does not have a direct or easy translation to English. The phrase "lost in translation" has the potential to occur on a daily basis in a classroom in which students who

speak languages other than English are trying to learn English.

Reform Mathematics Pedagogy

My project primarily approaches mathematics teaching with a translanguaging approach and for specific goals of teaching mathematics with an emphasis on conceptual understanding, reasoning and sense-making, all aspects of reform mathematics pedagogy. Reform mathematics pedagogy refers to a set of teaching approaches aimed at changing the way math is taught in schools, with the goal of promoting more engaging and effective learning experiences for students (Boaler, 2016). This section will provide an overview of some of the key concepts and research related to reform mathematics pedagogy.

Math reform teaching, also known as inquiry-based or problem-based learning, is an approach to mathematics education that emphasizes active engagement and problem-solving. This approach differs from traditional math teaching, which often focuses on rote memorization and procedural fluency. Essentially, math reform teaching encourages students to explore mathematical concepts through inquiry and collaboration, rather than simply following a set of prescribed procedures. With that stated, research demonstrates that this approach can be effective for improving student achievement, particularly for students from underrepresented groups (Boaler, 2002).

One important aspect of reform mathematics pedagogy is the emphasis on problem-solving and inquiry-based learning. According to Boaler (2016), this approach involves providing students with open-ended, challenging problems that require them to engage in higher- order thinking and to work collaboratively with their peers. Moreover, collaborative learning is also an important component of reform mathematics pedagogy.

Reform mathematics pedagogy represents a shift away from traditional, rote memorization-based approaches to math education, towards more engaging, student-centered approaches that emphasize problem-solving, collaboration, and meaning making. Surely, these approaches can be highly effective for promoting conceptual understanding and critical thinking, and they can also help to reduce achievement gaps and improve outcomes for historically marginalized groups of students. If teachers of underprivileged students can incorporate the concepts of reform mathematics pedagogy in their teaching, then it stands to reason that these students will see improvement in their mathematical capabilities.

As Wolfmeyer (2023) explains, "design and enactment of teaching reform mathematics lessons. As the research reviewed shows, the first and most important step is to ask yourself: "What is the deeper meaning in the content that I am about to teach? Is there a big idea or concept?" From this, a teacher can infer what his or her students can bring to the table. After all, "From there you will be able to think about the conceptual understandings or experiences that your students are bringing to the lesson and how you will set the stage for an experience that draws from these and provides experiences in process-based mathematics" (Wolfmeyer, 2023). Certainly, it is important to contextualize one's lessons as a teacher. Through the incorporation of students' experiences, the learning process becomes more relevant to their lives.

Moreover, students must be able to take what they have learned and apply it to real-world scenarios. That is to say, if students do not find relevance in what they are learning, then they may fail to see the reasoning as to why they must learn it. This is especially true for English language learners. In conjunction with translanguaging, reform mathematics pedagogy can offer benefits to these students. Traditional mathematics instruction for high school

students typically involved the use of algorithms and formulas to solve problems. However, the issue was such that the concepts were taught in isolation. In other words, the concepts were taught without relevance to real-world situations. After all, “Most mathematics teachers receive the question of “when/where will we use mathematics in real life?” from their students. Therefore, there is a need to implement activities that will allow students to make connections between school mathematics and real life” (Karatas, Safak, et al, 2022, p. 34). Furthermore, researchers “concluded that real-life contexts increase students’ interest and motivation and demonstrate how mathematics is used to make sense of their world” (Karatas, Safak, et al, 2022, p. 34). In that vein, a necessary component of reform mathematics is mathematical discourse. Essentially,

> Mathematical discourse is a set of tools and practices which give students opportunities to share their ideas and make their understandings clear, construct convincing arguments regarding why and how things work, develop a language for expressing mathematical ideas, and learn to see things from other perspectives by including purposeful exchange of ideas through classroom discussion and other forms of verbal, visual, and written communication (Karatas, Safak, et al, 2022, p. 35).

In many cases, students may find it challenging to grasp the significance of learning mathematics, as it may not always seem immediately applicable to their lives. Therefore, one can deduce that, through reform mathematics, the importance and relevance of the subject can receive its proper dues. After all, “Effective teaching of mathematics and reform-based mathematics teaching practices encourage teachers to engage students in solving and discussing tasks that promote mathematical thinking, reasoning, and problem-solving" (Karatas, Safak, et al, 2022, p. 35). Some of the students that I teach arrive in the United States with not only a minimal

education, but they also may lack arithmetic skills, which serve as the foundational mathematical abilities required for executing basic arithmetic operations such as addition, subtraction, multiplication, and division. These skills encompass understanding numerical concepts, manipulating numbers, and applying arithmetic operations to solve mathematical problems. Crucial for everyday tasks such as managing finances, measuring quantities, and interpreting data, arithmetic skills provide the essential groundwork for more advanced mathematical concepts and problem-solving strategies. Indeed, strengthening arithmetic skills is paramount for developing mathematical proficiency and nurturing critical thinking abilities.

Furthermore, many of my students have experienced a litany of unfortunate circumstances in their countries of origin. Ultimately, this is what leads them to seek a better future in the United States. It is essential that these students learn the problem-solving skills that are essential to daily life. Reform mathematics, in conjunction with translanguaging, can help to hone and sharpen those skills to ensure that these students have every opportunity for a bright future.

In reform mathematics, the emphasis is on transforming traditional approaches to arithmetic education by prioritizing conceptual understanding, problem-solving, and real-world applications. This approach entails fostering deep comprehension of numerical concepts rather than relying on rote memorization of procedures, thus enabling students to understand the meaning and relationships behind arithmetic operations such as addition, subtraction, multiplication, and division. Problem-solving becomes a central focus, with students engaging in activities that require them to apply arithmetic skills in various contexts, thereby enhancing critical thinking and creativity. Multiple representations are utilized to illustrate arithmetic concepts, including manipulatives, visual models, and technology, which offer different perspectives and aid in understanding. By highlighting the practical applications of arithmetic in

everyday life, reform mathematics makes learning more meaningful and relevant for students, preparing them for success in mathematics and beyond. Surely, it falls upon educators to help these students arrive to higher-order thinking.

Reform mathematics is part and parcel of that. If students merely view mathematics classes as strict rote memorization, then we are doing them a disservice by not making the topic relevant. This is especially true in today's society. More than ever, students are honed on instant gratification rather than delayed gratification. Being that mathematics is such a logic-based content area, the problem-solving skills that the students employ in a mathematics class can help them deal with real life situations in a logical, ordered manner. After all, "real-world tasks provide students with learning opportunities that allow mathematics to be used to understand the world, strengthen mathematical knowledge, and provide students with opportunities to use mathematics to analyze the world they live in" (Karatas, Safak, et al, 2022, p. 34). Clearly, there is an avenue by which students can integrate the mathematics that they learn in school with their daily lives. The key is to help the students see the relevance in the content to their everyday lives.

This chapter brings together translanguaging with reform mathematics pedagogy, to motivate my project as well as others in this extremely important realm. Speaking from personal experience, translanguaging was not mentioned in a single required course for my ESL certificate, which I received in 2016. Undoubtedly, translanguaging opens doors for students to engage with English in manners in which teachers never had utilized. Translanguaging has the potential to be an invaluable resource for students who are in the process of acquiring English. Although my research is occurring in the context of a mathematics class, translanguaging transcends content. That is to say, it would not matter if the

research were to occur in a mathematics class, social studies class, or science class. What matters most is that language minoritized students are afforded the best opportunities for language development and academic content learning. Surely, having English proficiency will allow for my students to have the best chance for a productive livelihood as they begin their lives in the United States. Therefore, the importance of this research is paramount. According to Swanson, Kong, and Petcu, "Spanish-speaking children make up a large percentage (73.1%) of the emergent bilingual (EB) 1 population in the U.S. and represent a substantial number of students who do not demonstrate proficiency in math (Hemphill & Vanneman, 2011; National Assessment of Educational Progress, 2011; 2017; National Center for Education Statistics, 2020)" (2022).

Clearly, emergent bilinguals represent a subset of students underperforming in mathematics. Therefore, my research can be relevant in helping these students achieve mathematical proficiency in the future. Furthermore, King and Powell (2023) state, "Examinations of emergent bilinguals' mathematics achievement data indicate that emergent bilingual students continue to perform disproportionately lower than their same–aged, monolingual peers (Driver & Powell, 2017; Garcia & Cuéllar, 2006; Kong & Swanson, 2019; Swanson et al., 2019)" (2023). To help emergent bilinguals become proficient in mathematics is to make mathematics learning more equitable. In other words, I hope my research shows that translanguaging can promote equity in mathematics learning amongst emergent bilingual students.

Research in translanguaging as a means to enhance math performance for language learner students is imperative in addressing the complex relationship between mathematics content knowledge and literacy. As stated by King and Powell,

> "Though mathematics was once believed to be a universal language (Cavanagh, 2005), recent research focused on understanding the academic needs of emergent bilingual students has brought to light the confound of mathematics content knowledge and literacy (Abedi et al., 2004; Powell, 2011; Driver & Powell, 2017; Durán, 2011). For example, Alt et al. (2014) determined that emergent bilinguals performed lower than monolingual peers on a mathematics task that was "language heavy" (i.e., tasks with a lot of orally presented or written language, such as word problems; p. 223), but the same was not true for tasks that were language light. Similarly, Martiniello (2009) noted that emergent bilinguals had greater difficulty with items with grammatical and lexical complexity than monolingual peers." (2023)

This suggests that leveraging students' full linguistic repertoire, through translanguaging approaches, could facilitate comprehension and engagement with mathematical concepts. By incorporating translanguaging, educators can provide linguistic scaffolding and foster deeper conceptual understanding, ultimately improving math performance for language learner students.

In terms of current data, the statistics from the Pennsylvania Department of Education at education.pa.gov concerning School Level Proficiency Results for 2023 Keystone Algebra 1 at my school district underscore the urgency of research in bolstering the academic performance of English Language Learners (ELLs). With none of the ELL students achieving advanced or proficient levels, and a substantial 66.7% falling below basic proficiency, it is evident that targeted interventions are imperative. My students, and all language minoritized students, deserve the best opportunity to expand their full linguistic repertoires. As it happens, translanguaging provides a relatively unexplored avenue in the mathematics classroom.

Through the development of English, these students will be more likely to achieve

equitable outcomes that are more comparable to their American-born peers. Certainly, all students enter the classroom with unique experiences. It is common for ELL students to have very unique backgrounds that differ from their peers who were born in the country. For example, many of them make the long, arduous trek to reach the United States' border. Hence, it is incumbent upon the teachers to ensure that these students have every opportunity for success and equitable outcomes.

CHAPTER III– METHODOLOGY

In this chapter, I delve into the methodology utilized in my qualitative research endeavor. My aim was to gain deeper insights into how translanguaging practices impact my students' learning. To achieve this, I devised a unit study centered around signed numbers, leveraging translanguaging and reform mathematics as the foundational framework for designing and executing my lessons. The focus of data collection rested on the topic of "Signed Numbers," with a specific emphasis on comprehending the conceptual nuances involved in adding and subtracting signed numbers. Audio recordings were conducted over the course of one week during the 2022-2023 school year to capture the dynamics of classroom interactions and student engagement. What follows is a detailed account of the research methodology employed in my study.

Research Methodology

While various research methodologies exist, such as quantitative and qualitative approaches, I find that qualitative research aligns most harmoniously with the subject of translanguaging. Language is a dynamic entity, continuously evolving under the influence of social, cultural, and historical factors (García & Kleyn, 2016). Qualitative research, characterized by its interpretive and exploratory nature, delves into understanding human experiences and attitudes, fostering the generation of fresh insights and understandings (Creswell, 2018). Given these characteristics, qualitative research emerges as the most suitable avenue for this study.

Within my qualitative research framework, audio recordings and student interviews serve as pivotal components. The audio recordings undergo meticulous analysis to discern the modes of linguistic communication and to ascertain the activation of various features within the linguistic repertoire. This scrutiny is imperative, particularly considering that many of my

students do not have a great deal of experience with the English language. Thus, observing how linguistic features are employed or subdued through a translanguaging lens becomes essential for comprehending how language facilitates deeper comprehension of mathematical concepts.

Hence, the objective of this analysis is to uncover the patterns and dynamics of language utilization during learning interactions, alongside understanding my students' perceptions of translanguaging practices. The interviews with students play a crucial role in this endeavor, providing invaluable insights into their perspectives. Indeed, my students are integral participants in this research, and it is my responsibility as their educator to gauge their viewpoints regarding translanguaging as we embark on this scholarly exploration.

Research Context and Participant Characteristics

In this study, I conducted the research within the framework of a mathematics class tailored for students who were emergent bilinguals and had resided in the country for less than a year. Specifically, the focus was on students who were newly integrated into the American public education system, with the research taking place in a high school environment. The range of students' grades was diverse, spanning from 9th to 12th grade. Their proficiency level, according to WIDA standards, was identified as level one. While the WIDA proficient descriptors focus on assessing English language proficiency among multilingual students, they fall short in capturing the full complexity of students' linguistic repertoires and language practices. These descriptors often prioritize standardized forms of language associated with dominant linguistic norms, thereby marginalizing linguistic diversity and non-standard language practices (Seltzer, 2019).

I collected the data from two sections of my Foundations of Mathematics classes. As stated previously, this is a class designed for newly arrived students to this country. During the 2022-2023 school year my students came predominantly from Guatemala, Honduras, and

Brazil. Some of the descriptors are listed in the following table.

Section	Total of students	Age Range	Grade Level Range	English Proficiency Level
1 2	18 16	15-18	9-12	1-Entering

While both sections shared similarities in grade level and age ranges, a notable distinction was observed in gender composition. Section one comprised three female students and 15 male students, whereas section two had nine female students and seven male students. Notably, the students in both sections ranged in age from fourteen to eighteen years old, with many of them identifying as Hispanic or Latinx.

In my school district, it is imperative to highlight that when families enroll students and indicate a language other than English as their "primary" or "home" language on the "Home Language Survey (HLS)," students must undergo the WIDA Screener assessment. This assessment, as previously discussed in Chapter I, establishes their English language proficiency level prior to class assignments. Additionally, students also participate in an entry math assessment to assess their mathematical content knowledge and proficiency.

Furthermore, a significant subset of participants in this study are designated as Students with Limited or Interrupted Formal Education (SLIFE). These students have faced considerable disruptions in their education, often stemming from factors such as poverty, displacement, migration, or conflict. Consequently, they may have encountered limited access to formal schooling, presenting unique challenges within the educational system. These challenges encompass language barriers, substantial gaps in academic knowledge and skills, as well as socio-emotional difficulties resulting from their disrupted educational experiences.

Section one of the study included three students designated as SLIFE, while section two featured two students confronting similar educational challenges.

Unfortunately, I have seen through my experience some teachers who were not sensitive to the needs of language minoritized students. Some teachers are even indifferent about whether language minoritized students understand and learn the concepts. Certainly, it would be difficult for my students to achieve as much as they are capable of achieving under such circumstances. Being a bilingual teacher, I can offer great assistance in helping my students make sense of mathematical concepts and achieve conceptual understanding, one of the themes considered by the National Council of Teachers of Mathematics (NCTM) in the current reform movements in mathematics education (Karatas, Sumeyra,et al., 2022). For my students, it is not enough for them just to know a certain formula or algorithm. Rather, it is even more important for them to understand and be able to apply such concepts in real-world scenarios.

The recruitment process was an important aspect of my study involving children, as it involved seeking the permission of both the parent or legal guardian and the assent of the child to participate. Upon IRB approval, consent forms for parents or legal guardians (refer to Appendix A) were provided in the named languages of English, Portuguese and Spanish. These forms included an overview of the research study and its purpose. There was a time frame of two weeks for parents or legal guardians to decline students' participation in the study. Furthermore, an assent form was included for the students, outlining their understanding and agreement to participate in the study. These forms were provided in three different versions to accommodate the diverse linguistic backgrounds of the participants and their families, ensuring full comprehension and informed decision-making regarding their involvement. This approach

is essential for maintaining fairness, transparency, and respect for the rights and needs of all participants.

Recruitment of Participants for Interviews

The student interviews that I performed represented an opportunity to collect qualitative data regarding their experience in my translanguaging classroom. I based my student participation in these interviews on several factors, which I have elucidated below. This helped to ensure a mix of voluntary participation, student availability, and representation of different grade levels. With that said, the interviews were open to all students who were interested in participating. I desired to create a relaxed and welcoming environment where students felt comfortable sharing their thoughts and experiences without feeling obligated.

To minimize disruption to students' academic schedules, I conducted the interviews during their lunch breaks. This arrangement allowed for flexibility, as some students might have been unavailable during other times of the day due to class or extracurricular activities. Moreover, I preferred lunch interviews, because many of my students have employment obligations after the school day.

Given that interviews took place during lunch breaks, some of my students were available for individual interviews, while others were part of small group discussions. I designed the flexibility in the interview format to accommodate my students' varying schedules and to encourage a range of interaction styles. That is to say, some of my students tended to be introverted and felt more comfortable speaking to me on a one-on-one basis. However, other students were more than comfortable to express their opinions in the presence of their peers.

In addition to being voluntary and dependent on availability, I aimed to select participants who would represent a diverse range of grade levels within my math class. This intentional

choice allowed for a more comprehensive understanding of student experiences and perspectives across different stages of their academic journey. Additionally, the students with whom I spoke in these interviews represented a diverse range of performance levels in my class. Some of the students I interviewed were high performers in my class, while others performed lower academically in my class. I reasoned that it was important to have a variety of performance levels represented in these interviews rather than to confine the interviews to only my top-performing students.

In summary, I guided the selection of participants for the interviews through a combination of voluntary involvement, flexibility in timing, and an intentional effort to include students from different grades in my math class. By allowing for varied formats and times, the process aimed to accommodate diverse student needs and schedules, ultimately promoting a more inclusive and representative set of interviews.

Planning instruction for mathematics.

In this section, I outline my reasoning for choosing the topic for my study to be signed numbers. I wanted my students to make sense of negative numbers, and more specifically to gain a conceptual understanding of operating with these numbers beyond the application of rules. Signed numbers is a unit that we covered early in the school year. However, it has been consistent since I have been at the high school (2019-2020 school year) that my Foundations of Mathematics class starts relatively small in the first week of school, usually with no more than a handful of students. Nonetheless, as the year goes on, several students newly arriving to the country are added to the class throughout the year. Surely, it is very common for many of my students to not be part of the initial lessons and have problems with future topics as we delve into more advanced concepts that require the use and application of signed numbers.

As part of my research, I designed the lessons (refer to Appendix C for lesson plans and instructional materials) with the intent to pull my students towards making connections with real life situations, in which they were able to see an application of the concept we were studying. I also used manipulatives which let my students have a visual representation and as part of the implemented partner activities. To support the research questions, I was analyzing how I as the teacher communicated with my students, what parts of my linguistic repertoire were being activated and how my language practices were used. When designing my lessons, I prioritized fostering active student engagement in problem-solving, reasoning, communication, and making connections through the use of multiple representations. I incorporated discussion-based learning approaches to encourage students to engage in critical thinking and problem-solving, rather than simply being instructed on what to do.

Additionally, I implemented a pedagogical approach aimed at fostering deeper connections between mathematical concepts and real-world scenarios. By designing lessons that incorporated real-life applications, I provided students with opportunities to contextualize their learning, enhancing their understanding and engagement. Moreover, manipulatives helped facilitate the representation of mathematical operations and processes by offering visual representations, aiding students in conceptualizing abstract ideas.

Furthermore, I structured activities to encourage collaborative learning through partner activities, promoting dialogue and peer-to-peer interaction. Throughout these instructional strategies, my focus was on leveraging my full linguistic repertoire to effectively communicate with students. I continuously analyzed my language practices to

ensure alignment with the principles of translanguaging, striving to activate diverse linguistic resources in my interactions with students.

Central to my investigation was the examination of how these language practices influenced students' cognitive processes. By prioritizing higher-order thinking and reasoning skills, I aimed to cultivate a classroom environment where students actively engaged in problem-solving and critical analysis. Rather than simply imparting information, my approach encouraged students to participate in discussion-based learning, fostering deeper comprehension and intellectual growth. Through this inquiry, I sought to ascertain the extent to which translanguaging in mathematics instruction promotes meaningful learning experiences and empowers students to develop proficiency in mathematical reasoning.

Planning instruction for translanguaging

It is necessary to take into consideration the idea set forth by García et al. (2017) regarding the "translanguaging classroom," which is based on the concept of a multilingual ecology. This is a system in which students' full linguistic repertoires and cultures are celebrated, and the need for recognition and explicit instruction of all students' awareness of the different languages and scripts in their communities as the norm. Translanguaging can flourish as a pedagogical practice when teachers plan for instruction with objectives that reflect not only appropriate content, but also multilingual language objectives. To further this point, and to ensure stronger content learning, I created and planned lessons in which students have multiple opportunities to build content knowledge and to make meaning in different ways using their full linguistic repertoires.

As stated by Celic and Seltzer in the "Translanguaging: A CUNY-NYSIEB Guide for

Educators”

> Educators must provide all students, including emergent bilinguals, with the opportunities and affordances to construct new knowledge and understandings, and so co-develop the complex language practices which students must perform in school. The power of translanguaging strategies lies precisely in its ability to provide students with these opportunities to grapple with challenging academic content. At the same time translanguaging can play an important role in helping students notice their language practices and develop their bilingual identities. (2013)

When crafting and organizing instructional strategies to foster translanguaging within the mathematics classroom, I carefully considered various factors. Drawing inspiration from the comprehensive guidelines outlined by Celic and Seltzer in the “Translanguaging: A CUNY-NYSIEB Guide for Educators” (2013,) I incorporated several strategies into my lesson plans. Below, I have summarized these strategies in a convenient chart for reference.

Multilingual Ecology	Instructional Foundations	Multilingual Collaborative Work	Translanguaging Resources to promote Language Development
Learning Environment	Multilingual Language Objectives & Content Objectives	Student-centered classroom & Reform math teaching Partner Activities	Improving their full linguistic repertoires.

- Culturally relevant - Multilingual Examples: - Greetings and praising in students' home languages	-Integrated instruction using multilingual texts and teacher full linguistic repertoire. -Bilingual dictionaries & picture dictionaries	Discuss/Reflect/Negotiate content in any language & share in English - Students talk and discuss ways to represent signed numbers.	Multilingual word walls Cognates Visuals aids Manipulatives

Data Collection Methods

In the following sections, I delve into the specific data collection methods employed in this study. It covers audio recordings of specific lessons, interviews with students, and artifacts.

Audio Recordings

To further elaborate on this research, I employed various qualitative methods. For instance, it was imperative to record audio during the classes. This approach enabled the analysis of patterns and observation of how features of the linguistic repertoire were being utilized, thereby providing insights into the research questions. I selected specific lessons to record, totaling four in all. Particularly, the lessons on which I focused were those that involve the instruction of making sense of zero-pair and basic operations with signed numbers. Specifically, I focused on the addition and subtraction of signed numbers and how to make sense of these concepts (refer to Appendix C for Instructional Materials). My reasoning behind choosing these lessons for my research is that my students have struggled with operations of signed numbers. Thus, these concepts represented an opportune lesson for the analysis of translanguaging in my Foundations of Mathematics class. In turn, this allowed me to analyze the progress that the

students were making with translanguaging in regards conceptual understanding of the topic of study.

Interviews (One-on-One and Small-Group)

As part of my data gathering process, I engaged students in both individual and small group interviews to explore their experiences with math learning and to investigate the impact of translanguaging on their mathematical understanding. Regarding some of the topics of the interviews, refer to Appendix B for the protocol of the semi-structured student interviews. In these interviews I asked my students to discuss their experiences and their perceptions of the way that language was being used during instruction and what they considered was most beneficial for their learning.

To delve deeper into addressing my second research question, particularly concerning students' perspectives, I carried out four interviews in a small-scale setting. For instance, one interview involved three students, while two others were conducted individually between a student and me. The fourth interview was comprised of four students. These interviews aimed to capture my students' viewpoints and experiences regarding the use of translanguaging within my mathematics class. Understanding their perceptions of this approach is pivotal for crafting effective teaching methodologies. As part of the data collection process, I included my personal reflections following each daily data collection session and interview sessions.

Artifacts

As part of my research, I aimed to collect and reflect on various teacher materials used during the instructional process. These encompassed lesson plans and teacher instructional materials (refer to Appendix C). Additionally, these included references to posters, manipulatives, and other resources utilized in the classroom setting. By meticulously collecting

these instructional aids, my goal is to acquire a comprehensive understanding of the breadth of instructional strategies implemented throughout the research period.

Table 1: Research Design

Research Question	Participant Sample	Data Collection Method	Method of Analysis
How does a teacher use translanguaging in the teaching of mathematics, utilizing her full linguistic repertoire when communicating verbally with students?	Section 1: 18 students Section 2: 16 students One teacher	• Audio recordings • Artifacts	Stage 1: Transcribing audio recordings. Stage 2: Coding for language practices and language use. Stage 3: Recognition of patterns from the codes. Stage 4: Streamlining and integrating codes that encapsulate relevant themes within translanguaging.
What are students' experiences in the translanguaging mathematics classroom, including their behaviors mathematical and otherwise?	Nine total students	• Interviews with students (small groups/one-on-one)	Repeat stages one through four from above, except applied to the individual and small group interviews.

Data Management and Analysis

As data collection progressed, I implemented stringent security measures to ensure its integrity. Electronic data, such as audio recordings, was securely stored on a password-protected laptop. Paper-based materials, including students' work, were meticulously filed within a locked cabinet, and organized in folders for easy access. Furthermore, digital data, including audio recordings, underwent secure transfer to an online platform accessible only through personal passwords. Backup copies of all data were also stored on a separate online

platform for added security.

For transcription, coding, and analysis, a password-protected laptop equipped with comprehensive antivirus software was utilized, ensuring the protection of sensitive information throughout the process. The analysis of the collected data unfolded across four distinct stages, each meticulously detailed in subsequent sections. During the data collection process and transcription of data, I ensured anonymity and confidentiality by utilizing pseudonyms for the names of students.

In my study, it's essential to distinguish between translanguaging and code-switching, with a focus on the dynamic interactions between me and my students in activating and suppressing features of our linguistic repertoires. While code-switching involves the abrupt switching between languages within a conversation, often perceived as a direct translation or juxtaposition of languages, translanguaging transcends such rigid boundaries (García, 2009). In translanguaging, the use of multiple languages is seamless and fluid, with individuals drawing from their entire linguistic repertoire to communicate effectively (García & Li Wei, 2014). This approach allows for the integration and blending of linguistic features across named languages to construct meaning and navigate complex linguistic environments.

Moreover, in chapter four, a more detailed explanation will be provided regarding how I, the teacher and my students activate and suppress linguistic features within the context of the classroom. This examination will delve into the nuanced ways in which individuals negotiate language use, considering factors such as context, audience, and communicative purpose. By exploring these dynamics, I can better understand how translanguaging practices shape language learning and classroom interactions.

Stage 1: Transcribing Audio Recordings

All audio recordings and interview sessions were converted into written text. Non-English expressions were transcribed exactly as spoken. These transcripts encompass Spanish and English and Portuguese. Moreover, I did not translate these various languages; any remarks remained in the language in which they were spoken. These audio recordings captured every aspect of the lesson, even interactions not directly related to mathematics. For example, the students may greet me or each other, and I transcribed it. I left out nothing, and I accounted for every interaction.

Stage 2: Coding for Language Practices and Language Use

In the second stage of my study, I employed coding, a systematic process defined by Creswell (2018) as organizing and interpreting data to derive insights and themes. Given the focus on translanguaging and the data's nature encompassing classroom recordings and student interviews, descriptive coding emerged as the most appropriate method. Descriptive coding, outlined by Charmaz (2006), involves identifying, labeling, and categorizing phenomena in a text, providing a comprehensive framework for analyzing language practices.

Within this process, I meticulously categorized various forms of language interaction evident in the data. This included discerning instances where students utilized features of their linguistic repertoire in Spanish or English or employed a hybrid form of communication. Through detailed coding, I identified specific circumstances under which students engaged with different aspects of their linguistic repertoires, ensuring thorough coverage of all occurrences. Following Saldana's (2021) guidance, this coding approach provided insights into student language usage and extended to analyze my own interactions with students. This comprehensive analysis illuminated the dynamics of teacher-student communication and the complexities of

language practices within the classroom context.

Furthermore, the coding process facilitated exploration into the extent of students' activation of their full linguistic repertoires. By applying consistent criteria to my own language use, I also aimed to gain insight into the reciprocal nature of language interactions within the classroom, unveiling contextual nuances that enrich our understanding of translanguaging in a mathematics class.

Stage 3: Recognition of Patterns from the Codes

During this stage, the data was analyzed to recognize patterns of language use. In addition, I found it necessary to distinguish what features of the linguistic repertoire were being activated or suppressed by the teacher or students given a circumstance, and how it was used. In other words, I sought to identify the meaning of the "expected" intention of why I or the students activated or suppressed aspects of the linguistic repertoire.

As stated before, descriptive coding helped to cluster data into similar categories to detect patterns as frequency (i.e., categories with the largest number of codes), interrelationship (i.e., categories that seem to connect in some way). As Saldana describes, descriptive coding is particularly useful when there are different types of data gathered for one study, such as interview transcripts, field notes, and documents (Saldana, 2021).

Stage 4: Streamlining and Integrating Codes that Encapsulate Relevant Themes within Translanguaging in the Mathematics Learning Environment

During this stage, I explored the research questions by combining codes that pertained to the theme of my research: Translanguaging within the mathematics learning environment. This involved analyzing and categorizing the collected data to identify patterns and connections relevant to the utilization of my full linguistic repertoire when communicating with students in

mathematical contexts. Additionally, I scrutinized the data to understand the experiences of students within my classroom, including their behaviors both in mathematical and non-mathematical contexts. Throughout this process, I made adjustments to ensure alignment with the demands of qualitative research and to revisit the essence of my research questions. This iterative approach not only facilitated a deeper understanding of translanguaging practices but also provided insights that could inform future research endeavors.

Additional Relevant Context

As I have stated, it is important for the teacher to engage in the translanguaging process alongside his or her students. While most my students' full linguistic repertoires primarily included Spanish, it was not the only language spoken in my class. I had a small group of students who spoke Portuguese. and the students use Portuguese infrequently in my class. For these reasons, I am also an emergent multilingual communicator with highly proficient use of English and Spanish and am beginning to engage using Portuguese. Just as I am to have my students engage in translanguaging, I will participate too in "named languages" that are less familiar to me. For example, the second most prevalent language among my students was Portuguese. Although Portuguese and Spanish share many similarities, I am not fluent in Portuguese. Nevertheless, my Portuguese- speaking students have expanded my knowledge of Portuguese. I would venture to say that these Portuguese speakers are quite adept at assimilating Spanish. This is particularly due to the similarities between the two languages. In that essence, they have already partaken in translanguaging. With that stated, the research that I completed will be relevant to my research questions. Once again, it is of the utmost importance to see how translanguaging influences learning in a mathematics class.

Validity and Reliability of the Study

The research that I perform is of the utmost importance. Equally important, however, is the validity and reliability of the data that I collect. If the data I collect is not valid and reliable, then it is all for naught. Certainly, "Sampling procedures, data collection tools, and other elements of study design will affect the validity and reliability of a project, so these various elements undergo a great deal of scrutiny in assessing the value of a project" (Given, 2016, p.75). The question that arises is: How can we ascertain the validity and reliability of the data?

Creswell (2014) highlighted the importance of employing various techniques to validate qualitative data. These methods include cross-referencing data from multiple sources, verifying findings with participants, offering detailed and comprehensive descriptions of the research context, and transparently addressing any biases inherent in the researcher's perspective. Selection of the data (audio recordings of the lessons, instructional materials, interviews, and teaching artifacts) was intentional and provided multiple ways to add to the study's validity. The intention behind this design was to address the research inquiries by gathering data from different sources and employing triangulation techniques, as outlined by Creswell (2014). As a means of validating the coding process, I employed peer intercoder agreement tests to ensure the reliability and accuracy of my coding methods, following the recommendations of Saldaña (2021). According to Saldaña, when conducting solo coding, qualitative researchers can ensure the reliability of their interpretive coding process by enlisting a team of investigators to establish intercoder agreement. To validate my coding process early on, I enlisted the help of two critical friends (Given, 2008, p. 166), who utilized a codebook I developed along with sample interview data. This process yielded a 82% match between the sample data I had coded independently and that of my peer intercoder group.

During the analysis of data and presentation of findings, I remained diligent in considering my biases and positionality in relation to the research population and context. Reflection on these factors persisted throughout the phases of data collection and analysis.

Additionally, “For a study to be trustworthy, it must be more than reliable and valid. It must be ethically conducted with sensitivity to power dynamic” (Rossman & Rallis, 2017, p. 51). In light of this, I ensured that informed consent was obtained from all participants, respecting their autonomy and confidentiality throughout the research process. Throughout the data collection phase and transcription process, I upheld the integrity of the study by safeguarding anonymity and confidentiality. This was achieved through the use of pseudonyms to protect the identities of the students, thereby enhancing the validity of the research. Additionally, I practiced reflexivity to acknowledge and address any potential biases stemming from power differentials between myself and the participants.

Along with the aid of critical friends, member checking is an important component of this process. Similar to the concept of critical friends, member checking involves sharing research findings with study participants to verify accuracy. This can help enhance the validity and reliability of research, as it allows participants to offer feedback on the researcher's interpretations. As a means of ensuring validity and safeguarding participants' well-being during the interview process, Seidman (2013) suggests employing member-checking. This approach involves verifying the accuracy of interviews and assessing whether participants perceive any vulnerability in the transcription and analysis of their data. Member-checking not only serves to validate the data and analysis but also provides an opportunity for participants to voice concerns about potential misrepresentation or vulnerability. Once the coding phase commenced and initial analyses were conducted, I reached out to all interviewees and invited

them to review a selection of transcripts. In my communication, I reassured participants of their anonymity and encouraged them to communicate any concerns regarding vulnerability. I explained the member-checking process, ensuring that participants understood its purpose. Following this, participants were contacted, and they confirmed the accuracy of the transcripts and analysis, expressing that they did not feel vulnerable as a result of their participation.

Limitations of the Study

Limitations are an inevitable aspect when performing research. That is to say, no matter the lengths to which the researcher goes in providing efficacy to the research, certain factors play a role in providing limits to the study. For example, the research may be limited by a small sample size, which can affect the generalizability of the findings. It may be challenging to obtain a large and diverse sample of participants in a specific context. Furthermore, qualitative research is often conducted in specific contexts and with a limited number of participants. As a result, the findings may not be generalizable to other settings or populations. As Creswell (2014) notes, "Qualitative research is not designed to generalize findings to a larger population, but rather to provide an in-depth understanding of a particular phenomenon in a particular context" (p. 212).

The sample size for the interviews was relatively small, consisting of nine student participants. This could have impacted the emergence of themes during data analysis. Moreover, limitations related to interviewees' verbal proficiency, comfort level in discussing personal matters in front of others, and being recorded were also considered. Additionally, unintended power dynamics may have influenced the interactions. As both the researcher and their teacher, these dynamics might have either facilitated or hindered students from fully engaging. Throughout the study, I remained attuned to potential power imbalances between

myself, the students, and other adults present in the room. Data collection aimed to ensure clear and accurate information was obtained using appropriate methods, allowing participants to recognize and articulate their achievements, regardless of size.

Additionally, qualitative research can be time-consuming and resource intensive. Teddlie and Tashakkori (2009) note that "Qualitative research requires a significant investment of time and resources, from participant recruitment and data collection to data analysis and interpretation". In this sense, one limitation of my study pertains to the number of lessons that were audio-recorded and analyzed. Due to constraints such as time and resources, only a limited number of lessons could be recorded and subjected to analysis. As a result, the scope of the data collected may not fully represent the breadth and depth of the instructional practices observed throughout the entire study period. This constraint could potentially limit the generalizability of the findings and the ability to draw comprehensive conclusions about the effectiveness of the instructional strategies employed. However, efforts were made to select a representative sample of lessons that captured a range of instructional contexts and student interactions to mitigate this limitation as much as possible.

The focus of my study centers on translanguaging and individuals' utilization of their entire linguistic repertoire, as well as my students' reflections with this phenomenon. Surely, this is pertinent, especially as the immigrant population of the United States continues to grow. Nevertheless, my study does not measure my students' growth in English. In other words, I did not give my students a baseline English test with which to compare results of a post-test upon completion of this study. Including this aspect of the study of translanguaging in the mathematics classroom may be relevant in the future.

CHAPTER IV: RESULTS OF THE INVESTIGATION

In this chapter, I present the findings derived from analyzing and interpreting the data sources within the context of translanguaging. Specifically, I illuminate the language practices of both the teacher and students in the mathematics classroom. Departing from traditional perspectives that view languages as static entities, I adopt the fluid and socially constructed approach advocated by translanguaging scholars (Otheguy, R., García, O., et al, 2015). While I employ the distinction of named languages such as Spanish and English for data analysis, I underscore the central role of translanguaging and its disruptive impact on conventional notions of language use (Wei, 2018). Throughout this discussion, I elucidate the patterns of linguistic practices observed within the mathematics classroom, exploring how linguistic elements are activated and suppressed within the speakers' repertoire. Furthermore, chapter IV encompasses the analysis of student interviews, providing valuable insights into their reflections on translanguaging and its role in their development of mathematical concepts. By incorporating qualitative analysis of student interviews, this chapter offers a comprehensive examination of translanguaging dynamics and their implications for both teaching and learning in the multilingual mathematics classroom.

Exploring Translanguaging Dynamics: Moving Beyond “Named Languages” in the Mathematics Classroom

Upon collecting my raw data, I commenced the process by transcribing and coding it, employing a descriptive method as outlined by Saldana (2021). This involved identifying segments of data with descriptive or summary labels to encapsulate their essence. I refined my coding procedure to specify not only the nature of the events but also the respective "named language" in which they occurred. After completing the third revision, a thorough review of the

coding was conducted to ensure each label encompassed both aspects. The finalized summary of the codes can be found in Appendix D.

Once I gathered the data, coded it, analyzed it, and made sense of its patterns, many observations came to light regarding my language practices in the translanguaging mathematics classroom setting. In earlier thinking on bilingual education, code-switching was intended to explain the process of communicating with multiple languages which "refers to the alternation between languages in a specific communicative episode" (Wei, 2018). However, translanguaging delves deeper, and it is intended to explain and analyze how multilingual speakers use their full linguistic repertoire. Furthermore, translanguaging, "is a process of meaning- and sense-making. The analytical focus is therefore on how the language user draws upon different linguistic, cognitive and semiotic resources to make meaning and make sense" (Wei, 2018). In this context one can view, "translanguaging as the deployment of a speaker's full linguistic repertoire without regard for watchful adherence to the socially and politically defined boundaries of named (and usually national and state) languages" (Otheguy, R., García, O., et al, 2015, p. 283). While looking at the patterns of communication, in "named languages" may appear to be analyzing the communication with a code-switching perspective, my ultimate goal is to make sense of the "why" and "how" behind the translanguaging that occurs. Towards that end, coding within the "named languages" allows me to determine how suppression and activation of my full linguistic repertoire, and my students, occurs. The idea, therefore, is to highlight the ways in which the students and I activate and suppress certain aspects of our linguistic repertoires.

Activating and Suppressing "Named Languages" By the Teacher and Students

Of my research questions, question one is, "How does a teacher use translanguaging in the teaching of mathematics, utilizing her full linguistic repertoire when communicating verbally with students?" Based on the research, numerous findings have come to light. To fully engage with my linguistic repertoire and how I use it, it is necessary to analyze the communication that occurs during my lessons. To that end, I examine how often, and with which intended purpose each code occurs in Spanish, English, hybrid Spanish-to-English, and hybrid English-to-Spanish (refer to Appendix D). Through this analysis, it is possible to achieve a clearer picture of what is occurring linguistically and mathematically in my lessons. Surely, at the time of the lesson, one is not cognizant of how often certain occurrences take place. Coding the data, re-coding it, making sense of it, and categorizing it based on occurrences and intended purpose in Spanish, English, or hybrid language allows for insights into the ways that activation and suppression of my full linguistic repertoire aid in mathematical meaning and sense-making.

Necessarily, this research extends beyond that of named languages. As such, "A proper understanding of translanguaging requires a return to the well-known but often forgotten idea that named languages are social, not linguistic, objects" (Otheguy, R., García, O., et al, 2015, p.281). For example, much like countries may have named national dishes, named languages encompass those languages that one can identify, such as Spanish or English. One understands that the students in this study speak languages other than English, with the primary language being Spanish. The linguistic systems of a named language may be unique from one language to another. Certainly, one must take this into account when analyzing communication in a multilingual setting such as the class included in this study. What one person contains in his or her full linguistic repertoire may differ from another person's based upon lived experiences.

Furthermore, “When it comes to the concepts of named languages, monolingualism (or monolingual), and bilingualism (or bilingual), we are not denying their existence; rather, we are restricting them to their proper domain of discourse” (Otheguy, R., García, O., et al, 2015, p. 293). From this, one can infer that an inherent difference exists between translanguaging, code-switching, and named languages. To clarify, this research is centered on translanguaging. While my examination includes language practices within the context of named languages, it's crucial to emphasize that the primary focus remains on how translanguaging is utilized in the teaching of mathematics. Translanguaging refutes the concept of a named language because translanguaging sees language and thought as fluid and not separated into neat and organized buckets separate from one another. My coding of the data utilizes the “named languages" of Spanish and English but not in an approach consistent with codeswitching. I reject the notion that languages are separate but do notice that in my linguistic practice I am activating the so-called "name language" of Spanish sometimes and the so-called "named language" of English other times. Are there patterns in the ways I activate and suppress these aspects of my full linguistic repertoire? Are there patterns by which students experience these communicative actions that I take?

Figure 4.1 Teacher’s use of “named languages” by intended purposes.

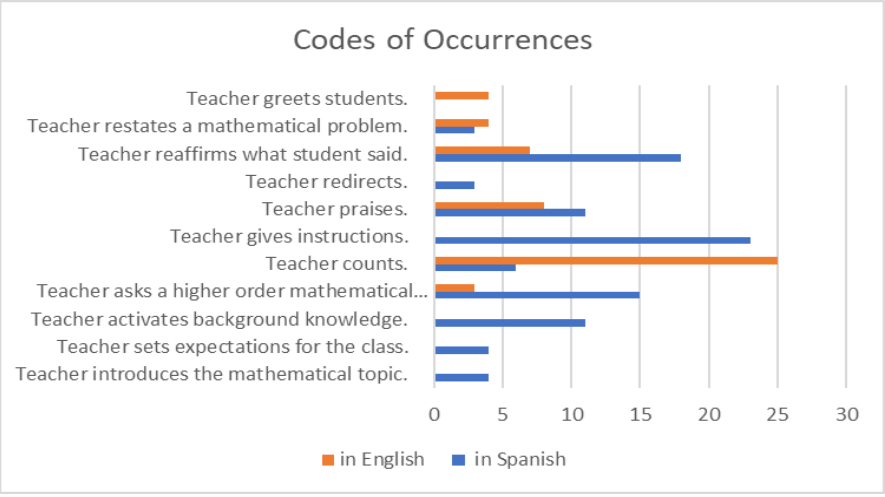


Figure 4.2 Teacher “asking” and “explaining.”

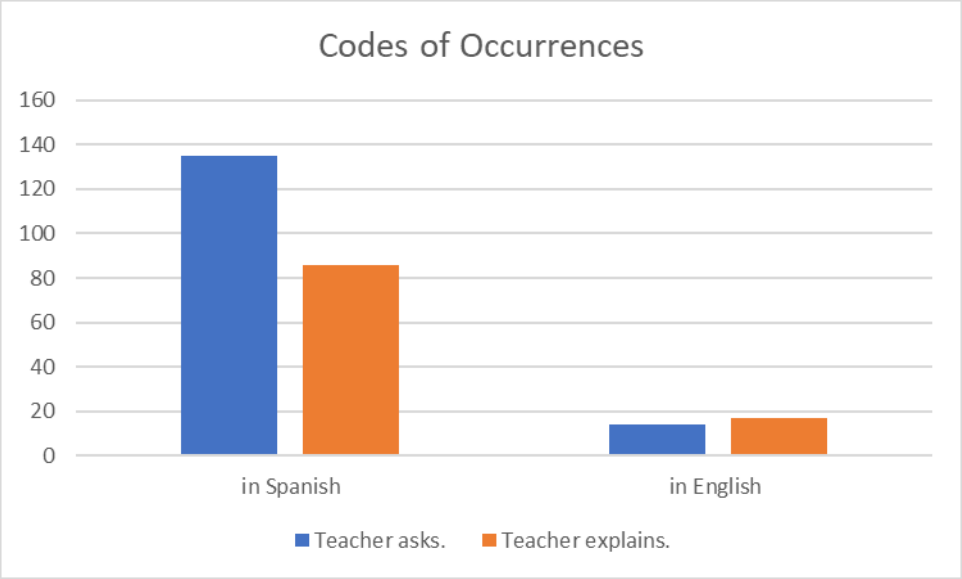


Figure 4.1 and Figure 4.2 display the results of the coding by intended purposes and “named languages”. The figures shows that there are different uses of language and how they are communicated, whether that be in Spanish or English. For example, the teacher reaffirms what the student said in Spanish 18 times and seven times in English Moreover, codes occur multiple times over. As another example (Figure 4.2), the code “teacher asks” occurs 135 times in Spanish, yet only 14 times in English. The data begins to point us to understanding how I activate or suppress aspects of my full linguistic repertoire. These figures were made from the analysis of language transcriptions recorded during four lessons in the translanguaging mathematics classroom. Full transcriptions of the raw data are available upon request; data tables representing the coding process are included in Appendix D. As I continue this chapter, each of the figures represents data from the same recorded lessons. This include breaking down the activation and suppression of my linguistic repertoire via the communications I make using “Spanish,” “English” and hybrid approaches.

Communication Patterns and Language Use

At first glance, it is apparent that many of the codes occur in Spanish. From that alone, it appears that my students may have a predisposition to reply to me in Spanish. Of course, I was not aware of the disparity between how many times I asked something in Spanish or English until I counted. To take this further, the code "student answers" (Figure 4.3) occurs 145 times in Spanish, and it occurs 27 times in English. In other words, my students were more than five times more likely to answer in Spanish than they were in English. Part of this is due to the occurrences of Spanish that I use as their teacher, but the other factor is that these students are activating parts of their linguistic repertoire that is more familiar. This is also likely why I am more frequently activating this aspect of my own linguistic repertoire, because I know this will generate enthusiasm and engagement among my students. Additionally, most of the responses that the students provide in English are straightforward answers that do not require much explanation. For the more in-depth mathematical explanations, the students revert to their aspect of their full linguistic repertoire that is more accessible in the moment.

Figure 4.3 Student answers, by "named language."

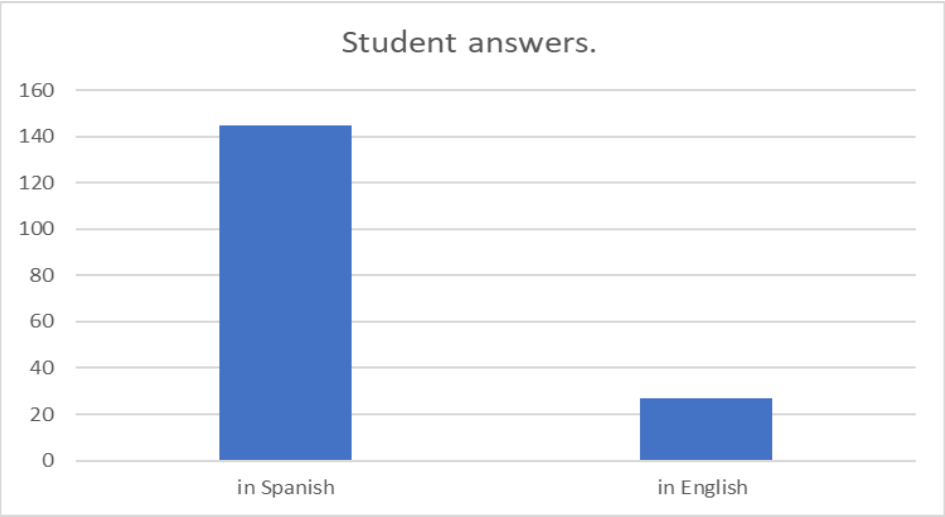
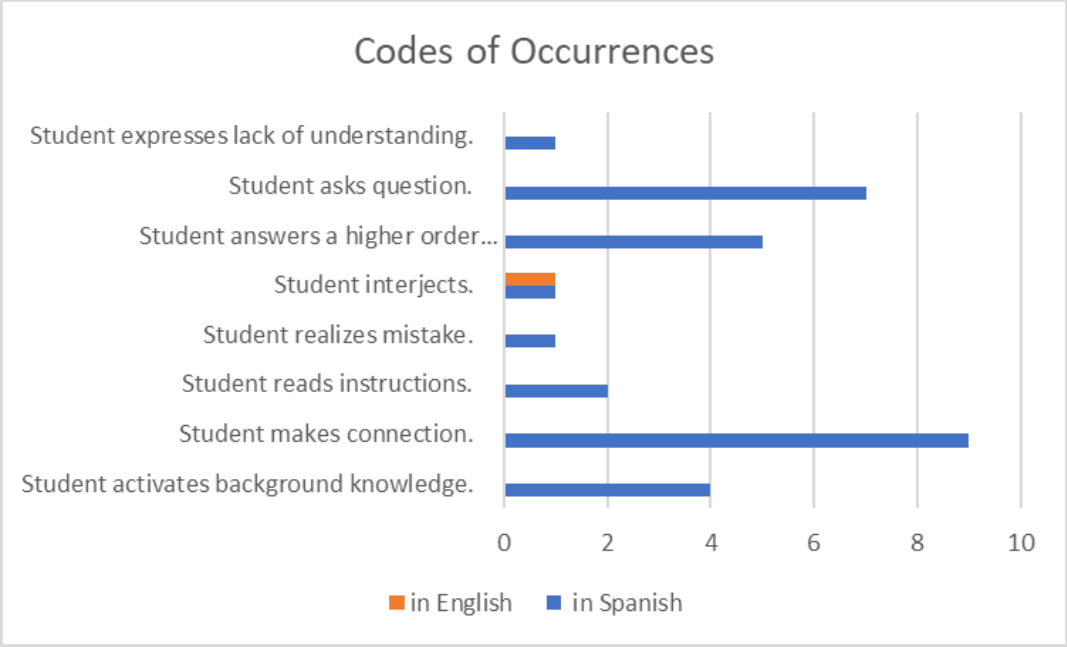
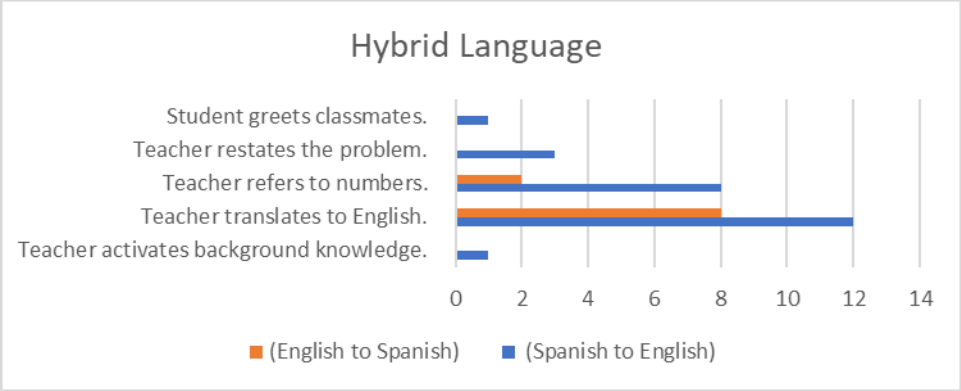


Figure 4.4 Students' use of "named languages" by intended purpose.



Regarding the use of hybrid language, when a communicator begins with one "named language" and continues with another one. Figure 4.4 indicates the instances where hybrid language occurs starting in Spanish and ending in English during the lessons. The most frequently occurring instance of hybrid Spanish to English is the translation to English, in that the instructor speaks in Spanish and translates it into English. This occurs twelve times. Overall, most of the hybrid language usage occurs on the part of the teacher. Students make use of Spanish to English hybrid language when greeting other students, otherwise there was no additional occurrence of student hybrid language use.

Figure 4.5 Teacher and students use of hybrid language



As referenced in figure 4.5, the students do not frequently utilize hybrid language themselves. Many of the interactions between the instructor and the students represent hybrid conversations. For example, I ask students questions in English, and they respond in Spanish appropriately. Throughout the lessons, I activate and suppress aspects of my full linguistic repertoire. The question is, when does this activation and suppression occur? Moreover, what do I activate and suppress? Mathematically speaking, the students all have unique backgrounds. Thus, a one-size-fits-all approach is inappropriate in this context. Hence, I must navigate a combination of linguistic and mathematical nuances and idiosyncrasies. Upon analysis of the transcribed data, it is apparent that I use Spanish with greater frequency when explaining mathematical concepts to the students. Throughout the lessons, the code "teacher explains in Spanish" occurs 86 times, and I ask a higher-order mathematical question in Spanish fifteen times. I introduce the mathematical topic each day and set the expectations for the class in Spanish, not English. On the other hand, I explain in English a total of seventeen times, and I ask a higher-order question in English three times. Moreover, the students respond in Spanish with more frequency than they do in English. What does this say about the communication that

occurs in the class? Even when I explain in English, the students show a greater penchant for responding in Spanish.

Being that my goal is to understand when I activate and suppress aspects of my full linguistic repertoire, it is important to identify under what circumstances these occurrences take place. For example, the teacher asks the students a total of 145 times in Spanish against only 14 times in English. In other words, my students are more likely to participate when I ensure that all students' languaging is present and active. It is logical to understand that questions that are asked in Spanish will elicit more responses than those asked in English. Thus, it stands to reason that concepts that require more in-depth knowledge and understanding have explanations and questions that are in Spanish. That is, the students feel more confident using their full linguistic repertoires when replying to content-focused questions.

On the other hand, the code "teacher praises" occurs a total of eleven times in Spanish and an additional eight times in English. Of the occurrences of similar items in both languages, this is the most even ratio between an occurrence in Spanish and an occurrence in English. Surely, praise helps the students to become more self-confident. However, this kind of communication does not require any response; it is perfectly acceptable if the students do not reply to praise. Therefore, one can deduce that when I know that the students are unlikely to respond to me, I am more inclined to activate English modes of communication. Thus, I activate my English repertoire when I am praising my students. Interestingly, the code "teacher reaffirms what the students say" occurs in English a total of seven times in the lessons. This occurs after a student speaks in Spanish. In other words, I re-speak what the student has said in Spanish in English, and I confirm what the student has said. As such, this is hybrid communication between the students and the teacher, in that the students respond to something that the teacher has said in

Spanish with their unique Spanish replies, and the teacher reaffirms the students' replies in English.

Implications of Language Use in the Mathematics Classroom

Upon analysis of these occurrences, the natural question is, "What are the consequences of these kinds of communications?" In other words, how does reflecting on the use of Spanish, English, and hybrid language help the teacher to think about how translanguaging works in the classroom? On the one hand, in future teaching I want to continue to be spontaneous in accessing and suppressing the various aspects of my linguistic repertoire. On the other hand, with these reflections I have a better sense of how my students were affected by these spontaneous language moves. I should not prompt the students into translanguaging; these occurrences must continue to occur organically and at the same time my subconscious language choices have moved into an awareness that did not exist prior to the analysis and reflection. It is clear to see that the students use Spanish the majority of the time, regardless of any use of English on the part of the teacher.

Considering the analysis conducted on the lesson transcripts, what does the data on occurrences of language codes from transcripts convey about how I am activating and or suppressing named languages? Surely, one must start by looking at the instances in which I used English or Spanish to count during the lesson. There are six instances where the teacher activates the use of Spanish compared to 25 times where the teacher activates the use of English.

Looking at this data, one can infer that I, as the teacher, predominantly use English during "counting" interactions, with English occurring approximately four times more frequently than Spanish. Hence, it seems that I, as the teacher, am activating or suppressing the use of a "named language," in this case Spanish, based on the assumption that students already have

knowledge in English, particularly when it comes to concepts such as numbers. Certainly, this practice aligns with the notion that I am intuitively tapping into the linguistic repertoire with which my students are familiar. On the other hand, what does this mean in the context of translanguaging, where the goal is to allow all in participation to intuitively activate and suppress different aspects of one's linguistic repertoire? This is not merely about code-switching; it is about understanding how I, as the teacher, am naturally tapping into my linguistic resources to facilitate communication. Undoubtedly, the prominence of counting in English suggests a preference or a tendency towards utilizing this language more frequently in this context, or with this purpose. From here, it is necessary to delve deeper into the types of verbal communication where I seem to clearly activate my English repertoire when interacting with students.

How can one relate this to the concept of translanguaging? This suggests that I am consciously or subconsciously choosing to utilize English when I suspect that the content or concept being discussed is something my students already understand in that language. By activating English in these instances, I aim to facilitate smoother communication and comprehension. Upon review of the data, and the emerging codes, the following sets of "categories of communication" were related to the “named languages” in which they typically occur:

1. **Classroom Procedures**: I set classroom expectations and explain classroom rules and routines predominantly in Spanish. For instance, giving instructions for group work or explaining how to use certain classroom materials occurs in Spanish.

2. **Math Concepts**: When introducing new mathematical concepts, I primarily use Spanish and cognates in English. For example, explaining the concept of zero pair occurs in Spanish. As the teacher, I asked my students to think about a situation that could be

related or apply to the concept of zero pair. On the other hand, I activate English language when I use and highlight cognates as key vocabulary to students. That is to say, I am effectively leveraging the linguistic connections between the named languages to facilitate and expand language development. This occurs frequently with the inclusion of cognates in lessons. Cognates are words that have similar meanings and often similar spellings in different languages, making them a valuable tool for language development, especially for bilingual or multilingual learners. I realize that cognates facilitate and help my students in their language development.

3. **Math Skills**: In teaching specific math skills, such as operations involving negative numbers, I rely heavily on Spanish. This includes providing step-by-step instructions or modeling problem-solving strategies. However, when restating a mathematical problem, the activation of English is predominant language. For example, “negative four plus three equals negative one”.
4. **Interpersonal Relating**: During casual conversations or when building rapport with students, Spanish is the dominant language. This includes asking about students' interests or engaging in small talk before or after class. However, during one of the transcripts a student arrived late, and I activated my English repertoire to greet him with a familiar “Good morning, how are you?” This adaptive approach ensures effective communication, especially when I recognize the student's familiarity with this English expression.
5. **Questioning and Feedback**: When asking questions, I tend to use Spanish the most. As a teacher, I encourage my students to make connections or apply the concepts to real life situations. The key idea is for my students to be able to make meaning of the

mathematical concepts studied during class and not to rely on the memorization of made rules to operate with signed numbers. When giving praise or providing feedback on students' work or student' participation of the occurrences of similar items in both languages, this is the most even ratio between an occurrence in Spanish and an occurrence in English. An interesting pattern emerges where the teacher reaffirms students' contributions in English after they initially speak in Spanish. This indicates a form of hybrid communication, wherein students respond in Spanish and the teacher translates and confirms their responses in English. This dynamic underscores a unique interaction where students maintain their linguistic autonomy while the teacher facilitates understanding and validation through bilingual communication.

In reflecting on my teaching practices, I am considering how my choice of language aligns with my pedagogical objectives and my values. I recognize the importance of creating an inclusive and supportive learning space where every student feels valued and understood, regardless of their linguistic background. Embracing translanguaging, I aim to celebrate the richness of multilingualism, creating opportunities for students to express themselves authentically in whichever language feels most comfortable to them. By embracing all languages, we create a space where students can engage in sense making and move beyond mere repetition, allowing them to fully explore and understand complex concepts.

Student language practices

The second research question is, "What are students experiences in the translanguaging mathematics classroom, including their behaviors mathematical and otherwise?" I start by answering with more detail from data points that represent typical experiences throughout the data. As my students have varied linguistic repertoires that encompass foreign languages,

primarily Spanish, it is important to analyze how my students translanguage in the class setting. This analysis leads to numerous observations. An observation that arose during the data analysis is the dynamic nature of language. Language is inherently dynamic, continually evolving rather than remaining static. This occurs during the lessons utilized in this study. For example, the following interactions between me, as a bilingual teacher, and my student showcase the dynamic nature of language use.

Teacher: Good morning, Delber. How are you?

Student: Okay. ¿Qué onda?

Here, I initiate the conversation in English, addressing the student by name and asking a common greeting question. The student responds in English, indicating his well-being. However, he also uses Spanish features ("¿Qué onda?") to express familiarity or informality, potentially reflecting his comfort with the Spanish language and desire to establish a connection with me while activating Spanish features from his full linguistic repertoire.

Student: Miss, I need a pencil.

Teacher: I don't have pencils, I have pens.

Student: Deme un lapicero.

In this interaction, the student requests a pencil in English. However, I respond in English, indicating that I only have pens. Nevertheless, the student persists in Spanish, saying "Deme un lapicero" (Give me a pencil). The use of Spanish might indicate the student's preference or urgency in expressing her need using part of her linguistic repertoire, perhaps

because he feels more confident or articulate in Spanish when it comes to certain requests or interactions.

Indeed, these interactions highlight several aspects:

1. **Language Preference and Comfort**: The students demonstrate a preference for Spanish in certain contexts, suggesting a higher level of comfort or proficiency in expressing themselves in their activating their full linguistic repertoires, especially when communicating basic needs or informal greetings.

2. **Translanguaging Dynamics**: Both I, as the teacher, and the student engage in translanguaging, seamlessly integrating Spanish and English to navigate the communication process. This fluidity reflects the natural way in which bilingual individuals draw upon their linguistic resources to convey meaning effectively.

3. **Cultural and Linguistic Sensitivity**: My willingness to accommodate the student's language choice demonstrates sensitivity to the student's cultural and linguistic background, fostering a supportive and inclusive learning environment where students feel valued and understood.

These interactions exemplify the complexity and richness of bilingual communication in educational settings, where both teachers and students negotiate language use to facilitate meaningful interaction and learning. Surely, translanguaging helps to enrich this communication, as it allows participants to draw upon their full linguistic repertoires.

Making Connections with Real-Life Applications

By carefully analyzing the audio recording transcripts, I identified moments where translanguaging was employed naturally within the classroom setting, allowing for effective

communication and engagement among my students. More important yet, my students engaged and demonstrated the ability to apply and make connections with real-life situations and make sense of the concepts we were studying. To showcase some of these instances, I will focus on two separate parts or segments of one of my audio recording lessons.

From Transcript Period One – Lesson Day 1	Translation of Transcript
00:09:21 Teacher: Quiero que pienses en otro ejemplo que tú puedas usar donde esté representado el par cero. Student: Penso em uma comida e gasto essas calorias, mas como uma comida Teacher: Excellent! Que buen ejemplo! La comida, calorías y el gasto de esas calorías. Y como dice Mateo la comida te da calorías. So, calories and food, or exercise and eating.	00:09:21 Teacher: I want you to think of another example that you can use where the zero pair is represented. Student: I think of a meal and spend those calories, but eat a meal. Teacher: Excellent! What a good example! Food, calories, and the expenditure of those calories. And as Mateo says, food gives you calories. So, calories and food, or exercise and eating.

In the provided transcript excerpt, the student is engaging in a mathematical reasoning exercise where he is asked to think of an example representing zero pairs apart from the one provided. The student responds in Portuguese by describing a scenario involving food consumption and expenditure of calories, effectively illustrating the concept of a zero pair. This response indicates the student's ability to abstract mathematical concepts into real-world contexts, demonstrating comprehension. The teacher's positive reinforcement, "Excellent! Que buen ejemplo!" acknowledges the student's successful application of mathematical understanding. This interaction highlights the students' capacity to make sense of mathematical concepts by relating them to familiar situations, thereby deepening their conceptual understanding.

From Transcript Period Two– Lesson Day 1	Translation of Transcript
00:10:22 Teacher: ¿Qué otro ejemplo, podrías referirte para representar el par cero? 00:10:31 Student 1 Por ejemplo, con un auto. Si tu viajas y regresas donde estabas, no te desplazas. 00:10:41 Student1: Bueno, otra vez, ahí mi regreso. --- 00:10:49 Teacher: Qué otro ejemplo? What other example? 00:10:54 Student 2: Compro algo y luego lo devuelvo. Teacher: That is a good example!	00:10:22 Teacher: What other example could you refer to represent zero pair? 00:10:31 Student 1 For example, with a car. If you travel and return to where you were, you do not move. 00:10:41 Student1: Well, again, here I return. --- 00:10:49 Teacher: What other example? What other example? 00:10:54 Student 2: I buy something and then I return it. Teacher: That's a good example!

In the transcript, the students and I use translanguaging to discuss examples of "zero pair," a concept often used in math to illustrate balance or neutrality. Students use real-world examples, like driving a car or returning a purchased item, to explain a mathematical concept. In this exchange, translanguaging allows them to connect these examples to the target concept, reinforcing their learning. This blending of translanguaging and experiencing the mathematical concepts represents a powerful source of learning for my students.

Certainly, learning and translanguaging are intricately connected, particularly in multilingual educational contexts. Translanguaging refers to the fluid use of multiple languages in a single communicative context, allowing individuals to draw on all their linguistic resources to make sense of concepts, express themselves, and interact with others. Simultaneously, learning is about making sense of the world by connecting experiences with concepts, and language is the primary vehicle through which students make meaning, enabling them to express

their thoughts, relate personal experiences, and engage with academic content in ways that resonate with them. In the role of the teacher, my task is to facilitate this journey by creating a classroom environment that embraces translanguaging and harnesses the rich linguistic resources that students bring with them. As shown in the previous transcripts, when given the freedom to utilize their full linguistic repertoires, my students can contextualize the mathematical concepts that they student and apply them to real-world situations.

Furthermore, when I encourage students to use their full linguistic repertoires, whether it is Spanish, English, or another language, I allow them to access their prior knowledge and experiences. This makes it easier for them to understand new concepts and see how they fit into their broader learning journey. By giving them the freedom to engage with the material in a manner that feels natural, I help them build connections that are meaningful and relevant.

In this setting, students can use their language skills to make sense of mathematical concepts, drawing on firsthand experiences to grasp the underlying principles. This association between experience and concept is at the heart of making sense and making meaning. By validating their unique linguistic backgrounds and allowing them to approach learning from a place of comfort, I create an environment where they are more likely to actively participate, take risks, and develop a deeper understanding of the content. When students find relevance and context in what they are learning, they become more engaged and confident, resulting in a classroom where diverse perspectives are valued and learning becomes a shared, meaningful journey.

Making Sense of the Math - Students Deepening Their Understanding of Mathematical Concepts

The following segment showcases an instance of math sense-making and conceptual

understanding happening in the mathematic classroom.

From Transcript Period one – Lesson Day 1	Translation of transcript
00:23:12 - Teacher: Entonces la pregunta es, ¿quién tiene el mayor valor? ¿Who has more? - Student: Student one. - Teacher: that's right! Y, ¿cómo podemos justificar esa respuesta? ¿Cómo podríamos explicar que el estudiante 1 tiene más? - Student: luck! Good luck. - Teacher: By luck? I like that, I like the way you are thinking. - Teacher: What about if we compare the numbers? si comparamos los números, qué número es más grande? dos o negativos cinco? - Student: dos - Teacher: So we can say because two is greater than negative five. Sabemos que el estudiante 1, es el que tiene más valor. ¿Por qué? Porque dos es más grande que negativo 5.	00:23:12 - Teacher: So the question is, who has the greater value? - Student: Student one. - Teacher: that's right! And, how can we justify that answer? How could we explain that student 1 has more? - Student: luck! Good luck. - Teacher: By luck? I like that, I like the way you are thinking. - Teacher: What about if we compare the numbers? If we compare the numbers, which number is greater? Two or negative five? - Student: Two - Teacher: So we can say because two is greater than negative five. We know that student 1 has more value. Why? Because two is greater than negative 5.
00:27:11 - Teacher: Viendo la siguiente pregunta donde estamos razonando, dice si tomaras un puñado más grande de piezas. Si tu agarrarás más. ¿Tendrías una mejor oportunidad de tener un valor más alto? Discute esto con su pareja y explica ¿por qué? Quiero que en parejas tú hables y escríbas lo que piensan y ya lo discutimos todos. (Teacher gives class time to work on the question)	00:27:11 - Teacher: Looking at the next question where we are reasoning, it says if you were to take a larger handful of pieces. If you grab more. Would you have a better chance of having a higher value? Discuss this with your partner and explain why? I want you to talk in pairs and write down what you think and then we will all discuss it.
00:31:04 - Teacher: Ok, clase ¿que pensaron?, ¿Qué dijieron? si yo tengo otra oportunidad de coger otro puñado donde cojo más	00:31:04 - Teacher: Okay, class what did you think? What did you say? If I have another chance to grab another handful where I grab more chips.

fichas. ¿Tú crees que voy a tener un valor más grande? - Students: Noo! - Teacher: ¿No? ¿Por qué no? - Student1: Porque si agarra todos negativos, no va a tener un valor más grande. - Student2: porque él puede sacar positivos y yo puedo sacar negativos - Teacher: Perfecto, me gusta como lo dices. Tú puedes agarrar más, pero en esa oportunidad puede que hayas cogido más negativo. No estoy segura de que voy a coger más positivo.	Do you think I will have a greater value? - Students: Noo! - Teacher: No? Why not? - Student1: Because if you grab all negatives, you won't have a greater value. - Student2: because he can pick positives and I can pick negatives - Teacher: Perfect, I like the way you say it. You can grab more, but this time you might have grabbed more negatives. I'm not sure that I'll grab more positives.

First, it is important to notice that in the provided transcript section, evidence of translanguaging emerges as the teacher and students fluidly integrate both Spanish and English into their interactions. The teacher initiates the conversation in Spanish, seamlessly transitioning to English for certain prompts such as "Who has more?" The students respond in Spanish and English. Use of the full linguistics repertoire allows comprehension and engagement, with students effectively conveying their thoughts and ideas. Furthermore, in this section of the transcript, it is apparent that the students are actively engaged in the process of comprehending and applying mathematical concepts, with a particular focus on signed numbers. The analysis of their interactions reveals several key aspects that underscore their understanding of this mathematical domain:

1. Comparison of Numbers: The teacher prompts the students to compare numbers, asking them to justify their reasoning for determining who has the greater value. The students engage in this comparison by recognizing that the number 2 is greater than negative 5. This demonstrates their understanding of numerical magnitudes and the concept of greater than and less than.

2. Reasoning: The teacher introduces a question about the likelihood of obtaining a higher value when selecting a larger handful of pieces. Students discuss the scenario considering the possibility of selecting positive or negative numbers. Through this discussion, they demonstrate an understanding of probability and the impact of positive and negative numbers on the overall value.

3. Critical Thinking and Justification: Students provide reasoning to support their answers, articulating their thoughts about why selecting a larger handful may not necessarily result in a higher value. They consider the potential for selecting negative numbers, highlighting the importance of critical thinking and justification in mathematical reasoning.

In summary, the interactions among students in this transcript indicate an active process of sense-making in mathematics, especially regarding signed numbers. The students demonstrate their capacity to engage in mathematical reasoning, apply conceptual understanding of signed numbers, and justify their reasoning based on mathematical principles.

Findings from the Students' Interviews

To further answer the second research question and especially with a focus on the students' experiences, I conducted four interviews. I conducted these interviews in a small-scale setting. For example, one of the interviews included three students. Two of these interviews were one on one with me and a single student. Finally, I conducted the fourth interview with four students. The purpose of these interviews was to gauge my students' perceptions and experiences regarding translanguaging in the context of my mathematics class. Understanding students' perspectives on this approach is essential for designing effective instructional strategies. In this section, I present insights gleaned from interviews with students in translanguaging mathematics classrooms, focusing on their experiences, challenges, and perceptions.

Overview of the Coding Process for the Interviews

The interviews that I conducted included students from my high school-level Foundations of Mathematics classes. For these interviews, a qualitative approach guided the data collection and analysis process. Following Saldana's (2021) recommendations for qualitative data analysis, I employed descriptive coding to identify recurring patterns and themes in the students' responses. This allowed for more cohesion upon the completion of the four interviews, as it allowed me to identify similarities between the responses that the students provided independent of one another.

The coding process involved multiple steps, starting with familiarization with the interview transcripts. Next, I generated initial codes based on the content of the interviews. Then, I organized these codes into broader themes that captured the essence of the students' experiences. Finally, I conducted constant comparison and refinement of the codes and themes to ensure accuracy and comprehensiveness. Refer to Appendix E to see the codebook of student interviews.

As a means of validating the coding process, I employed peer intercoder agreement tests to ensure the reliability and accuracy of my coding methods, following the recommendations of Saldana (2021). According to Saldana, when conducting solo coding, qualitative researchers can ensure the reliability of their interpretive coding process by enlisting a team of investigators to establish intercoder agreement (2021). To validate my coding process early on, I enlisted the help of two critical friends (Given, 2008, p. 166), who utilized a codebook I developed along with sample interview data. This process yielded a robust assessment of 82% agreement between the sample data I had coded independently and that of my peer intercoder group, indicating a good level of consistency and reliability in the coding process. By achieving this percentage agreement,

I gained confidence in the validity of my coding approach and the trustworthiness of this qualitative data analysis.

Identifying Themes

Upon conducting a thorough examination and validation of my codes, my data analysis yielded two primary themes that emerged from the interviews: "Enjoyment of Translanguaging" and "Language Support and Strategies." These overarching themes encapsulate the essence of the students' experiences with translanguaging in a mathematics classroom for language minoritized students. Furthermore, these two themes encompass a multitude of subthemes for each category.

First, my students conveyed an overwhelmingly positive attitude toward the use of multiple languages in the classroom. They appreciated the comfort and perceived benefits of translanguaging, which allowed them to use their complete linguistic repertoires. This approach eased their transition into English language learning in a mathematical setting. Additionally, a notable aspect of this theme was the reduced pressure students felt, as they could gradually incorporate English while relying on their named languages. One student commented, “Utilizando poco a poco el español y el inglés a la vez, uno va empezando a agarrar poco a poco las palabras, entendiendo un poco mejor ya parte por parte” (Interview 1). This translates to, “Using Spanish and English little by little at the same time, one begins to grasp the words little by little, understanding a little better part by part.” Surely, this illustrates the gradual and less overwhelming process that translanguaging offers.

Moreover, my interviews revealed a preference for mixed-language instruction, with my students indicating that this approach enhanced their understanding of mathematical concepts. They appreciated learning in both Spanish and English, allowing for greater comprehension and reducing stress. One student remarked, “Sí, una mezcla entre los dos... ya uno tiene comprensión

que son esas palabras" (Interview 3). In English, this means that a mix between the two languages helps in understanding specific terms. Certainly, this student demonstrates that he is reaping the benefits of translanguaging.

The second major theme that I identified focused on language support and strategies for understanding. My students frequently mentioned that using both English and Spanish helped them comprehend unfamiliar terms and concepts. In other words, the ability to leverage their linguistic repertoires allowed them to approach academic challenges with greater confidence. One student mentioned, "Buscar las palabras claves y traducirlas... ya tienes ganado parte del problema" (Interview 2), meaning "Finding key words and translating them allows you to have already 'won over' part of the problem."

This theme also covered the students' strategies for understanding complex topics in English, such as translation, mixing languages, or breaking down words. Specifically, the students found that these strategies helped them navigate the content and boosted their participation and confidence in class. As one student stated, "Cuando miras las palabras que nos has enseñado en matemáticas, ya tenemos una idea de lo que eso significa" (Interview 4). This translates to, "When you look at the words you've taught us in math, then we already have an idea of what that means". This flexibility allowed students to find pathways to comprehension and helped them feel more at ease in the classroom.

While the enjoyment of translanguaging and the language support and strategies formed the core themes, the impact on my students' participation and confidence also emerged as a significant aspect of the interviews. The students noted that translanguaging provided an inclusive classroom environment, leading to increased participation and confidence. As one student remarked, "La confianza que nos da... Voy a intentarlo" (Interview 1), indicating that the

supportive atmosphere encouraged them to try and engage more actively in class.

Discussion of Findings

The findings from the interviews offer valuable insights into my students' experiences with translanguaging in my Foundations of Mathematics classes. They highlight the importance of incorporating both Spanish and English to support comprehension, participation, and confidence among language minoritized students. Overall, the students' perspectives emphasize the effectiveness of translanguaging approaches in promoting inclusive and equitable learning environments in mathematics classrooms. The findings highlight the significance of considering students' perspectives in designing instructional approaches that effectively support language minoritized students' learning needs. By incorporating both Spanish and English instruction, educators can create inclusive learning environments that foster comprehension, participation, and confidence among all students.

In reviewing the values and hopes expressed by my students regarding the use of translanguaging in the mathematics classroom, I find confirmation of my beliefs in the transformative potential of embracing linguistic diversity. Surely, my students are linguistically diverse, and this diversity represents the potential for strength in conjunction with translanguaging. My students overwhelmingly expressed positive attitudes towards the utilization of multiple languages to support their learning.

Additionally, the fact that my students felt at ease using their full linguistic repertoires to facilitate English development aligns closely with my values of creating a supportive and inclusive learning environment. Their perceptions of translanguaging as beneficial for improving comprehension of mathematical concepts and enhancing language proficiency validate my hopes for teaching in this manner. Also, their acknowledgment of the benefits of using both languages

simultaneously resonates with my belief in the power of leveraging students' full linguistic repertoires to promote deeper understanding.

My students' narratives also revealed the positive impact of translanguaging on their participation and confidence in the classroom. Undoubtedly, the supportive atmosphere created by incorporating both Spanish and English instruction encouraged shy or timid students to engage more actively and express themselves with greater confidence. This emphasizes the importance of creating a safe and inclusive space where students feel empowered to utilize their linguistic resources without fear of judgment.

By allowing students to use their full linguistic repertoires and encouraging them to engage with the material in a way that feels comfortable to them, I foster a learning environment where they can make meaningful connections between their lived experiences and academic content. This approach helps students find relevance and context in what they are learning, ultimately leading to a more inclusive and impactful educational experience.

In conclusion, the discussion of findings shows that translanguaging plays a crucial role in my students' learning experiences. It not only enhances comprehension and reduces stress but also fosters a supportive classroom environment where students can build confidence and participate more actively. Their overall positive experiences with translanguaging affirm my commitment to embracing linguistic diversity in the mathematics classroom. Moving forward, I will continue to reflect on their experiences and seek innovative ways to support their language learning journey, ensuring that all students feel valued, empowered, and confident in expressing themselves in any language they choose.

CHAPTER V: DISCUSSION OF THE RESULTS

In this chapter, I discuss the theoretical underpinnings and practical implications of translanguaging practices in the mathematics classroom. First, I explore how the use of the full linguistic repertoire, including activating and suppressing parts of it, contributes to understanding language use in teaching mathematics. Second, I highlight the importance of effective translanguaging practices in fostering inclusive classroom environments and supporting students' mathematical sense-making and conceptual understanding. I also reflect on how these findings have influenced my own teaching practice, primarily with my renewed attention to teaching mathematics for sense-making and conceptual understanding via the students and my full linguistic repertoire. Furthermore, I advocate for the integration of translanguaging strategies into curriculum and teacher training programs to promote linguistic diversity and equity in education. Finally, I address limitations, challenges, and suggest avenues for future research. Through this chapter, I aim to provide valuable insights for educators and policymakers regarding the integration of translanguaging practices in educational settings.

Engaging with the Theory

The findings of my study shed light on the theoretical underpinnings of translanguaging in the mathematics classroom. By examining how I utilize my full linguistic repertoire, including activating and suppressing parts of it, this study contributes to the understanding of language use in my Foundations of Mathematics class. Moreover, I navigate between different linguistic features to facilitate mathematical learning. My research highlights the dynamic nature of language in teaching mathematics, emphasizing the importance of recognizing and harnessing the diverse linguistic resources available to both teachers and students.

As the premise of translanguaging allows for individuals to draw upon their full linguistic repertoire, the data from this study elucidates that translanguaging represents a beneficial means in which students can bridge the gap between their "named languages". Furthermore, as this study focuses on application in a mathematical classroom, it is evident that the students have garnered more comfort in their language development journey. Through extensive research, it became apparent that translanguaging represented a possibility of utilizing my students' knowledge of their full linguistic repertoires to facilitate their learning in my mathematics class. In turn, this made it necessary to further delve into the depths of translanguaging research to either prove or disprove its efficacy in a Foundations of Mathematics class designed for students who are in the process of acquiring English. Certainly, this setting is unique. In my years of teaching, the Foundations of Mathematics class that I teach is among the only mathematics courses in my school district in which the students receive instruction in multiple languages, not in a monolingual fashion. Surely, this affords a grand opportunity to study the theory of translanguaging in this setting.

Bilingual speakers can activate and suppress different aspects of the named languages they understand (Kleyn and García, 2019). Thus, through translanguaging, these individuals translanguage. In other words, they can transcend named languages by going beyond any single language (García & Wei, 2014; 2022; Wei, 2011). Therefore, what implications did my study bring to light regarding these theories? Among the desired outcomes from translanguaging is equity and inclusivity (Garza, 2017). Moreover, as part of this equity and inclusivity is the concept of meaning-making. Translanguaging offers multilingual students the possibility of constructing meaning, as they have their full linguistic repertoires as a resource to help make sense. This transcends linguistic codes, modalities, and makes full use of their linguistic

repertoire to enable meaning-making (Tai and Wei, 2020). Additionally, translanguaging offers the possibility of linguistic justice for my students. Unfortunately, my students are underrepresented for their minoritization via race, language, and culture and translanguaging affords them a playing field responsive to these injustices.

Implications for the Math Community

Translanguaging represents a significant shift in educational practice, especially within reform math pedagogy, offering an inclusive approach that leverages the linguistic diversity of students. This section explores its implications in reform math pedagogy, focusing on its potential to create deep conceptual understanding and facilitate meaning-making. As was shown by the transcripts presented in chapter four, where the students and I discuss mathematical concepts using our full linguistic repertoires, this analysis emphasizes how translanguaging can empower students to navigate complex ideas and engage with math in a meaningful way.

Central to effective math education is the ability to make sense of abstract concepts. Translanguaging allows students to use all their linguistic resources to construct meaning from these concepts, thus providing a pathway to deeper understanding. As it was analyzed from the transcripts, students discussed the mathematical notion of "zero pair," using examples from their everyday lives to illustrate the concept. By allowing students to express themselves using their full linguistic repertoire, my goal was to facilitate a process where students can draw connections between abstract ideas and real-world experiences, ultimately leading to more profound conceptual understanding.

This ability to draw features from their full linguistic repertoire is crucial for language minoritized students. When students are free to use their full linguistic repertoire, they can better articulate their thoughts, ask questions, and make inferences. Certainly, the process of making

meaning is a cornerstone of reform math pedagogy, where understanding is built through exploration, collaboration, and contextualization.

It is important to note that translanguaging helps in contextualizing mathematical concepts, a critical aspect of developing a robust conceptual framework. In the transcripts, students use familiar examples, such as calories in food and exercise, driving a car, or returning a purchased item, to illustrate the idea of a "zero pair." These real-world contexts help demystify abstract concepts, making them more accessible and relatable to my students. Undoubtedly, when students can connect classroom learning to their lived experiences, they are more likely to grasp and retain the underlying principles.

Conceptual understanding in math is not just about knowing the "how" but also the "why." Translanguaging facilitates this deeper level of understanding by creating spaces where students are encouraged to think critically and reflect on the relationships between concepts. Surely, teachers who embrace translanguaging create opportunities for students to explore mathematical ideas in a way that resonates with their cultural and linguistic backgrounds, leading to a more meaningful learning experience. On the part of my students, I can attest to the efficacy of translanguaging in regard to making meaning in my mathematics class.

Certainly, my students' participation is of the utmost importance in my class. Translanguaging promotes active participation by creating a classroom environment where students feel comfortable expressing their thoughts in the language that best suits them. This inclusive approach encourages collaborative dialogue, allowing students to learn from one another and build upon each other's ideas. My role as the teacher in facilitating this collaboration is crucial, as I guide discussions and encourage students to explore different perspectives.

In reform math pedagogy, collaboration is key to developing a comprehensive

understanding of mathematical concepts. When students engage in translanguaging, they can share their insights with classmates who may have different linguistic backgrounds, culiminating in an exchange of ideas or methods to solve mathematical problems. This collaborative process not only enhances conceptual understanding but also contributes to a sense of community within the classroom. When students can use their full linguistic repertoires, they are better able to navigate the complexities of mathematical concepts and see how these concepts fit into their broader learning journey. This not only enhances their understanding but also embraces a sense of ownership over their learning process. As their teacher, I seek to encourage translanguaging on the part of my students by providing a classroom environment that values diversity and promotes meaningful connections.

Implications for Practice

The practical implications of my study are significant for educators seeking to implement translanguaging in the mathematics classroom. My findings demonstrate that effective translanguaging practices involve the intentional activation of various linguistic resources to support students' mathematical understanding. Certainly, teachers should leverage their own linguistic repertoire and create an inclusive environment where students feel empowered to utilize their multilingual capabilities. Additionally, my research underscores the importance of fostering a positive classroom culture that values linguistic diversity and promotes collaborative learning experiences.

Being that I am not the only teacher who teaches language minoritized students, the implications for practice can transcend the class that I teach. In other words, what implications for practice have come to light regarding translanguaging based upon my study? To start, it would behoove teachers across all disciplines to remain open-minded about the concept of

translanguaging. Regardless of the subject area, translanguaging represents the possibility of improved outcomes for students who are in the process of expanding their linguistic repertoire to include English. These students are in a unique position in that they can draw upon their repertoires of multiple languages. In turn, this allows teachers to utilize students' full linguistic repertoires.

Another implication of practice relevant to this study is that translanguaging can provide clearer communication between teachers and students. In my experience, if my students receive instruction in another content area class other than mine, a high likelihood exists that instruction occurs solely in English. This completely disregards what my students bring to the table regarding the linguistic knowledge that they already possess. On the part of the students whom I serve, class participation remains low if they feel as though they are marginalized. From this marginalization stems the possibility of apathy. If these students become apathetic about that which they learn, then it is unlikely that they will achieve the same levels of success as if their linguistic repertoires were to receive recognition in class. This, however, is not an indictment on their content area teachers. After all, these teachers have had the concept of "English-only" engrained in their teaching methods that it is all they know regarding students of different linguistic backgrounds. Times are shifting, and translanguaging is now more relevant than ever. Responsive to the apathy typically experienced by language minoritized students, my project demonstrates the enthusiasm for learning that takes place via translanguaging.

My students reported benefits such as improved understanding of mathematical concepts and enhanced language proficiency. For instance, one student expressed, "Utilizando poco a poco el español y el inglés a la vez, uno va empezando a agarrar poco a poco las palabras, entendiendo un poco mejor ya parte por parte" (Interview 1), which translates to "Using Spanish

and English little by little at the same time, one begins to grasp the words little by little, understanding a little better part by part." From this feedback, I infer that my students believe translanguaging helps them progress gradually in English development. In essence, they felt less overwhelmed compared to if they were prohibited from using their full linguistic repertoire.

Impact on My Practice

As a practitioner, this study has profoundly influenced my approach to teaching mathematics. That is to say, I now recognize the value of incorporating translanguaging to enhance student engagement and comprehension. By embracing the linguistic diversity present in my classroom, I aim to create a more inclusive learning environment where all students feel supported in their mathematical journey. Additionally, this research has inspired me to continually reflect on my teaching practices and seek innovative ways to leverage language as an important component for mathematical instruction.

In my case, I have a distinct advantage when it comes to the implementation of translanguaging in my classroom. I am a foreign-born immigrant like most of my students. Because of this, my knowledge of Spanish helps me to translanguage with my students. While it is advantageous that I speak the same language as many of my students, translanguaging would still be relevant even if my linguistic repertoire included languages other than Spanish. Even before embarking on this study, I subconsciously knew that I had a fortunate happenstance in that I am bilingual. Thus, I would do my students a disservice if I were to neglect this advantage. On the contrary, I opine that it is obligatory to embrace my bilingualism. Ironically, upon beginning my career as an English language learner teacher, my mind was much more occupied with the idea that my students should only be immersed in English. I had thought that they should only speak English and disregard their full linguistic

repertoires. After all, they have numerous standardized tests to take each year that are dependent upon their base knowledge of English. With more experience, the neglect of their full linguistic repertoire seemed increasingly ludicrous. Of course, with a repertoire that expands to multiple languages, my students have many opportunities to make meaning that a monolingual student does not have.

Upon placing my focus on the study of translanguaging in the context of my Foundations of Mathematics class, I find myself increasingly cognizant of my use of translanguaging principles. This is not only for my part, but for my students' part as well. I do not take for granted that I represent a possible successful outcome to my students. Many of them look to me as a beacon of hope, despite any hardships they have experienced in life. The fact that I make use of their full linguistic repertoires in my classroom, coupled with the fact that I am an immigrant, surely aids in my students' development of mathematical sense-making and language development.

A factor to which I had not given much prior thought was the recording of my lessons and how this would potentially impact my practice. That is, engaging in the process of recording myself and delving into a meticulous analysis has been eye-opening. Initially, the idea of listening to my own voice, dissecting every nuance of my teaching, seemed daunting to me. However, as I delved deeper into the exercise, I realized the immense value it holds for personal and professional growth. By extension, this process has allowed for a profound impact on my practice as an educator who seeks to implement translanguaging into her teaching. Surely, this recording and subsequent analysis served as a catalyst for introspection, prompting me to reflect not only on what it meant for me to record myself but also on the broader implications for educators.

Upon analysis of my recorded lessons, the lessons and discussions amongst me and my students traversed through various dimensions, from the practical aspects of translanguaging usage to the profound impact it has on student learning and classroom dynamics. One aspect that resonated deeply with me was the notion of linguistic repertoire and its intersection with student engagement. During the analysis of my recorded lessons, my analysis allowed me to discern moments of student activation and suppression within their linguistic capabilities. This heightened awareness not only enriched my understanding of student needs but also challenged me to create a more inclusive and dynamic learning environment.

Moreover, the dialogue underscored the importance of intentional reflection and analysis in refining teaching practices. The question posed, "When do I hear my students activating and suppressing aspects of their linguistic repertoire, and how does this surprise me?" prompted me to delve deeper into the intricacies of language use in the classroom. Additionally, it encouraged me to critically evaluate my pedagogical approaches and consider how translanguaging can enhance student learning experiences. During my interviews with students, an emerging theme was the challenges my students faced with pronunciation in English. Some students indeed struggled with pronunciation or expressing themselves confidently in English, impacting their participation in the language. This highlighted a perceived need for support in developing their English language skills. They believe that by refining their English skills, they can achieve greater understanding. One student aptly remarked, “Tal vez a veces uno solo entiende cómo se escriben, pero no sabe pronunciarlo” (Interview 3), conveying the occasional difficulty in pronouncing English words despite understanding their written meaning.

Furthermore, these recorded lessons helped to spark my contemplation on the broader significance of this practice for educators at large. Certainly, the impact on my practice has been

profound, but this study can be beneficial for the teaching practice in general. Embracing translanguaging requires a shift in mindset and a commitment to fostering an open door to diverse language interactions. By analyzing and reflecting on my teaching, I validate the effectiveness of translanguaging and help spread the adoption in mathematics teaching.

In essence, recording myself and engaging in a detailed analysis have been transformative experiences. This has provided me with invaluable insights into my teaching practice, prompting me to reevaluate my pedagogical approaches and embrace the principles of translanguaging pedagogy. Moving forward, I am committed to integrating these reflections into my practice and advocating for their adoption among fellow educators. Also, this research has prompted me to advocate for my students and for best practices such as embracing translanguaging as a viable means to draw upon students' full linguistic repertoires. Certainly, I noticed upon the analysis of the data that my students' engagement was piqued by their full linguistic repertoires. For example, one of my students mentions in Portuguese, "Penso em uma comida e gasto essas calorias, mas como uma comida". Then, I respond with, "Excellent! Que buen ejemplo! La comida, calorías y el gasto de esas calorías". In these few seconds, the student and I include three separate named languages in our communication with one another. The languages are Portuguese, English, and Spanish. Without the use of our full linguistic repertoires, this conversation would not be able to take place. Furthermore, it is important to note that the students are making sense of this communication, even though it spans three distinct named languages.

Implication for Policy

My findings have implications for educational policy in a broad sense, particularly regarding the integration of translanguaging practices into curriculum and teacher training

programs. Moreover, my research has elucidated the fact that policymakers should consider the importance of providing professional development opportunities that equip teachers with the knowledge and skills to effectively leverage linguistic diversity in the mathematics classroom (García & Wei, 2014). Additionally, policies should promote the development of inclusive instructional materials that recognize and validate students' diverse linguistic backgrounds (Creese & Blackledge, 2018).

The research I have performed encapsulates the transformative potential of reflective practice, not only for personal growth but also for informing broader educational policies. As an educator, my commitment to continuous improvement is paramount, and the process of recording and analyzing my teaching serves as a cornerstone for professional development. By delving into the nuances of my language practices, I gained valuable insights into the effectiveness of translanguaging and identified areas for refinement of my pedagogical practices. Also, these insights can be reflective of educational practices that transcend content area (Otheguy et al., 2015). Moreover, the significance of this process extends beyond individual classrooms, carrying profound implications for educational policies and practices. Certainly, embracing translanguaging necessitates a paradigm shift in educational frameworks. Educators should embrace the linguistic repertoires of their students to great benefit. Additionally, they should emphasize the importance of recognizing and valuing students' diverse linguistic repertoires, thereby fostering inclusive learning environments conducive to academic success.

Furthermore, this study underscores the necessity for systemic support and resources to facilitate the adoption of reflective practices among educators. Professional development initiatives tailored to translanguaging pedagogy, particularly in mathematics education, are essential for equipping teachers with the necessary tools and strategies to effectively implement

these approaches in their classrooms (García & Wei, 2014). By advocating for policies that prioritize reflective practice and translanguaging pedagogy, educators can embrace teaching methodologies that promote student engagement and academic achievement. Through collaborative efforts and a commitment to continuous improvement, the goal is the cultivation of a culture of reflective teaching practices that elevate the quality of education for all students.

In summary, the implications for policy underscore the importance of investing in professional development initiatives that promote reflective practice and translanguaging pedagogy. By recognizing the transformative potential of these approaches, policymakers can pave the way for meaningful educational reform that empowers teachers and enhances student learning outcomes. Additionally, a shift in the focus of English-only instruction to a more inclusive and diverse approach that champions students' linguistic repertoires rather than shunning them offers the possibilities of improved outcomes for students.

Limitations & Challenges

Despite the insights gained from this study, certain limitations and challenges warrant acknowledgment. For example, one such limitation is the potential for bias in data interpretation, as my perspectives may influence my analysis. As an immigrant, I can relate and foster close relationships with my students. In fact, many of my students have confided in me that they view me as a beacon of hope. Additionally, the generalizability of my findings may be limited by the specific context in which I conducted the research, which is a Foundations of Mathematics class designed for language minoritized students. Furthermore, navigating the complexities of translanguaging in the classroom presents challenges, such as ensuring equitable participation and addressing potential language barriers. Although I was raised as a monolingual Spanish speaker, my Portuguese leaves much to be desired. Thus, it is imperative to avoid any linguistic

pitfalls that may occur, as I must serve all my linguistically diverse students with the same importance.

Also, this research sheds light on another inherent limitation of the study, particularly concerning the focus on improving language development proficiency in English. This study deals primarily with understanding students' experiences with translanguaging, its implementation in the classroom setting, and its implications for mathematical learning. While it is undeniable that translanguaging usage inherently facilitates students' engagement with English, my study was not designed to measure or evaluate improvements in English proficiency explicitly. This limitation is crucial to acknowledge, as it underscores the need for clarity and specificity in defining my research questions and outcomes, which is why I have clearly defined such questions in this research. By delineating the parameters of the study, I ensured that the findings were accurately aligned with my intended objectives. In this case, while the study provided valuable insights into the efficacy of translanguaging pedagogy in enhancing mathematical understanding, its findings should not be extrapolated to imply direct correlations with improvements in language development proficiency in English.

Moreover, addressing this limitation necessitates a nuanced understanding of the multifaceted nature of language learning and instruction. Translanguaging operates within a broader framework of fostering meaningful language interactions. While it undoubtedly contributes to students' linguistic development, its primary focus lies in facilitating deeper engagement with academic content rather than exclusively focusing on language proficiency. Therefore, it would be beneficial in the future to expand upon the language development aspect of translanguaging in the mathematics classroom. After all, the concept of translanguaging is

akin to a rabbit hole of possible studies. Translanguaging transcends content areas in an academic setting; it is relevant in any person's life who is developing another language.

To conclude, while my research offers valuable contributions to the field of translanguaging, it is essential to acknowledge its limitations regarding the scope of language proficiency outcomes. I performed my research in the context of a Foundations of Mathematics class geared towards students who are in the process of expanding their linguistic repertoires. Of course, my class is unique. Therefore, it will be interesting to see the philosophy of translanguaging become incorporated into a more diverse variety of classes in the future. For now, the limitation is that I have only performed research in a class that is niche for my students specifically. To combat this limitation, it would be necessary to implement the practice of translanguaging in many other content area classes to represent further diversity on this topic.

Suggestions for Future Research

Future research in this area should explore the long-term effects of translanguaging practices on students' mathematical achievement and attitudes towards learning (García & Wei, 2018). Additionally, investigating the role of technology in facilitating translanguaging in the mathematics classroom could yield valuable insights. Furthermore, comparative studies examining the effectiveness of translanguaging approaches across different cultural and linguistic contexts would contribute to our understanding of its universal applicability (Creese & Blackledge, 2018).

Building upon the insights gained from this study, there are several avenues for future research that could deepen one's understanding of translanguaging in the mathematics classroom and its implications for language development and mathematical learning.

One such area of future study would be to explore the long-term effects of translanguaging on students' language development and mathematical proficiency (García & Wei, 2018). Surely, a study of this magnitude could provide valuable insights. After all, my study did not encompass multiple years. In the future, it may be beneficial to analyze the effects of translanguaging on a year-over-year basis amongst the same participants. Certainly, these studies tracking students over multiple academic years would allow researchers to observe the sustainability of any benefits gained from translanguaging practices. Additionally, investigating how translanguaging impacts students' overall academic performance and educational trajectories could provide a comprehensive understanding of its efficacy.

Another such area of future study could be to conduct comparative studies across different educational settings and student populations could help elucidate the universality of translanguaging practices and their effectiveness (Creese & Blackledge, 2018). As I have stated, I performed my study in the classroom setting of a Foundations of Mathematics course geared to language minoritized students who are developing English. In other words, this is a small sample size of the total number of language minoritized students and students in general. Thus, comparing classrooms where translanguaging is actively encouraged to those where it is not utilized could provide evidence of its impact on student engagement, comprehension, and academic achievement. Furthermore, examining how translanguaging strategies vary across different subject areas and grade levels could offer insights into its applicability beyond mathematics.

A third aspect of relevant future study would be to investigate the effectiveness of teacher training programs focused on integrating translanguaging practices into the classroom, regardless of content area (García & Wei, 2014; Otheguy et al., 2015). By assessing the impact of

professional development initiatives on teachers' attitudes, knowledge, and implementation of translanguaging, future researchers can identify best practices for supporting educators in creating inclusive and linguistically diverse learning environments. Additionally, exploring the role of teacher beliefs and attitudes towards translanguaging in shaping classroom practices could inform targeted interventions to promote its adoption.

A fourth area for future research in our technologically advanced society would be to explore the role of technology in facilitating translanguaging practices in the mathematics classroom. Surely, current technology offers multiple avenues for language learners to expedite the process of acquiring another language. Investigating the efficacy of digital tools and resources designed to support multilingual learners in accessing mathematical content and expressing their understanding could offer innovative solutions to enhance instructional practices. Furthermore, examining how online platforms and digital learning environments can foster collaborative translanguaging opportunities among students could contribute to the development of inclusive pedagogical approaches in the area of translanguaging.

Considering the socio-cultural contexts in which translanguaging occurs and its implications for identity construction and social interaction represents an important direction for future research (García & Wei, 2018). Exploring how students negotiate their linguistic and cultural identities in translanguaging practices within diverse classroom settings could provide valuable insights into the intersections of language, culture, and learning. For example, I teach a diverse group of students. Surely, most of my students are of Hispanic and Spanish-speaking origin. However, I also have students from Europe, Asia, and the Middle East that are in the process of acquiring English. Therefore, it stands to reason that studying what role the students' cultural identities plays in translanguaging could provide interesting insight. Additionally,

investigating the role of translanguaging in promoting linguistic equity and social justice in education could inform policy and practice aimed at addressing linguistic diversity in schools.

In conclusion, future research endeavors that build on this study's findings can advance future educators' understanding of translanguaging in the mathematics classroom and its broader implications for language education and educational equity. Through addressing the identified gaps and exploring new avenues of inquiry, future researchers can contribute to the development of effective pedagogical strategies that support the diverse linguistic needs of students in multilingual educational contexts.

Conclusion

This study has delved deep into the theoretical underpinnings, practical implications, and my personal reflections surrounding the integration of translanguaging practices in my Foundations of Mathematics classes. Through an in-depth analysis of my teaching practices and student interactions, I have gained valuable insights regarding the dynamic nature of language use and its impact on mathematical learning. These implications for theory highlight the significance of recognizing and harnessing the diverse linguistic resources available to both teachers and students. By embracing translanguaging as a beneficial means of bridging linguistic gaps and promoting equity and inclusivity, educators can create more inclusive learning environments conducive to academic success for all students. This is especially true for students whose named language is a language other than English. Moreover, the exploration of translanguaging theories highlights the potential for negotiation of meaning and linguistic justice, particularly for underrepresented multilingual students.

In terms of practice, my study emphasizes the importance of the activation of various linguistic features to support students' mathematical understanding. Surely, this is at the very core of translanguaging. Educators should leverage their linguistic repertoires and create inclusive classroom cultures that value linguistic diversity. By embracing translanguaging pedagogy, teachers can help to ensure that all students have equal access to meaning-making and the understanding of complex concepts.

Overall, the impact on my practice has been profound, leading to a reevaluation of my teaching methods and a commitment to incorporating translanguaging techniques to enhance student engagement and comprehension. As an immigrant educator, I recognize the value of my bilingualism in facilitating meaningful language interactions and supporting my students' development of English and mathematical concepts.

Looking forward, there are several avenues for future research that could deepen our understanding of translanguaging in the mathematics classroom. Long-term studies tracking the effects of translanguaging practices over time, comparative studies across different educational settings, investigations into the role of technology, and explorations of socio-cultural contexts represent promising areas of inquiry. Certainly, through addressing these research gaps, educators and policymakers can continue to advance translanguaging pedagogy and promote educational equity for all students.

Surely, this study serves as a testament to the transformative potential of reflective practice and the importance of embracing linguistic diversity in educational settings. If educators can foster a culture of inclusivity and innovation, they can empower students to succeed academically and thrive in an increasingly multicultural world. The incorporation of

translanguaging principles in an academic setting can assuage the struggles that afflict those students who are acquiring English.

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APPENDIX A - Consent Forms

PARENTAL CONSENT FORM -ENGLISH

Your child (or ward) is invited to participate in a research study being conducted through Kutztown University. I ask that you read this form and ask any questions you may have before you decide whether or not you want your child (or ward) to participate in the study. The University requires that you give your signed agreement if you choose to have your child (or ward) participate.

This study is being conducted by Ana Bogotá, ELD teacher, at Phoenixville Area High School as a part of a doctoral study at Kutztown University.

Title of the Study:

Translanguaging in the Mathematics Classroom for Newcomers: An Approach to Higher Order Thinking.

This research has been approved by the Kutztown University IRB – approval #09042023.

Purpose of the Study:

The purpose of this study is to explore how translanguaging impacts the learning of mathematics in our foundations of mathematics class. Translanguaging comprises a natural way of acquiring another language, and it involves a more holistic and fluid approach. It presents an opportunity for our learners to use their native resources as an asset to build their knowledge and grow upon them. Furthermore, in order to pursue higher-order level thinking, students will be expected to apply strategies where they are required to think, analyze, and discover new content with guidance and support from the teacher.

Procedures:

If you agree to have your child (or ward) participate in this study, I would ask your child (or ward) to do the following:

- *Allow for the anonymous use of their class work, and assessments to be collected, analyzed, and presented in the study; to also potentially be interviewed by their instructor twice throughout the end of the school year, The interviews will take place at the high school in a classroom or conference room whose location will be determined based on availability. The duration of each interview will be around 10 to 15 minutes.*
- *Participate in class activities and discussions using his or her full linguistic repertoire that will be recorded and analyzed in the study for approximately two weeks.*

Risks or Discomforts, and Benefits of Being in the Study:

The study has no risk involved in participating. Additionally, there are no benefits to participating

in the study. Any component of the study is a regular part of the class curriculum, and agreeing to participate has no positive or negative impact on the participant's class grade.

Confidentiality and Anonymity:

Records will be kept private and will be handled in a confidential manner to the extent provided by law. In any report or presentation, we will not include any information that will make it possible to identify a research study participant. Your child (or ward) will remain anonymous.

Voluntary Participation:

Your child's (or ward's) participation is voluntary, refusal to participate will involve no penalty or loss of benefits to which they are otherwise entitled, and you may discontinue your child's (or ward's) participation at any time without penalty or loss of benefits to which they are otherwise entitled.

Contacts and Questions:

The researcher conducting this study is your child's instructor: Ana Bogotá, ELD Math Teacher, Phoenixville Area High School, email: bogotaa@pasd.com, phone: 484-927- 1534. The researcher's advisor is Dr. Mark Wolfmeyer, Secondary Education, email: wolfmeyer@kutztown.edu, phone: 610-683-4763.

You may ask any questions you have now. If you have questions later regarding the research study, you may contact the researcher listed above. If you have any questions or concerns about the rights of research participants, please contact the IRB Committee at Kutztown University at 484-646-4167.

Statement of Consent:

I have read the information described above and have received a copy of this information. I have asked questions I had regarding the research study and have received answers to my satisfaction. I am 18 years of age or older and voluntarily consent to allow my child (or ward) to participate in this study.

_____

Signature of Parent/Guardian Date

_____

Relationship of Parent/Guardian to Participant

Youth Assent

I have read the information described above and I have received permission from my parent(s) to participate in the study. I understand the procedures, what will happen to me in the study and have had my questions answered to my satisfaction. I know that I can quit the study at any time. I agree to participate in the study.

_____

Signature of Minor for Assent Date

Thank you for your participation.

Parental Consent Form –Spanish

FORMULARIO DE CONSENTIMIENTO DE LOS PADRES

Su hijo(a) (o pupilo(a)) está invitado a participar en un estudio de investigación que se está llevando a cabo a través de la Universidad de Kutztown. Le pido que lea este formulario y haga cualquier pregunta que pueda tener antes de decidir si desea o no que su hijo(a) (o pupilo(a))participe en el estudio. La Universidad requiere que usted entregue su acuerdo firmado si decide que su hijo(a) (o pupilo(a)) participe.

Este estudio está siendo realizado por Ana Bogotá, maestra de ELD, en Phoenixville Area High School como parte de un estudio de doctorado en la Universidad de Kutztown.

Título del estudio:

Translanguaging en el aula de matemáticas para estudiantes recién llegados: un enfoque para el pensamiento de orden superior

Esta investigación ha sido aprobada por el IRB de la Universidad de Kutztown – aprobación # 09042023.

Propósito del estudio:

El propósito de este estudio es explorar cómo las practicas de translanguaging impactan el aprendizaje de las matemáticas en la clase de Fundamentos de Matemáticas. Translanguaging comprende una forma natural de adquirir otro lenguaje, e implica un enfoque más holístico y fluido. Presenta una oportunidad para que nuestros alumnos utilicen activamente sus recursos nativos para construir su conocimiento y expandirlo. Además, para perseguir el pensamiento de nivel superior, se espera que los estudiantes apliquen estrategias donde se requiere que piensen, analicen y descubran contenido nuevo con la orientación y el apoyo del profesor.

Procedimientos:

Si usted acepta que su hijo(a) (o pupilo(a)) participe en este estudio, le pediría a su hijo(a) (o pupilo(a)) que haga lo siguiente:

- Permitir el uso anónimo de su trabajo de clase y las evaluaciones que se recopilan, analizan y presentan durante clase; ser entrevistado por la instructora dos veces antes del final del año escolar, las entrevistas se llevarán a cabo en la escuela secundaria en un aula o sala de conferencias cuya ubicación se determinará según la disponibilidad. La duración de cada entrevista será de alrededor de 10 a 15 minutos.
- Participar en actividades y discusiones en clase usando su idioma nativo que serán grabadas y analizadas para el estudio durante aproximadamente dos semanas.

Riesgos o molestias, y beneficios de estar en el estudio:

El estudio no tiene ningún riesgo involucrado en la participación. Además, no hay beneficios al participar en el estudio. Cualquier componente del estudio es una parte regular del currículo de la clase, y aceptar participar no tiene ningún impacto positivo o negativo en la calificación de la clase del participante.

Confidencialidad y anonimato:

Los registros se mantendrán privados y se manejarán de manera confidencial en la medida prevista por la ley. En ningún informe o presentación, se incluirá ninguna información que permita identificar a un participante del estudio de investigación. Su hijo(a) (o pupilo(a)) permanecerá en el anonimato.

Participación voluntaria:

La participación de su hijo(a) (o pupilo(a)) es voluntaria, la negativa a participar no implicará ninguna penalización o pérdida de beneficios a los que de otro modo tenga derecho, y usted puede interrumpir la participación de su hijo (o pupilo) en cualquier momento sin penalización o pérdida de beneficios a los que tenga derecho.

Contactos y preguntas:

La investigadora que realiza este estudio es la profesora de su hijo(a) (o pupilo(a)): Ana Bogotá, maestra de matemáticas de ELD, Phoenixville Area High School, correo electrónico: bogotaa@pasd.com, teléfono: 484-927- 1534. El asesor de la investigadora es el Dr. Mark Wolfmeyer, Educación Secundaria, correo electrónico: wolfmeyer@kutztown.edu, teléfono: 610-683-4763.

Puede hacer cualquier pregunta que tenga. Si tiene preguntas más adelante con respecto al estudio de investigación, puede comunicarse con la investigadora mencionada anteriormente. Si tiene alguna pregunta o inquietud sobre los derechos de los participantes de la investigación, comuníquese con el Comité IRB de la Universidad de Kutztown al 484-646-4167.

Declaración de consentimiento:

He leído la información descrita anteriormente y he recibido una copia de esta información. He hecho preguntas que tenía con respecto al estudio de investigación y he recibido respuestas a mi satisfacción. Tengo 18 años de edad o más y doy mi consentimiento voluntario para permitir que mi hijo(a) (o pupilo(a)) participe en este estudio.

_____

Firma del padre/tutor Fecha

_____

Relación del padre/tutor con el participante

Asentimiento juvenil

He leído la información descrita anteriormente y he recibido permiso de mi(s) padre(s) para participar en el estudio. Entiendo los procedimientos, lo forma en que participare en el estudio y he tenido mis preguntas respondidas a mi satisfacción. Sé que puedo abandonar el estudio en cualquier momento. Estoy de acuerdo en participar en el estudio.

_____

Firma del estudiante Fecha

Gracias por su participación.

Parental Consent Form –Portuguese

TERMO DE CONSENTIMENTO DOS PAIS

Seu filho (ou filha) (ou protegido/a) é convidado a participar de um estudo de pesquisa que está sendo conduzido pela Universidade de Kutztown. Peço que leiam este formulário e façam quaisquer perguntas que possam ter antes de decidir se querem ou não que seu filho (ou filha) (ou protegido/a)participe do estudo. A Universidade exige que você envie seu acordo assinado por escrito se decidir ter seu filho (ou filha) (ou protegido/a) participando.

Este estudo está sendo conduzido pela professora de ELD Ana Bogotá na Phoenixville Area High School como parte de um estudo de doutorado na Universidade de Kutztown.

Título do Estudo:

Translanguaging na sala de aula de matemática para recém-chegados: uma abordagem para o pensamento de ordem superior

Esta pesquisa foi aprovada pelo IRB da Universidade de Kutztown – aprovação #09042023.

Objetivo do estudo:

O objetivo deste estudo é explorar como as práticas de translinguização impactam a aprendizagem da matemática na aula de Fundamentos da Matemática. Translanguaging compreende uma maneira natural de adquirir outro linguagem, e envolve uma abordagem mais holística e fluida. Representa uma oportunidade para nossos alunos usarem ativamente seus recursos nativos para construir seu conhecimento e expandi-lo. Além disso, para buscar o pensamento de alto nível, espera-se que os alunos apliquem estratégias onde são obrigados a

pensar, analisar e descobrir novos conteúdos com orientação e apoio do professor.

Procedimentos:

Se você concordar com a participação de seu filho (ou filha) (ou protegido/a) neste estudo, você pedirá ao seu filho (ou filha) (ou protegido/a) para:

- Permitir o uso anônimo de seus trabalhos de classe e avaliações que são coletadas, analisadas e apresentadas durante a aula, ser entrevistado pelo instrutorduas vezes antes do final do ano letivo, as entrevistas serão realizadas no colégio em uma sala de aula ou sala de aula cujo local será determinado com base na disponibilidade. A duração de cada entrevista será de cerca de 10 a 15 minutos.
- Participar de atividades e discussões em sala de aula utilizando sua língua materna que serão gravadas e analisadas para estudo por aproximadamente duas semanas.

Riscos ou desconfortos e benefícios de estar no estudo:

O estudo não tem risco envolvido na participação. Além disso, não há benefícios em participar do estudo. Qualquer componente do estudo é uma parte regular do currículo da turma, e concordar em participar não tem impacto positivo ou negativo na nota da classe do participante.

Confidencialidade e anonimato:

Os registros serão mantidos em sigilo e tratados confidencialmente na medida prevista em lei. Nenhum relatório ou apresentação deve incluir qualquer informação que possa identificar um participante no estudo de investigação. Seu filho (ou filha) (ou protegido/a) permanecerá anônimo.

Participação voluntária:

A participação de seu filho (ou filha) (ou protegido/a) é voluntária, a recusa em participar não envolverá qualquer penalidade ou perda de benefícios aos quais ele ou ela tenha direito de outra forma , e você pode interromper a participação de seu filho (ou filha) (ou protegido/a) a qualquer momento, sem penalidade ou perda de benefícios aos quais você tem direito.

Contatos e dúvidas:

A pesquisadora que conduz este estudo é a professora de seu filho (ou filha) (ou protegido/a): Ana Bogotá, professora de matemática ELD, Phoenixville Area High School, e-mail: bogotaa@pasd.com, telefone: 484-927- 1534. O orientador do pesquisador é o Dr. Mark Wolfmeyer, Faculdade de Educação, e-mail: wolfmeyer@kutztown.edu, telefone: 610-683-4763.

Você pode fazer qualquer pergunta que tiver. Se você tiver dúvidas mais tarde sobre o estudo de pesquisa, você pode entrar em contato com o pesquisador listado acima. Se você tiver dúvidas ou preocupações sobre os direitos dos participantes da pesquisa, entre em contato com o Comitê de IRB da Universidade de Kutztown pelo telefone 484-646-4167.

Declaração de consentimento:

Li as informações descritas acima e recebi uma cópia dessas informações. Fiz perguntas que fiz sobre o estudo de pesquisa e recebi respostas para minha satisfação. Tenho 18 anos de idade ou mais e dou meu consentimento voluntário para permitir que meu filho (ou ala) participe deste

estudo.

_____

Status dos pais/responsáveisData

_____

Relação dos pais/responsáveis com o participante

Jovens acenam

Li as informações descritas acima e recebi permissão do(s) meu(s) pai(s) para participar do estudo. Compreendo os procedimentos, como participo do estudo e tive minhas dúvidas respondidas a contento. Sei que posso sair do estúdio a qualquer momento. Concordo em participar do estudo.

_____

Assinatura do aluno Fecha

Obrigado pela sua participação.

APPENDIX B - Semi-Structured Interview Protocol

Interviewer: Ana Bogotá

Date:

Time:

Participant/s:

- What are your thoughts or feelings regarding the use of multiple languages in your mathematics class?
- Tell me about a moment when you used both English and your home language to understand a mathematical concept?
- Do you think that using more than one language in class helps you learn math better? Why or why not?
- What strategies do you use to understand mathematical concepts when they are presented in English?
- What specific factors or aspects of this class motivate you to participate? Conversely, what factors or aspects deter you from participating?

APPENDIX C - Lessons Plans and Teacher Instructional Materials

Lesson Title: Exploring Zero Pairs and Addition of Signed Numbers with Manipulatives

Class: Foundations of Mathematics

Grade level: High school

Objectives:

Content Objective:

SWBAT:

- Understand the concept of zero pairs.
- Identify and create zero pairs using manipulatives.
- Apply their understanding of zero pairs to represent and model addition of signed numbers.

Multilingual Objective:

- Language structures: Students will practice using academic language related to integers, such as phrases to describe "positive" and "negative" numbers, understanding "zero pairs," and techniques for "cancelling out" terms. These structures will be drawn from their full language repertoire.
- Content vocab: Students will utilize their full Language repertoire to comprehend and engage with concepts such as Zero pair, Positive number, Negative number, Addition, greater than, and less than.
- General academic vocab: Students will develop academic vocabulary skills using their Full Language Repertoire, encompassing terms like compare, represent, model, explore, and combine across languages.

Translanguaging strategies:

- Teacher/students use of full linguistic repertoire
- Partner work
- Translations for written directions.
- Cognates for content and academy vocabulary

    Combine - Combinar (Spanish), Combinar (Portuguese)

    Sum - Sumar (Spanish), Somar (Portuguese)

    Compare - Comparar (Spanish), Comparar (Portuguese)

Positive - Positivo (Spanish), Positivo (Portuguese)

Negative - Negativo (Spanish), Negativo (Portuguese)

- Directions/instruction given in multiple languages. (English, Spanish, and Portuguese)

Materials:

- Integer tiles or colored counters (positive and negative).

- Teacher-guided document with visual representations and examples.

- Who has mores? Activity sheet. *'WHO HAS MORE?' activity sheet is inspired by the CPM Educational Program's Sample Lesson: Integer Tiles – Teacher Edition.

Procedure:

1. Introduction (10 minutes):

Begin by asking students what they remember of positive and negative numbers and what applications or uses in real-world situations these terms may have.

Clarify any misconceptions and provide examples of positive and negative numbers with connection to real-life situations (e.g. temperatures, scores, money transactions, Altitude, Depths). Explain that signed numbers can represent quantities that are greater than zero, or that are less than zero.

Introduce the concept of zero pairs: Use visual examples and real-life situations that represent pairs of positive and negative integers that combine to equal zero. Write some examples on the board, such as (+3) + (-3) = 0 or (-4) + (+4) = 0.

Ask for students to think and share examples or situations where we can observe the concept of zero pairs.

Explain that zero pairs are important when adding and subtracting integers because they help us understand how positive and negative numbers interact.

2. Hands-On Exploration (10 minutes):

Distribute integer tiles to each group. Have students work in pairs or small groups to explore zero pairs using the manipulatives.

Instruct them to create different combinations of positive and negative integers that add up to zero.

Encourage students to discuss their findings and observations with their peers. Ask guiding questions to prompt their thinking, such as "What happens when you combine a positive and

negative integer?" or "Can you create multiple zero pairs using different numbers?"

3. Guided Practice (10 minutes):

Lead a guided practice session where students solve integer addition problems involving zero pairs.

Use the manipulatives to model each problem, demonstrating how to identify and cancel out zero pairs.

Provide opportunities for students to participate by asking them to identify zero pairs and explain their reasoning.

Guide students through solving a few problems together, emphasizing the importance of zero pairs in simplifying calculations.

4. Partner activity: (10 minutes)

Distribute the 'WHO HAS MORE?' activity sheet. This activity is inspired by the CPM Educational Program's Sample Lesson: Integer Tiles – Teacher Edition.

Explain Activity Instructions:

With your partner, you will engage in a hands-on activity using + and - tiles as manipulatives.

From the bag of + and – tiles, reach into the bag, grab a small handful of tiles, and place them on your desk. Make sure each person has their own bunch of + and - tiles.

On your paper, write down the combination of tiles you received.

Compare the piles of tiles with your partner. Determine whose pile has the greatest value.

Write down the value of each pile and justify your answer.

Discuss with your partner: If you took a bigger handful of tiles, would you have a better chance of having a higher value? Explain your answer.

5. Closure (5 minutes):

- Review the key concepts covered in the lesson, emphasizing the role of zero pairs in addition of signed numbers.

- Ask students to share any insights or observations they made during the exploration and practice activities.

What do you notice about adding integers?

Lesson Title: Applying the Concept of Zero Pairs and Subtraction of Signed Numbers

Class: Foundations of Mathematics

Grade level: High school.

Objectives:

Content Objective:

SWBAT:

- Understand the concept of zero pairs.

- Identify and create zero pairs using manipulatives.

- Apply their understanding of zero pairs to represent and model the subtraction of signed numbers.

Multilingual Objective:

- Language structures: Students will practice using academic language related to integers, such as phrases to describe "positive" and "negative" numbers, understanding "zero pairs," and techniques for "cancelling out" terms. These structures will be drawn from their full language repertoire.
- Content vocab: Students will grasp content-specific vocabulary encompassing terms like zero pair, positive number, negative number, subtract, take away, remove, and minus, drawing upon their linguistic capabilities.
- General academic vocab: Students will hone academic vocabulary skills by employing their complete linguistic repertoire, incorporating words like compare, represent, model, explore, and combine across various languages.

Translanguaging strategies:

- Teacher/students use of full linguistic repertoire
- Partner work
- Translations for writing directions.
- Cognates for content and academy vocabulary

    Subtract - Substraer (Spanish), Subtrair (Portuguese)

    Minus - Menos (Spanish), Menos (Portuguese)

    Difference - Diferencia (Spanish), Diferença (Portuguese)

    Compare - Comparar (Spanish), Comparar (Portuguese)

    Positive - Positivo (Spanish), Positivo (Portuguese)

Negative - Negativo (Spanish), Negativo (Portuguese)

- Directions/instruction given in multiple languages. (English, Spanish and Portuguese)

Materials:

- Integer tiles or colored counters (positive and negative).

- Teacher-guided document with visual representations and examples.

- - Who has mores? Activity sheet. *'WHO HAS MORE?' activity sheet is inspired by the CPM Educational Program's Sample Lesson: Integer Tiles – Teacher Edition.

Procedure:

Warm-up (5 minutes):

- Review the concept of zero pairs from the previous lesson.

- Distribute integer tiles to pairs of students.

- Have students practice adding some sign numbers using the manipulatives.

Introduction (10 minutes):

Review the concept of subtraction. What words represent subtraction? How can we model subtraction using manipulatives?

Guided Practice: (15 minutes)

With the use of the manipulatives start modeling the problems using “only” positive numbers. For example: 7 – 5

Repeat several examples, have students practice with different problems. Students will sketch their work on their activity sheet.

Now, include the subtraction using negative signed numbers. For example: $-8-(-3)$. Use academic vocabulary to explain the operation and its meaning: “take away”, “remove”.

Add an example and guide students to inquire how we might model the subtraction of the problem 3 – 7?

- Start with tiles to represent 3
- Then remove a group of 7. Is that possible?
- How many zeros would you need to add to the group of 3 so that you could take away ? Justify your answer

Use students' answers to guide them to use zero pairs to model subtraction problems involving signed numbers.

Show examples on the board of subtracting signed numbers using zero pairs.

Partner Practice (10 minutes):

1. In the "WHO HAS MORE?" activity sheet from the previous lesson.

2. Have students work with their partners to complete the activity, applying the concept of zero pairs to represent and model the subtraction of signed numbers.

3. Encourage students to discuss their reasoning with their partners and to check their work and verify that they have correctly identified and canceled out zero pairs, as they work through the activity.

4. Circulate around the room to provide assistance and feedback as needed.

Closure (5 minutes):

- Review key concepts covered in the lesson.

- Ask students to share any insights or challenges they encountered while applying the concept of zero pairs to subtraction.

> What can we do if we are using signed numbers that represent larger numbers and we don’t have enough manipulatives?

Assessment:

Observe students' participation in partner activities and discussions to assess their understanding of zero pairs and operations involving signed numbers.

Check students' work to assess their ability to operate with signed numbers.

Evaluate students' responses and how they explain their reasoning or justify their answers to assess their ability to apply their understanding of signed numbers.

Student Activity Sheet – Spanish Version

WHO HAS MORE? - ¿QUIÉN TIENE MÁS?

1. With a partner, get a bag. Con un compañero, obtenga una bolsa.

2. Reach into the bag, get a small handful of checkers, and put them on your desk. Each person should have his or her own bunch of checkers. Meta la mano en la bolsa, toma un pequeño puñado y ponlos en tu escritorio. Cada persona debe tener su propio manojo de fichas.

a. Draw in the table what you got. Dibuja en la tabla lo que cada uno tiene.

Student 1:	Student 2:

b. Whose pile has the greatest value? Write the value of each pile to justify your answer. ¿Quién tiene el mayor valor? Escribe el valor de cada pila para justificar tu respuesta.

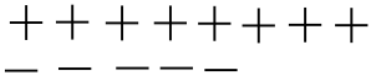
c. If you took a bigger handful of tiles, would you have a better chance of having a higher value? Discuss this with your partner and decide why or why not. Si tomaras un puñado más grande de piezas, ¿tendrías una mejor oportunidad de tener un valor más alto? Discuta esto con su pareja y decida por qué si o por qué no.

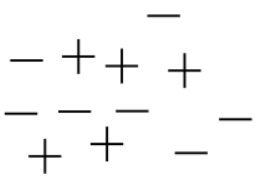
d. What happens to a positive number when you add a negative number to it? How does this affect the result?¿Qué le sucede a un número positivo cuando le agregas un número negativo? ¿Cómo afecta esto al resultado?

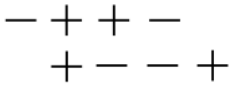
e. When adding negative numbers, can you think of any rules or patterns that make it easier to understand?Al sumar números negativos, ¿puedes pensar en alguna regla o patrón que lo haga más fácil de entender?

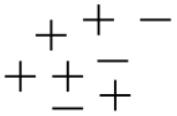
f. Can you show an example of adding a negative number that results in a positive sum? What does this mean? ¿Puedes mostrar un ejemplo de sumar un número negativo que da como resultado una suma positiva? ¿Qué significa esto?

What is the value of each collection of tiles?

a. 

b. 

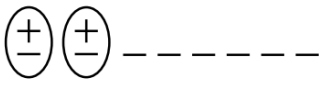
c. 

d. 

MODELING ADDITION / Modelando la suma

Addition means to combine, put together, or calculate the sum or total.

For each expression below: First, Build each expression with + and – tiles.

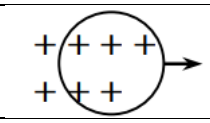
Solve	Sketch it	Write the solution as an equation.
a. $-8 + 2$		$-8 + 2 = -6$.
b. $-5 + (-3)$		

c. $2 + (-4)$		
d. $-7 + (-7)$		
e. $-4 + 3$		
f. $-4 + 8 + (-2)$		
g. $-3 + 5 + 3$		
h. $-6 + 6$		

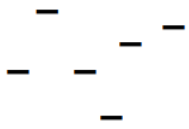
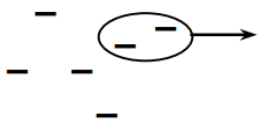
What do you notice about adding integers? - ¿Qué notas acerca de la suma de números enteros?

SUBTRACTION

what does it mean to subtract? To find the difference, take away, minus…

Solve	Sketch it/ Draw it	Write the solution as an equation.
a. 7 – 5		7 – 5 = 2
b. 8 – 4		
c. 10 – 3		

In each part labeled (a) through (c) below, either the picture or number sentence is given. Work with your team to build it, draw it and then write it. Be sure to calculate the final value.

a. Start with:  Then: 

b. −8 − (−3) =

c. −3− (−2) =

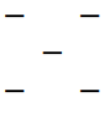
How might you model the subtraction problem 5 – 8? ¿Cómo podrías modelar el problema de la resta 5 – 8?

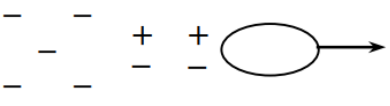
a. Start with tiles to represent 5. Comience con fichas para representar 5.

b. Then remove a group of 8 – is that possible? Luego elimine un grupo de 8, ¿es posible?

c. How many zeros would you need to add to the group of 5 so that you could take away 8? Justify your answer ¿Cuántos ceros necesitaría agregar al grupo de 5 para poder quitar 8? Justifica tu respuesta

In each part labeled (a) through (c) below, either the picture or number sentence is given. Work with your team to build it, draw it and then write it. Be sure to calculate the final value.

a. Start with: 

Add enough zeros so you can remove 2 positives: 

b. 3− (−3) =

c. 0 − 5 =

For each of the expressions below: • Build an assortment of tiles that represents the first integer. • Explain how to subtract using words. • Draw the process on your paper. • Record the expression and result as a number sentence.
Para cada una de las expresiones siguientes: • Cree una variedad de mosaicos que represente el primer entero. • Explicar cómo restar usando palabras. • Dibuja el proceso en tu papel. • Registre la expresión y el resultado como una oración numérica.

Solve	Sketch it/Draw it	Write the solution as an equation.
–8 – (–2)		
−6 – 2		
–3 – 4		
0 – 4		
–2 –(–5)		

1 – (–1)		
−1− (−9)		

Student Activity Sheet – Portuguese Version

WHO HAS MORE? QUEM TEM MAIS?

With a partner, get a bag of + and – tiles from your teacher. Com um parceiro, ganhe uma bolsa de + e – do seu professor.
Reach into the bag, get a small handful, and put them on your desk. Each person should have his or her own bunch of + and – tiles. Entre na bolsa, pegue um pequeno punhado e coloque-os em sua mesa. Cada pessoa deve ter seu próprio grupo de + e - telhas.

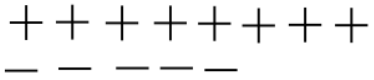
1. Write what you got on your paper. Anote quem tem mais na sua função.

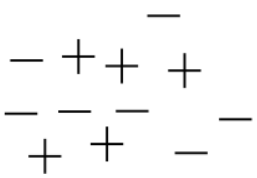
Student 1	Student 2

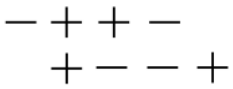
g. Whose pile has the greatest value? Write the value of each pile to justify your answer. Qual pilha tem mais valor? Insira o valor de cada pilha para justificar sua resposta.

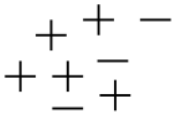
h. If you took a bigger handful of tiles, would you have a better chance of having a higher value? Discuss this with your partner and decide why or why not. Se você pegasse um punhado maior de peças, teria mais chances de ter um valor maior? Discuta isso com seu parceiro e decida por que ou por que não.

What is the value of each collection of tiles?

a. 

b. 

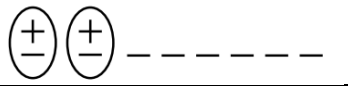
c. 

d. 

MODELING ADDITION- ADIÇÃO DE MODELAGEM

Addition means to combine, put together, or calculate the sum or total.

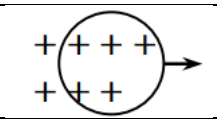
For each expression below: First, Build each expression with + and – tiles.

Solve	Sketch it	Write the solution as an equation.
i. $-8 + 2$		$-8 + 2 = -6$.
j. $-5 + (-3)$		
k. $2 + (-4)$		
l. $-7 + (-7)$		
m. $-4 + 3$		
n. $-4 + 8 + (-2)$		
o. $-3 + 5 + 3$		
p. $-6 + 6$		

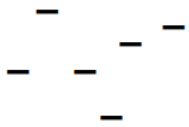
What do you notice about adding integers? - O que você percebe sobre a soma de inteiros?

SUBTRACTION

What does it mean to subtract? To find the difference, take away, minus…

Solve	Sketch it/ Draw it	Write the solution as an equation.
d. 7 – 5		7 – 5 = 2
e. 8 – 4		
f. 10 – 3		

In each part labeled (a) through (c) below, either the picture or number sentence is given. Work with your team to build it, draw it and then write it. Be sure to calculate the final value.

a. Start with:  Then: 

b. −8 − (−3) =

c. −3− (−2) =

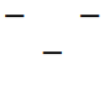
How might you model the subtraction problem 5 – 8? Como você poderia modelar o problema de subtração 5 – 8?

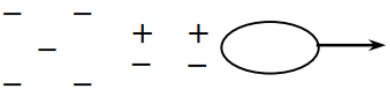
1. Start with tiles to represent 5. Comece com blocos para representar 5.

1. Then remove a group of 8 – is that possible? Então exclua um grupo de 8, é possível?

d. How many zeros would you need to add to the group of 5 so that you could take away 8? Justify your answer. Quantos zeros eu precisaria adicionar ao grupo de 5 para remover 8? Justifique sua resposta

In each part labeled (a) through (c) below, either the picture or number sentence is given. Work with your team to build it, draw it and then write it. Be sure to calculate the final value.

a. Start with: 

Add enough zeros so you can remove 2 positives: 

b. 3− (−3) =

c. 0 − 5 =

For each of the expressions below: • Build an assortment of tiles that represents the first integer. • Explain how to subtract using words. • Draw the process on your paper. • Record the expression and result as a number sentence.
Para cada uma das seguintes expressões: • Crie uma variedade de blocos que representam o primeiro inteiro. • Explique como subtrair usando palavras. • Desenhe o processo em seu papel. • Registre a expressão e o resultado como uma sentença numérica.

Solve	Sketch it/Draw it	Write the solution as an equation.
–8 – (–2)		
−6 – 2		
–3 – 4		
0 – 4		
–2 –(–5)		
1 – (–1)		
−1− (−9)		

APPENDIX D - Table of Frequencies by Intended Purpose and "Named Language"

Codes of Occurrences in Spanish (From Transcripts)	**Codes of Occurrences in English (From Transcripts)**	**Codes of Occurrences in Hybrid Language (Spanish to English) (From Transcripts)**	**Codes Occurrences in Hybrid Language (English to Spanish) (From Transcripts)**
1) Teacher introduces the mathematical topic. (Occurs once each lesson.)	1) Teacher asks. (Occurs 14 times.)	1) Teacher activates background knowledge. (Occurs once.)	1) Teacher translates to Spanish. (Occurs eight times.)
2) Teacher sets expectations for the class. (Occurs once each lesson.)	2) Teacher praises. (Occurs eight times.)	2) Teacher translates to English. (Occurs 12 times.)	2) Teacher refers to a number. (Occurs twice.)
3) Teacher asks. (Occurs 135 times.)	3) Teacher counts. (Occurs 25 times.)	3) Teacher refers to a number. (Occurs eight times.)	
4) Teacher activates background knowledge. (Occurs eleven times.)	4) Teacher greets students. (Occurs once each lesson.)	4) Teacher restates the problem. (Occurs three times.)	
5) Teacher asks a higher order mathematical question. (Occurs fifteen times.)	5) Teacher reaffirms what student said. (Occurs seven times.)	5) Student greets classmates. (Occurs once.)	
6) Teacher counts. (Occurs six times.)	6) Teacher explains. (Occurs 17 times.)		
7) Teacher gives instructions. (Occurs 23 times.)	7) Teacher restates a mathematical problem. (Occurs four times.)		
8) Teacher praises.	8) Student interruption.		

(Occurs 11 times)	(Occurs once.)		
9) Teacher redirects. (Occurs three times.)	9) Student answers. (Occurs 27 times.)		
10) Teacher reaffirms what student said. (Occurs 18 times.)	10) Teacher asks a higher order mathematical question. (Occurs three times.)		
11) Teacher explains. (Occurs 86 times.)	11) Student interjects. (Occurs once.)		
12) Teacher restates a mathematica l problem. (Occurs three times.)			
13) Student activates background knowledge. (Occurs once.)			
14) Student makes connection. (Occurs nine.)			
15) Student reads instructions. (Occurs twice.)			
16) Student realizes mistake. (Occurs once.)			
17) Student interjects.			

(Occurs once.)			
18) Student answers a higher order mathematical question. (Occurs three times.)			
19) Student answers. (Occurs 145 times.)			
20) Student asks question. (Occurs seven times.)			
21) Student shares a real-life application of mathematical concept. (Occurs once.)			
22) Student expresses lack of understanding. (Occurs once.)			
23) Student explains the connection to the concept. (Occurs once.)			

APPENDIX E - Codebook of Student Interviews

Some codes appearing only once or a few times in the data were included because they are unique and provide valuable insight despite their low frequency.

Theme	***Category***	***Code***	***Frequency***
Comfort and Perceived Benefits	Positive Attitudes	Positive Attitudes Towards Multilingualism	6
		Perception of Improved Understanding	7
		Recognition of Enhanced Language Skills	1
Language Support and Understanding	Facilitated Understanding	Facilitated Understanding Through Bilingual Instruction	9
		Appreciation for Instructions Using Full Linguistic Repertoire	1
		Desire for Accessible Language Support	2
Preference for Mixed-Language Instruction	Preference for Bilingual Instruction	Preference for Bilingual Instructional Approach	4
		Recognition of Learning Benefits from Mixed-Language Instruction	4
		Appreciation for Learning Mathematical Concepts in Both	3

		Languages	
Challenges with Pronunciation and Expression	Pronunciation Difficulties	Challenges with Pronunciation of English Words	4
		Confidence Issues in Expressing Ideas in English	3
		Need for Language Support to Overcome Challenges	4
Strategies for Understanding	Language Translation	Language Translation as a Strategy	8
	Mixing Languages	Mixing Languages to Aid Comprehension	6
	Breaking Down Words	Breaking Down Words for Better Understanding	2
Impact on Participation and Confidence	Increased Participation	Increased Participation Due to Language Support	3
	Boosted Confidence	Boosted Confidence in Classroom Participation	2
	Supportive Learning Environment	Perception of Supportive Learning Environment Through Multilingual Instruction	6