Journal of Research in Applied Linguistics
ISSN: 2345-3303 – E-ISSN: 2588-3887 – https://rals.scu.ac.ir
Published by Shahid Chamran University of Ahvaz

Please cite this paper as follows:

Chang, S. J., Bui, K., & Harman, R. (2025). Culturally sustaining sfl praxis in mathematics: Supporting newly arrived multilingual learners in high school classrooms. *Journal of Research in Applied Linguistics*, *16*(2), 27-43. https://doi.org/10.22055/rals.2025.49825.3631

Shahid Chamran University of Ahvaz

Research Article

Culturally Sustaining SFL Praxis in Mathematics: Supporting Newly Arrived Multilingual Learners in High School Classrooms

Seon Ja Chang[1], Khanh Bui[2], & Ruth Harman[3]

[1]Corresponding author, Department of Language and Literacy Education, University of Georgia, Athens, GA, USA; *seonja.chang@uga.edu*

[2]Clarke County School District, ESOL Educator, Athens, GA, USA; *khanhbui1a06@gmail.com*

[3]Department of Language and Literacy Education, Professor, University of Georgia, Athens, GA, USA; *harmanruth@gmail.com*

Received: 18/08/2025 Accepted: 06/10/2025

Abstract

The Common Core State Standards for Mathematics and the National Council of Teachers of Mathematics call for simultaneous development of disciplinary understanding and literacy that prepares students to apply their knowledge to real-world contexts. This focus, however, presents both opportunities and challenges for teachers working with newly arrived multilingual learners (NMLs) in mathematics classrooms. In response, this theoretical study explores key tenets of our Culturally Sustaining Systemic Functional Linguistics Praxis in mathematics (CS SFL; Harman & Burke, 2020). These tenets include: (1) implementing an embodied 3M (multilingual, multimodal, and multicultural) Teaching and Learning Cycle; (2) engaging in recursive weaving between conceptual and procedural mathematical understanding; and (3) reimagining mathematics learning through translanguaging and cultural conversations. We illustrate our approach by discussing the curriculum design and implementation of foundations of algebra classroom at a newly established space for high school NMLs in the southeastern United States, highlighting both its strengths and challenges.

Keywords: Bilingual Education; Culturally Sustaining Systemic Functional Linguistics; Mathematics Education; Newly-Arrived Multilingual Youth.

1. Introduction

Due to political conflict, climate change, and other life-threatening challenges, there has been a significant increase in the number of multilingual youth entering the United States at secondary school level (Oikonomidoy et al., 2019; Patel et al., 2023; Sugarman, 2023). While the newly arrived multilingual learners (NMLs) bring rich cultural and linguistic resources to classroom discourse, they often face challenges as they need to simultaneously engage with disciplinary knowledge and language (de Oliveira & Westerlund, 2022; Kim et al., 2024). STEM classrooms, in particular, present difficult hurdles, especially for high school NMLs, due to the complexity of the disciplinary discourse and its dense text structures (Aguirre-Muñoz et al., 2024; Lee & Stephens, 2020).

The Common Core State Standards for Mathematics (CCSS-M) and the Next Generation Science Standards (NGSS)[1], now adopted or adapted by the majority of U.S. states, not only outline what knowledge students should learn but also emphasize the disciplinary practices they should embody as emergent scientists and mathematicians (Allensworth et al., 2022). These standards encourage students to engage in creative and critical thinking that can be applied to real-life contexts. While these new ways of learning offer important affordances for multilingual learners (Zygouris-Coe, 2012), they also present challenges—particularly when teachers are not adequately prepared to support NMLs in integrating disciplinary language and literacy in STEM (Ángeles, 2025).

To address these 21st century demands, we developed a CS SFL-informed framework for science instruction aligned with the new vision of the NGSS (Harman et al., 2020), informed by systemic functional linguistics (Halliday, 1978) and culturally sustaining pedagogies (CSP; Paris, 2012; Paris & Alim, 2017). Through this collaborative project

with and *for* secondary science teachers and multilingual learners, we recognized the importance of integrating knowledge development, language development, and cultural sustenance in science classrooms. For example, the culturally sustaining approaches used during our *Steps to College* through science multilingual family workshops benefitted all participants in different ways. Students were often pushed by family members to engage in science investigations in their home languages, while also experiencing cultural connections to school science topics; teachers in the project could experience and take part in CSP practices such as translanguaging and application to real life issues that are often missing from classroom discourse.

In our more recent work, we have been working in an algebra classroom at GROW[2], a center for high school[3] NMLs in the southeastern United States. To support teachers and learners in this context, we have adapted our CS SFL praxis to include a unique register and distinct discursive practices in mathematics (Halliday, 1978). Importantly, in terms of equity and access, research has shown that foundational understanding of algebra functions as a gatekeeper for multilingual learners (Blanchard & Muller, 2015; Moses, 1982). Specifically, studies have indicated that students who successfully complete algebra courses tend to perform better on mathematics proficiency assessments (e.g., U.S. Department of Education, Institute of Education Sciences, & Regional Educational Laboratory Appalachia, 2021), develop a stronger grasp of advanced mathematical concepts, and are more likely to enroll in higher-level math courses during high school (e.g., Walters & Nucci, 2025), thereby enhancing these students' future career opportunities.

Given these considerations, this study aims to illustrate our CS SFL-informed pedagogical design (Harman & Burke, 2020; Harman & Khote, 2018) by drawing on the work of two multilingual educators: the first author, Seon Ja Chang, and the second author, Khanh Bui, in the GROW algebra classroom. As an inquiry grounded in reflective practice, the study incorporates reflections by Chang and Bui following each class, along with subsequent discussions involving the third author, Ruth Harman, the process of which will be explained in more detail throughout this paper.

Because we developed our praxis by drawing on recent literature in mathematics instruction, we first provide a brief literature review of classroom strategies in mathematics that have been used to optimize teaching and learning for multilingual learners. This literature supported us in developing the conceptual tenets of our CS SFL approach in mathematics with an emphasis on three intersecting areas: language development, knowledge development, and cultural sustenance (Harman et al., 2020). Building on this discussion, we provide readers with an explanation of the core tenets of CS SFL in mathematics. We then illustrate how our CS SFL praxis was enacted in a mathematics classroom for NMLs and discuss the perceived strengths and challenges of our curriculum design and implementation.

2. Literature Review

2.1. Embodied Multimodal Meaning-Making in Mathematics Education for Multilingual Learners

Research has shown that in multilingual and multicultural mathematics classrooms, teachers need to be attentive to the diverse semiotic resources available to support student learning. Relying solely on spoken or written language can hinder multilingual learners' ability to express mathematical understanding, as they may not be fully proficient in the language of instruction (Adler & Sfard, 2016; Poza, 2018). When students are unable to articulate their thinking due to language barriers, they may refrain from sharing or developing their ideas. To address this, Adler and Sfard (2016) advocate for the integration of multiple modes beyond language when teaching topics like linear functions, enabling multilingual students to communicate more effectively and deepen their grasp of mathematical concepts.

Expanding on this multimodal approach, research has indicated that students engaged more deeply with problem-solving when their communication included speech, gestures, gaze, and other actions (e.g., Bui & Harman, 2019; Evans et al., 2011). Kress and van Leeuwen (2020) similarly emphasized that meaning-making in classrooms should involve a full range of semiotic modes—such as visual, spoken, gestural, written, and even three-dimensional forms—tailored to the context and domain of learning. Incorporating these diverse modes can support students in articulating and internalizing their understanding more effectively.

While previous research has often treated nonlinguistic tools like gestures and visuals as supplementary cognitive aids (Arzarello et al., 2009; Chen & Herbst, 2013), this study proposes recognizing them as essential meaning-making resources and strategically implementing a diverse range of semiotic resources to support NMLs in mathematics. The

following section examines literature on how algebra has been taught and the instructional emphases that have guided these approaches.

2.2. Teaching Algebra Functionally Through Conceptual–Procedural Integration

Algebra has traditionally been taught through decontextualized approaches (Sharpe et al., 2024), emphasizing symbolic manipulation and procedural knowledge (e.g., simplifying expressions). However, these methods can pose additional challenges for multilingual students beyond language itself, as they often limit opportunities to engage meaningfully with mathematical concepts. In response, scholars have advocated for a functional approach to algebra, in which students engage with multiple representations, such as graphs, equations, and tables, to make sense of mathematical relationships within real-world contexts (e.g., Bui, 2023; Shin et al., 2023). For instance, in a ninth-grade coordinate algebra class for multilingual students, Bui (2023) found that the functional approach supported authentic learning experiences by deepening students' conceptual understanding while also promoting procedural fluency. Accordingly, our CS SFL in mathematics framework aligns with this functional approach to teaching algebra. In addition, we explicitly integrated multilingual and multicultural elements into our classroom, which we explore through related literature in the next section.

2.3. Translanguaging and Cultural Conversations in Mathematics Education for Multilingual Learners

Both the CCSS-M and NCTM stress the importance of thinking mathematically, engaging in mathematical discourse, and demonstrating understanding through extended oral, written, and multimodal texts, all of which require rich, contextualized language use. These demands often pose challenges for multilingual students with emerging English proficiency, such as NMLs (Esquinca, 2012; Zahner et al., 2024). In response, a growing body of research has recognized translanguaging as a meaningful pedagogical approach in mathematics classrooms for NMLs (e.g., Ángeles, 2025; de Araujo et al., 2018; Di Sarno-García & Gimeno-Sanz, 2025; Krause, 2023). For instance, in a study conducted in a U.S. elementary classroom, Krause (2023) examined how NMLs engaged with mathematical word problems through intentional and sustained translanguaging practices. The findings demonstrated that translanguaging supported students in making sense of mathematical tasks, articulating their reasoning, and participating meaningfully in classroom discourse by actively drawing on their full linguistic repertoires.

Moreover, a common misconception among educators is that mathematics is a universal language with the same system of numbers and mathematical symbols used across countries (de Araujo et al., 2018; Farsani et al., 2022). However, this belief overlooks the culturally and linguistically situated nature of mathematical learning. For example, Moschkovich (2015) noted that multilingual learners often struggled to understand word problems when the cultural context was unfamiliar, leading them to rely heavily on teacher support. To address this issue, scholars have argued for integrating multilingual students' funds of knowledge into mathematics instruction that engage students in cultural conversations and recognize their lived experiences. Along these lines, Nasir et al. (2008) emphasized that cultural awareness is especially important in mathematics instruction precisely because it is often perceived as a universal and culture-free subject. Similarly, White et al. (2016) argued that pre-service teachers need to understand the relationship between language and culture and how both are embedded in mathematics education.

Informed by this body of research, we situate our CS SFL framework for mathematics within a continuum of efforts toward more equitable and inclusive mathematics education, framing it around three core tenets that we discuss in the following section.

3. Culturally Sustaining SFL Praxis in Mathematics (CS SFL in Mathematics)

In this paper, we draw primarily on the theory of social semiotics, as informed by Systemic Functional Linguistics (SFL), to explore the disciplinary discourse of mathematics and its dynamic practices (Halliday & Martin, 2003; Halliday & Matthiessen, 2014), aligned with the frameworks of the CCSS-M and the NCTM. This perspective emphasizes the importance of explicitly teaching the genres and linguistic features of mathematical registers as an integral part of mathematics instruction for multilingual learners (e.g., Huang et al., 2005; Schleppegrell, 2007). Specifically, the discourses of mathematics include genres such as explanation, justification, and generalization, as well as registers that include technical terms, symbolic representations integrated with written language, and complex grammatical structures like nominalization, relational clauses, and dense noun phrases (Martin, 1992; Schleppegrell, 2007). In a mathematics

classroom with NMLs, explicit attention to these genres and registers can makes mathematical reasoning more visible and accessible, thereby supporting students in engaging with mathematical concepts, communicating their understanding, and participating more fully in disciplinary practices.

In addition, our research and professional development initiatives are informed by CSP (Paris 2012; Paris & Alim, 2017), an approach that not only affirms but also actively sustains and nurtures the linguistic and cultural practices students bring to school, positioning these as valuable assets for learning. In the case of NMLs, for example, we view their experience of language brokering in their communities (e.g., translating, representing, negotiating) as providing them with sophisticated cognitive strategies for co-construction of mathematic knowledge in school contexts (Garcia, 2009).

Building on these SFL and CSP theoretical foundations (e.g., Harman & Burke, 2020; Harman & Khote, 2018), and drawing on our ongoing work in K–12 and teacher education, three principles inform our CS SFL approach to mathematics instruction: (1) implementing an embodied 3M (multilingual, multimodal, and multicultural) Teaching and Learning Cycle; (2) engaging in recursive weaving between conceptual and procedural mathematical understanding; and (3) reimagining mathematics learning through translanguaging and cultural conversations. As illustrated in the outermost circle of Figure 1, these three principles are anchored in an understanding of the dynamic interplay between culture, language, and knowledge (Harman et al., 2020). Furthermore, the white dotted lines indicate that these tenets are enacted fluidly, without rigid or fixed boundaries between them.

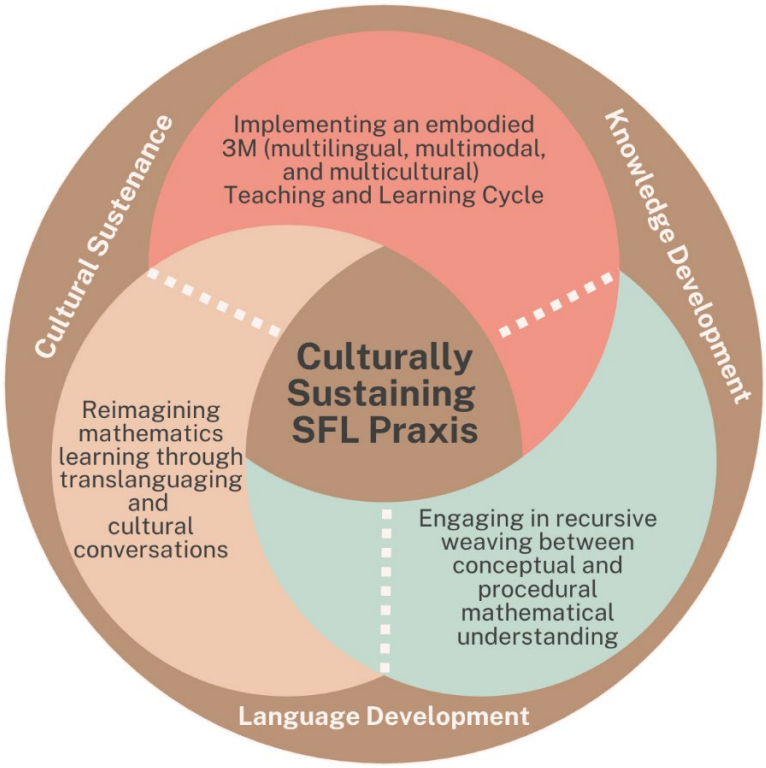


Figure 1. Culturally Sustaining SFL in Mathematics

As elaborated in the sections that follow, we propose three tenets of CS SFL in mathematics that align with the visions of the CCSS-M and NCTM, offering educators practical insights for supporting NMLs in their own classrooms.

3.1. Implementing an Embodied 3M (Multilingual, Multimodal, and Multicultural) Teaching and Learning Cycle

O'Halloran (2007) asserted that "the study of linguistic discourse alone has theoretical limitations which have the potential to simplify and distort the actual nature of pedagogical practice" (p. 79). This remark emphasizes the importance of attending to the multimodal nature of pedagogical practices in the teaching of disciplinary knowledge to multilingual learners (Bui, 2023). In response, we argue that mathematics discourse should draw on multimodal resources,

while also incorporating multilingual and multicultural dimensions. Building on this understanding, and reinterpreting an SFL-informed embodied Teaching and Learning Cycle (TLC) (Siffrinn & Harman, 2019), we propose the 3M TLC (multilingual, multicultural, and multimodal; see Figure 2) as a carefully staged process designed to support NMLs in developing mathematical genre and register awareness.

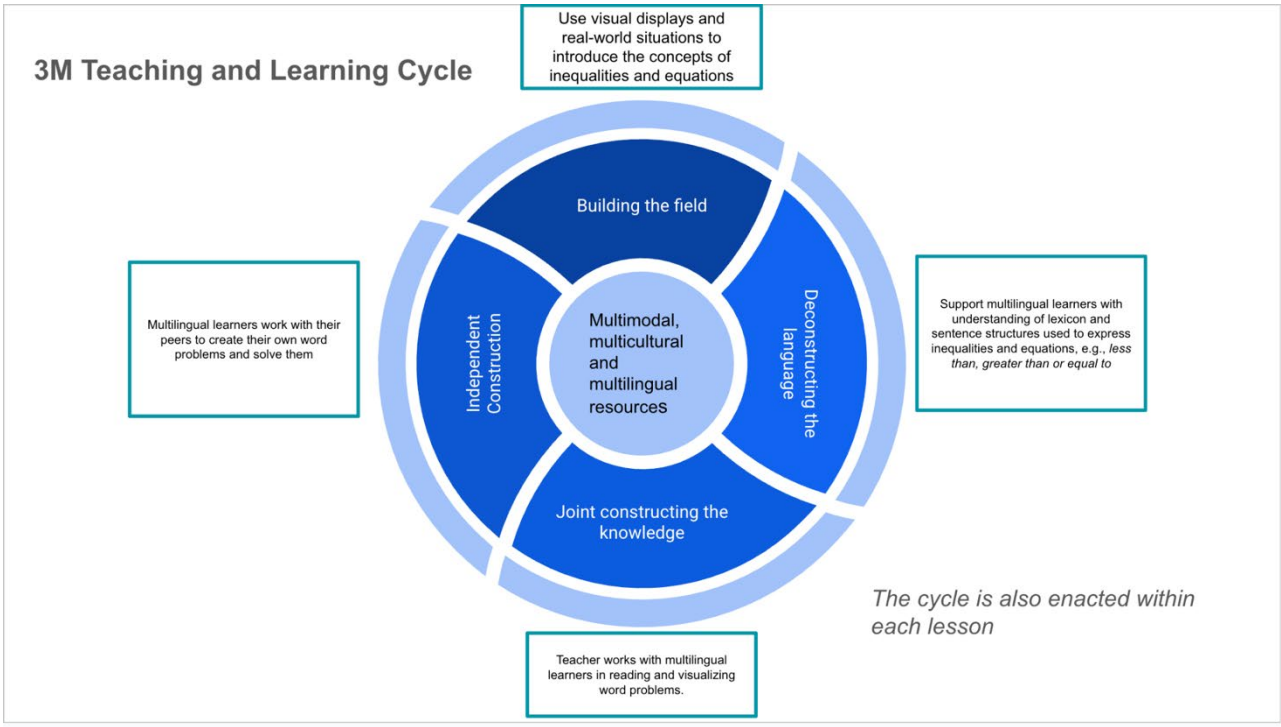


Figure 2. 3M Teaching and Learning Cycle

As illustrated in Figure 2, the 3M TLC begins with field-building activities that use embodied, multimodal resources and real-life scenarios to introduce key mathematical concepts. In the next phase, deconstruction of language, educators guide students in developing genre and register awareness by explicitly unpacking the lexico-grammatical features of mathematical discourse related to key concepts. This is followed by the joint construction phase, where educators and students collaboratively solve mathematical problems, with the teacher modeling the application of disciplinary language. Finally, in the independent construction phase, students apply their understanding by creating and solving mathematical problems. These phases unfold recursively, not only over the course of the semester but also within each module and lesson, providing students with multiple entry points for engagement and understanding.

3.2. Engaging in Recursive Weaving Between Conceptual and Procedural Mathematical Understanding

The CCSS-M emphasizes not only the development of conceptual understanding but also the application of mathematical knowledge to real-world and societal contexts, using tools such as equations, graphs, visual representations, and the communication of reasoning through language and multimodal literacy (CCSSO, 2010). Similarly, the NCTM highlights the importance of connecting algebra to other mathematical domains, students' prior knowledge, and everyday contexts (NCTM, 2014). These practices promote an integration of procedural fluency[4] and conceptual understanding, which are often bi-directional and iterative (Rittle-Johnson & Schneider, 2014). Aligned with these principles, our CS SFL approach intentionally and recursively embeds mathematics content within real-life contexts, fostering continuous transformation between conceptual understanding and procedural fluency. We propose that this dynamic interplay between mathematical discourse and everyday practices can support NMLs in navigating and deepening their understanding of mathematics through iterative movement between conceptual reasoning and procedural application.

3.3. Reimagining Mathematics Learning Through Translanguaging and Cultural Conversations

Another key priority of both the CCSS-M and the NCTM lies in their focus on mathematical practices such as reasoning abstractly, recognizing structure, and making sense of problems (CCSSO, 2010; NCTM, 2014). These goals

go beyond mere computation to promote conceptual reasoning and deeper mathematical understanding. However, engaging in such forms of mathematical discourse can be challenging for NMLs, whose language proficiency is still emerging and developing (King & Powell, 2023; Moschkovich & Scott, 2021). In alignment with Buxton et al. (2022), we view *translanguaging* (García & Wei, 2015), the use of students' full repertoires of meaning-making resources, as a vital component of CS SFL in mathematics classrooms. Particularly, we believe that remixing NMLs' linguistic and cultural repertoires through translanguaging can provide crucial scaffolding to support their ability to explain reasoning, construct arguments, and communicate mathematical ideas. Importantly, translanguaging involves more than incorporating students' home languages; it also entails affirming their cultural knowledge by inviting them into rich cultural conversations that deepen mathematical understanding.

In sum, we propose that a CS SFL approach to mathematics can provide meaningful support for educators working with NMLs by offering a carefully staged 3M process—multilingual, multimodal, and multicultural—that incorporates translanguaging alongside cultural conversations. This approach not only supports students in developing mathematical discourse, but also fosters the integration of conceptual understanding and procedural fluency. Building on this framework, the next section details our study and the context in which it was conducted.

4. Methodology

Our CS SFL praxis in mathematics project is both a pedagogical research and professional development initiative that draws on multiple data sources to explore effective approaches for teaching and learning mathematics with NMLs. This study, part of a broader research and development effort, was conducted at a center for NMLs called GROW, located in a southeastern U.S. school district. Since 2000, the state where GROW is housed has been experiencing rapidly shifting demographics due to increased immigration from countries in Central and South America (U.S. Census Bureau, 2019; Yrigollen-Robbins, 2024). In response to the linguistic and academic needs of NMLs, ongoing collaborative efforts among university researchers, district leaders, and classroom teachers have emerged in the region (e.g., Harman et al., 2025), within which our project is situated.

This particular study focuses on our work in a mathematics classroom at GROW, where Bui, a lead teacher and researcher, teaches the foundations of algebra to high school NMLs. We concentrated on one class of 11 students, most of whom had arrived in the U.S. less than a year prior and speak Spanish as their home language. Chang, a co-teacher and researcher, was present in Bui's classroom throughout the Fall 2024 semester. Instructional support was also provided by Ana Lopez, a bilingual paraprofessional and former secondary mathematics teacher from a Central American country. Additional team members included James Smith, the GROW coordinator, and Harman, a university-based researcher.

Aligned with CCSS-M and NCTM standards, Chang and Bui co-developed and implemented the CS SFL-informed curriculum for the foundations of algebra lessons. Drawing on the principles of our framework, the curriculum employed a functional approach to teaching algebra by integrating key domains outlined by CCSS-M, such as *Seeing Structure in Expressions*, *Creating Equations*, *Reasoning with Equations and Inequalities*, and *Rational Expressions*. We also incorporated O'Halloran's (2005, 2008) three modes—verbal, symbolic, and visual—of mathematical meaning-making into the recursive processes of the 3M TLC within real-world contexts, supporting both conceptual and procedural understanding as recommended by both standards. Throughout all phases of the 3M TLC, translanguaging and cultural conversations were intentionally woven in to scaffold students' development of disciplinary language and deepen mathematical understanding.

As a reflective inquiry (Finlay, 2008), we illustrate key aspects of our implemented CS SFL praxis by drawing on audio-recorded reflections from Chang and Bui after each lesson, as well as written reflective notes throughout the semester. These reflections were synthesized in subsequent meetings with Harman. The reflections were complemented by multiple data sources, including lesson plans, student work samples, classroom materials, field notes from classroom observations conducted by Chang during the Fall 2024 semester, and video and audio recordings of 12 consecutive 90-minute teaching sessions focused on one module addressing equations and inequalities.

In the following sections, we demonstrate our enacted CS SFL praxis through a specific module on equations and inequalities, including perceived strengths and challenges. We also highlight how our approach unfolded in practice and was experienced by both educators and learners.

5. CS SFL Praxis in Action in a GROW Mathematics Classroom

5.1. Implementing an Embodied 3M (Multilingual, Multimodal, and Multicultural) Teaching and Learning Cycle

Given that a key area of focus in our CS SFL praxis is to develop NMLs' awareness of mathematical genres and registers through the explicit teaching of disciplinary discourses, we purposefully integrated and sustained linguistic, cultural and multimodal resources within a carefully staged approach, 3M TLC. We see that the 3M TLC functioned as "a way of using the multi semiotic nature of mathematics to help students draw on the different meaning-making modes for understanding" (Schleppegrell, 2007, p. 148), thereby enhancing the learning experience (Jodairi Pineh, 2022). In the following sections, we illustrate each phase of the 3M TLC as implemented in the module on equations and inequalities.

5.1.1. Building the Field

One challenge noticed in our earlier CS SFL work in science (Harman et al., 2020) was that students often struggled to shift from every day, concrete language to the abstract and dense language characteristic of disciplinary genres. In response, we intentionally designed a progression within the 3M TLC that scaffolds the transition from everyday language to genre-specific mathematical discourse from the outset of the cycle. In particular, as shown in Table 1, we began the first phase of the 3M TLC by presenting students with pictures of a seesaw in a park and a scale with balls (see Figure 3) to introduce students to the new disciplinary concept of *equality* and *inequality*. These visual resources were accompanied by other multimodal supports, such as the teacher's gestures and heightened intonation. This contextualized language was then gradually transitioned into mathematical discourse, including references to geometric shapes, algebraic expressions, and terms such as *equation* and *solution*. Throughout this phase, students also engaged in oral repetition of the disciplinary sentence, such as "The solution to this equation is...," which was designed not only to foster genre and register awareness, but also to introduce the relational process characteristic of mathematical discourse. In our reflective sessions, we discussed how this approach not only laid a firm foundation for a conceptual understanding, but also supported the diverse learning styles of our students, encouraged active participation, and prepared them to move confidently into the next phase.

Table 1. *Excerpt from Classroom Observation (Videorecording, 10/24/24)*

Dr. Bui: Look at this, everyone (showing a picture of a seesaw in a park). When you go to a park, you might see something like this. And now, look at this (pointing to a picture of a scale with three poles on one side and one on the other, then holding his arm horizontally.) Are they **equal**?
Students: No!
Dr. Bui: That's right. they're **not equal**. How about this one? (pointing to a picture of a scale with one ball on each side.) Are they **equal**?
Jose: Yes, because it's even.
Dr. Bui: Yes, it's even, so they are **equal** (making an equal sign, =, with his two arms). So, "equal" means that you have the same amount on each side.
(After several rounds of student practice, Dr. Bui changes the image on the screen to a scale with geometric shapes, triangles and trapezoids. As he writes numbers in each trapezoid, he asks each student the same question: "Are they equal?")
Dr. Bui: Now, a little bit more, everyone (he writes 5 and 10 on the left side of the geometric scale, and 7 and x on the right side). How many do I have to have here (pointing "x") to make this equal?
Jose and Lucia: Eight!
Dr. Bui: Right, ¡excelente! The variable x must be 8 to make it **equal** (gesturing an equal sign with both hands). Now, I write this as an **equation** (writes $5 + 10 = 7 + x$ on the board and reads it aloud). So, I call number 8 a **solution** (writing "solution" on the board) **to this equation** (pointing to the equation written on the board). Now, everyone, say the word "**solution**." (Students repeat). Let's say the whole sentence together: "**The solution to this equation is eight**." (Writes the sentence on the board as students repeat.)
* Words in bold indicate those spoken with marked or heightened intonation.

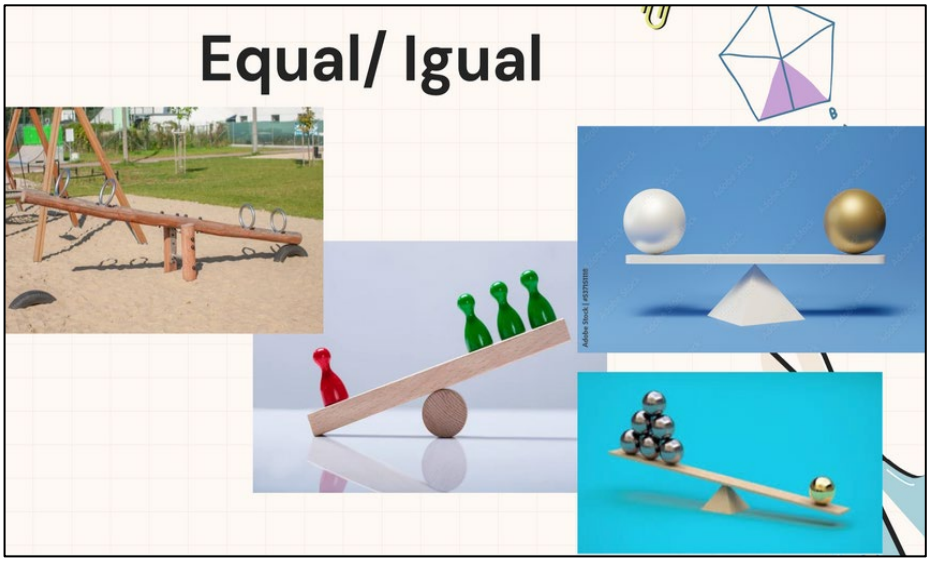


Figure 3. Slide on the Concept of "Equal"

5.1.2. Deconstructing the Language

After building the field of knowledge on equations and inequalities, we explicitly directed students' attention to the lexico-grammatical features of key concepts using a specially designed resource, *My Math Dictionary* (see Figure 4). As shown, we presented key concepts in both English and Spanish with corresponding verbal definitions, visual representations, and symbolic representations that illustrate how to express the numerical symbols as participants in grammatical structures with relational processes. This aligns with the CS SFL in mathematics approach by incorporating O'Halloran's (2005, 2008) three modes of mathematical meaning-making—verbal, symbolic, and visual—demonstrating how each semiotic mode differs and connects with each other to make meanings. In doing so, it supported students' understanding of how disciplinary language functions to convey abstract mathematical concepts. We also view this moment as demonstrating the potential for the concurrent development of disciplinary literacy and mathematical understanding in mathematics instruction for NMLs.

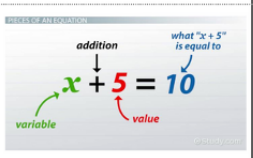
English	Español	Visual Representation	Example
equal	igual	$(3\times4)+2$ 2×7 $(3\times4)+2=2\times7$	5 +2 = 7 Five plus two **equals** seven. Five plus two **is the same as** seven.
variable an unknown value	**variable** un valor desconocido		X + 5 = 10 • X is a **variable** of this **equation**. • The **solution** is x=5. • This means "5" makes this statement true.
equation a mathematical statement that is made up of _____ _____ connected by an _____sign.	**ecuación**		

Figure 4. My Math Dictionary

5.1.3. Jointly Constructing the Knowledge

Following the deconstruction of language through *My Math Dictionary*, we moved into the next phase, where we collaboratively worked with our students to scaffold their understanding and support them in solving word problems. As noted earlier, engaging with mathematical genres such as recounting problem-solving procedures and explaining solutions can be challenging for NMLs. Many teachers, however, recognizing these challenges NMLs face in navigating disciplinary genres, may unintentionally simplify or "dumb down" the curriculum (Harman et al., 2020), ultimately doing a disservice to these students. In contrast, as Zolkower and Shreyar (2007) have shown, explicitly guiding students in using genre-specific language can enhance their mathematical understanding. To this end, we developed a template (see Figure 5) designed to scaffold NMLs' disciplinary language use and incorporated it into our lessons during the joint construction phase. As illustrated, we began by presenting a word problem aligned with the curriculum map provided by our state, followed by a collaborative analysis of the problem's lexico-grammatical structure. That is, together with our students, we identified key elements of the problem such as "adults," "students," and "tickets" as participants, and examined the circumstances that contextualize the problem. We then visualized this analysis to clarify the relational processes embedded in the word problem. Building on this shared understanding, students translated the problem into symbolic algebraic expressions and proceeded to solve it, supported by scaffolds such as step-by-step procedures and sentence frames (see the actual implementation of the template in Figure 6). To us, this shows that working with this template allowed our students to develop control over the target genre and register with scaffolded teacher support (Gibbons, 2006), and that they were ready to work independently. The illustration of the independent construction phases follows in the next section.

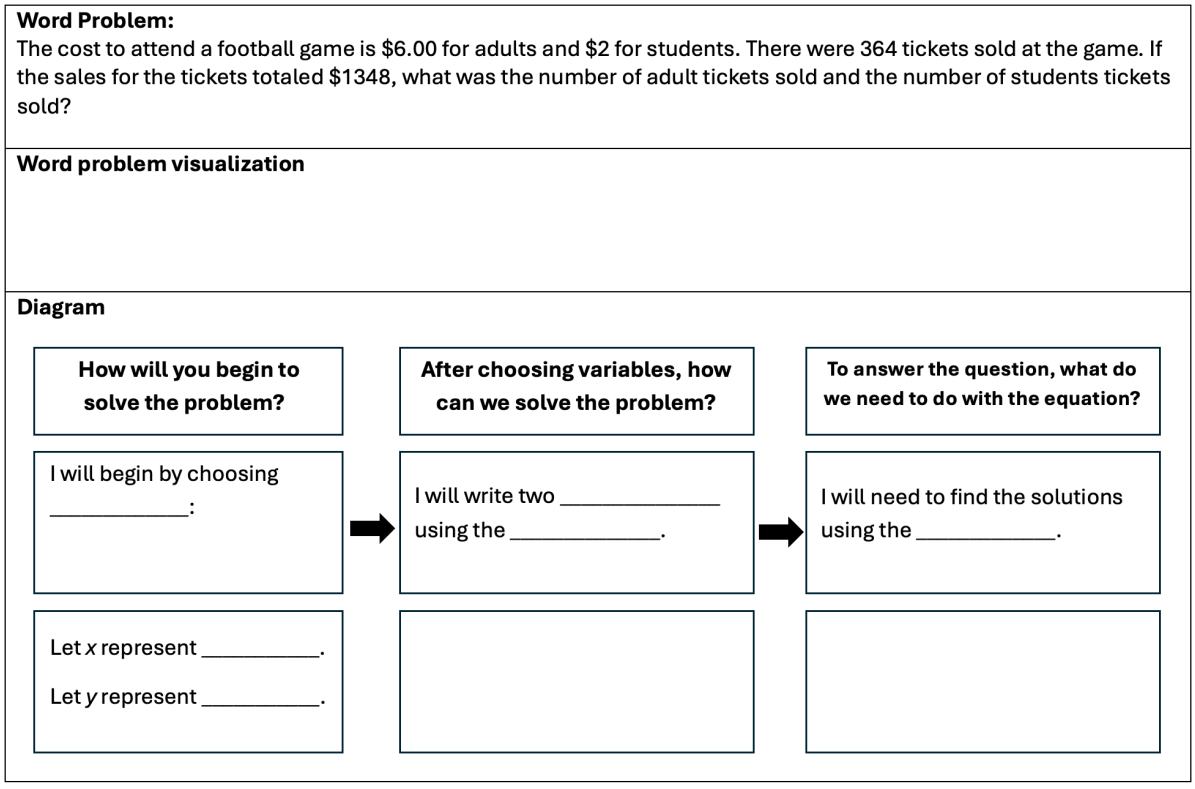


Figure 5. Template for Visualizing Thinking Process

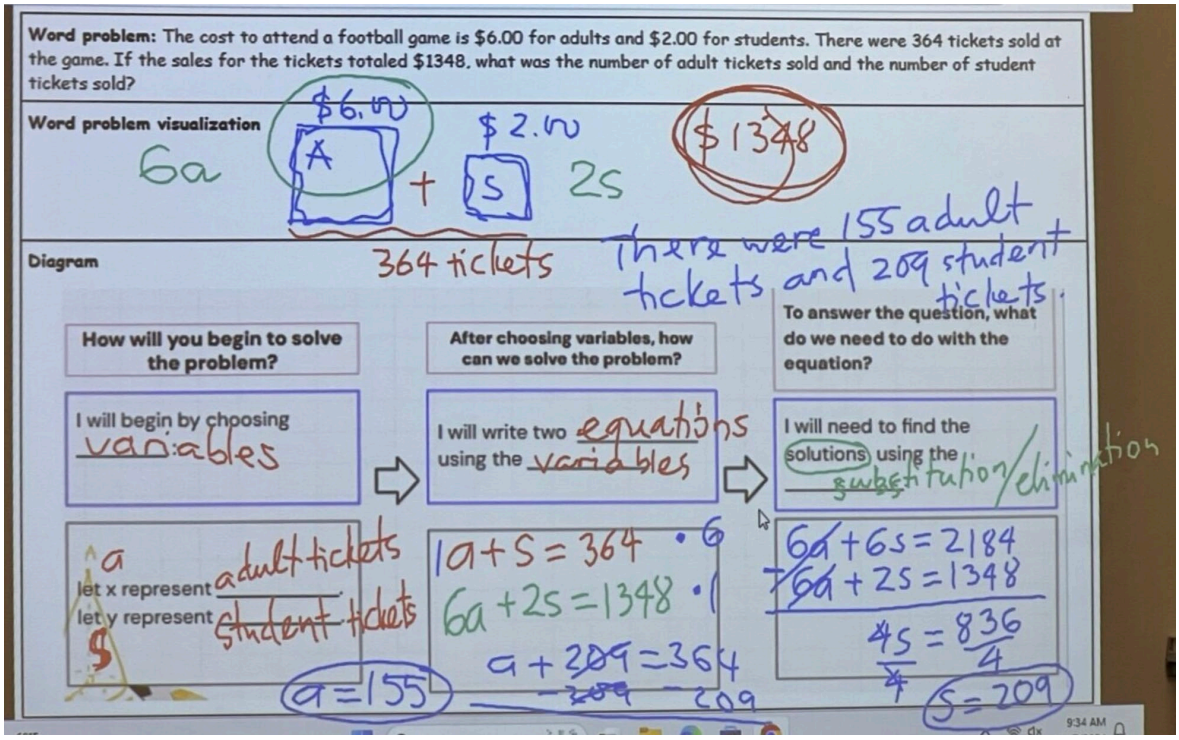


Figure 6. Implementation of the Template in Instruction

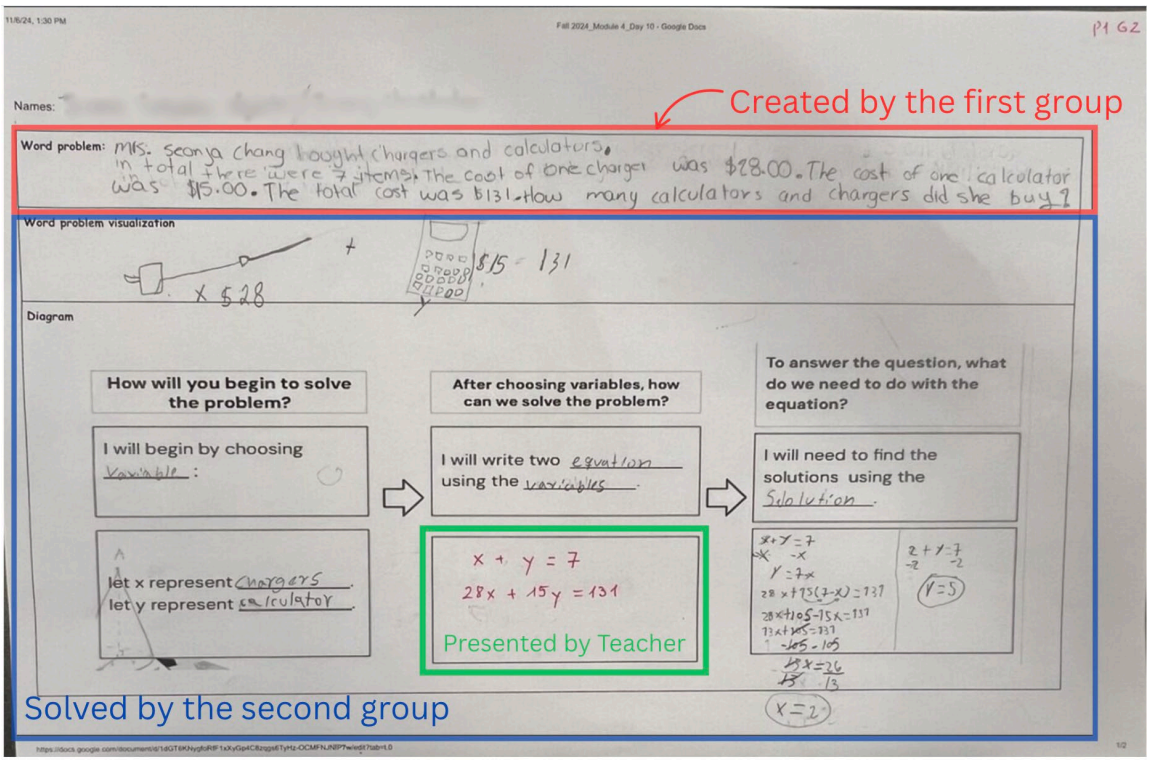


Figure 7. Creating Word Problems

5.2. Engaging in Recursive Weaving Between Conceptual and Procedural Mathematical Understanding

As we moved into the independent construction phase of our 3M TLC, we placed greater emphasis on integrating conceptual understanding with procedural fluency in real-world contexts, though this integration was iteratively

embedded throughout all phases of the cycle. As shown in Figure 7, as part of the module's summative assessment, we presented each group of students with a system of equations (written in red at the bottom center of the diagram: $x + y = 7$; $28x + 15y = 131$). Using these equations, students were tasked with collaboratively creating their own word problems based on real-life situations. This complex task required them to apply their conceptual understanding of equations and consider the genre features of mathematical word problems, drawing on their knowledge of processes and participants, and understandings developed throughout the earlier phases. After completing their word problems, groups exchanged problems with one another and solved them by following the procedural steps practiced during the joint construction phase, thereby reinforcing their procedural fluency. Throughout this interconnected process of developing conceptual understanding alongside procedural fluency, we observed that our students were no longer merely following prescribed steps; instead, they were actively engaging in mathematical thinking and taking ownership of their learning. However, despite the clear alignment of this project with CCSS-M requirements that NMLs must meet to graduate, we remain concerned about a potential gap between this type of assessment and state-level assessments, such as the end-of-course measurement that NMLs are likely to encounter in their home schools outside the GROW classroom. This gap calls for continued efforts from teachers, teacher educators, and researchers to develop meaningful and equitable solutions.

5.3. Reimagining Mathematics Learning Through Translanguaging and Cultural Conversations

In addition, as outlined in our conceptual framework for CS SFL in mathematics, we view translanguaging practices as a meaningful pedagogical tool that supports NMLs in navigating disciplinary understanding and fostering deeper connections to mathematical content (Ángeles, 2025; Alberto Mora et al., 2022; Buxton et al., 2022). These practices were impactful during the implementation of our curriculum when facilitated by a bilingual educator, Mrs. Lopez, who leveraged both linguistic and pedagogical expertise to deepen student comprehension. For instance, as shown in Table 2, during a lesson on equations and inequalities, Mrs. Lopez not only translated Bui's instruction into Spanish, but also expanded students' understanding by offering detailed and contextualized explanations. For instance, she clarified why equations typically have a single solution, whereas inequalities can have multiple solutions, using a relatable real-life example, such as her own age, to illustrate the concept. In our reflection, we discussed how this moment fostered an environment where students felt more at ease and actively engaged, asking additional questions. Moreover, we observed during our lessons that the absence of direct equivalents for certain mathematical terms in Spanish further complicated NMLs' understanding, making the bilingual teacher's contextualized explanations in students' first language even more essential. For example, when we introduced algebraic concepts such as *variable, coefficient,* and *like terms* in both English and Spanish (e.g., *variable, coeficiente,* and *términos semejantes*, respectively), Mrs. Lopez pointed out that while *like terms* can be translated as *términos semejantes*, the phrase carries a different meaning in Spanish and she provided additional explanation in Spanish to clarify the mathematical meaning for students. We believe these moments collectively highlight how scaffolding through translanguaging can deepen conceptual understanding and support students in seeing themselves as valued participants in mathematical learning.

Furthermore, acknowledging that cultural meaning-making processes in mathematics can vary across diverse countries (Kamilla Yurievna et al., 2023; Moschkovich, 2015; Nasir et al., 2008; White, 2016), our lessons incorporated culturally specific elements such as differences in comma usage (e.g., 3.5 vs. 3,5), coin systems (e.g., dollar vs. peso), and units of measurement (e.g., miles vs. kilometers; Fahrenheit vs. Celsius). We also encouraged students to compare the U.S. approach to algebra with the methods they had learned in their home countries. For instance, when Bui taught how to add unlike fractions, Mrs. Lopez pointed out that this process is taught differently in her home context. While students in the U.S. are typically taught to find the least common denominator (LCD) first, convert both fractions to equivalent forms with that common denominator, and then add the numerators, Mrs. Lopez explained that in her country, students are taught to cross-multiply first and then add the numerators. This moment clarified why some students had previously appeared confused during the lesson. In our view, it opened space for meaningful dialogue about the importance of flexibility in mathematical conventions and affirmed NMLs' prior knowledge as a legitimate and valuable foundation for learning within the U.S. educational context.

Taken together, our CS SFL praxis in mathematics highlights the potential for supporting NMLs in becoming active knowers and problem-solvers within their educational journeys. The functional approach, realized through multiple modes of representation within the 3M TLC, fostered recursive learning between conceptual understanding and procedural fluency. Moreover, by incorporating and sustaining NMLs' linguistic and cultural funds of knowledge through

translanguaging, our students engaged confidently and competently in developing mathematical disciplinary literacy and deepening their conceptual understanding. The following section further explores the affordances and considerations of this approach for classroom practice and broader educational contexts.

Table 2. *Translanguaging in Teachable Moments (Videorecording, 10/31/24)*

Dr. Bui: So that is a difference between inequalities and equation. Equation, you have only one solution. Say, in in quality, you have muchas solutions.
Mrs. Lopez: Así que esa es la diferencia entre las desigualdades y la ecuación. En la ecuación, tienes una sola solución. ¿Ves? En la desigualdad tienes muchas soluciones. ¿Listo? ¿Recuerdas? Sí. O sea... Sí, ok, sí. Sí. Esto es lo que está diciendo, chicos. Es que el valor de X... ¿Me prestan atención? ¿Cómo es el valor de X? Más bien, la inequación puede tomar todos los valores mayores que 12. Es como si yo le dijera, la edad de Ana es mayor que 30 años. Así, la edad de Ana es mayor que 30 años. Entonces ¿yo podré tener 25? no. ¿Yo podré tener 29? no. ¿Yo podré tener 30? no. Porque es mayor que 30 años. No es igual. A ver, si yo hubiera usado este símbolo ≥ Ahí sii yo digo es mayor o igual a 30, sí incluye el 30. Pero si solo digo mayor, no incluye el mismo número, sino todos los que son mayores que él. Por eso es que aquí el circulito es abierto, porque el circulito indica que no incluye este número, sino todos los mayores.
S: ¿Eso no afecta cuando estoy haciendo operaciones? es decir ¿Los pasos son iguales que con las ecuaciones?
Mrs. Lopez: Es casi igual, solamente hay una cosita diferente, pero Dr. Bui se las explicará después. De resto todo es igual cuando hacen las operaciones. Solo hay una pequeña diferencia.
Dr. Bui: So that is a difference between inequalities and equation. Equation, you have only one solution. Say, in in quality, you have muchas solutions.
Mrs. Lopez: So that's the difference between inequalities and equations. In an equation, you have a single solution. See? In an inequality, you have many solutions. Ready? Do you remember? Yes. I mean… Yes, okay, yes. Yes. This is what it's saying, guys. It's that the value of X… Are you paying attention? What is the value of X like? Rather, the inequality can take all the values greater than 12. It's like if I said, Ana's age is greater than 30 years. Like that—Ana's age is greater than 30 years. So, could I be 25? No. Could I be 29? No. Could I be 30? No. Because it's greater than 30 years. It's not equal. Now, if I had used this symbol ≥ then yes, if I say greater than or equal to 30, it does include 30. But if I just say greater than, it doesn't include that number, only those that are greater than it. That's why here the little circle is open, because the circle indicates that it doesn't include that number, just all the ones greater than it.
S: Doesn't that affect when I'm doing calculations? That is, are the steps the same as with equations?
Mrs. Lopez: It's almost the same; there's just one small difference, but Dr. Bui will explain it to you later. Everything else is the same when you do the operations. There's just a small difference.

6. Discussion and Conclusion

This paper has outlined the CS SFL in mathematics framework, developed and implemented in a foundational algebra classroom at GROW, a space designed to support high school NMLs in developing both mathematical understanding and disciplinary literacies. Within this setting, two multilingual educators collaboratively designed and enacted a mathematics curriculum intentionally aligned with both the CCSS-M and NCTM standards. Our illustrations of the pedagogical design and implementation underscore the importance of intentionally addressing three interconnected areas: knowledge development, language development, and cultural sustenance. We believe attending to these dimensions offers valuable insights and practical implications for educators, policymakers, and researchers working with the growing population of NMLs in secondary mathematics settings in the U.S.

First, our SFL-informed 3M TLC model highlights the importance of carefully staged integration of explicit language scaffolding in the development of disciplinary knowledge, thereby supporting genre and register awareness among NMLs in mathematics (Gibbons, 2006; Hammond & Gibbons, 2005). By carefully integrating multilingual, multicultural, and multimodal scaffolds, the 3M TLC provided NMLs with accessible entry points into abstract disciplinary concepts. For example, in a module on equations and inequalities, instruction began with concrete, everyday imagery, such as seesaws and balancing scales, and progressed through gesture, visual representations, and oral repetition toward formalized mathematical language. This carefully staged movement from the familiar to the abstract allowed students to internalize terms like *equation* and *solution*, and to practice using them meaningfully within disciplinary

sentence structures. Moreover, resources such as *My Math Dictionary* and a template for visualizing the thinking process served as consistent, visible language tools that supported students' independent use of mathematical language. These practices demonstrate an alternative to deficit-based approaches that oversimplify content and language (Harman et al., 2020) and highlight that disciplinary literacy and mathematical learning *can* and *should* occur simultaneously, offering classroom teachers and teacher educators pathways for engaging NMLs in rigorous, conceptually rich mathematical discourse.

Second, our CS SFL-informed framework in mathematics demonstrates that curriculum can be thoughtfully developed and implemented in classrooms with NMLs in ways that align with national and state standards, including the CCSS-M and NCTM. These standards emphasize the interplay between conceptual understanding, procedural fluency, and the application of mathematical knowledge to real-world contexts, the elements we intentionally infused into our curriculum. For instance, the creation of word problems based on systems of equations situated mathematical learning within students' lived experiences, enabling them to connect abstract reasoning with tangible, everyday situations. Moreover, the recursive interplay between conceptual and procedural learning in this phase not only strengthened students' mathematics understanding but also fostered ownership of their learning, cultivating them as active knowers and doers. However, we also acknowledge a persistent tension between these situated learning and the rigid structure of state-level assessments. This underscores the ongoing need for educators and policymakers to reconcile innovative, equity-driven pedagogies with standardized accountability measures that often fail to reflect NMLs' full capabilities.

Third, our study suggests the transformative potential of translanguaging and cultural conversations as meaningful pedagogical tools in mathematics classrooms with NMLs. We argue that translanguaging practices in these settings should extend beyond mere direct translation between two named languages or the isolated use of discrete semiotic modes (Alberto Mora et al., 2022; Buxton et al., 2022). As demonstrated by Mrs. Lopez's use of translanguaging, such practices should offer NMLs full access to complex mathematical ideas through contextually rich, linguistically responsive, and meaningfully situated explanations. Furthermore, by explicitly recognizing and affirming students' prior mathematical knowledge and the diverse ways they have been taught in their home countries (Moschkovich, 2015), we positioned NMLs' linguistic and cultural backgrounds as assets rather than obstacles. This underscores the importance of cultivating educators' openness to diverse cultural meaning-making practices.

Our enactment of the CS SFL praxis in mathematics education for high school NMLs was not without its challenges, even as it revealed strengths. While the framework offers meaningful pedagogical tools, its successful implementation requires careful, context-specific adaptation, particularly for teachers and teacher educators who may have limited experience working with NMLs. Moreover, our study highlights the importance of further research that explores NMLs' firsthand experiences within CS SFL-informed mathematics classrooms, as their voices can offer critical insights into how such approaches are received, negotiated, and transformed in practice. As the U.S. educational landscape continues to grow more linguistically and culturally diverse, we call on educators, researchers, and policymakers to embrace comprehensive and equity-oriented models like CS SFL praxis that reimagine mathematics classrooms as inclusive, intellectually rich spaces where all students can thrive.

Notes

[1]Introduced in the early 2010s, the CCSS-M and the NGSS are U.S. educational frameworks that outline what students should know and be able to do in mathematics and science at each grade level. They also emphasize the development of disciplinary practices, including problem-solving, reasoning, and the application of knowledge to real-world situations.

[2]All names are pseudonyms.

[3]High school in the United States refers to the final stage of compulsory secondary education, typically serving students in grades 9 through 12 (ages 14–18). Algebra is one of the four compulsory math courses required for high school graduation.

[4]NCTM (2014) defines procedural fluency as "the ability to apply procedures efficiently, flexibly, and accurately; to transfer procedures to different problems and contexts; to build or modify procedures from other procedures; and to recognize when one strategy or procedure is more appropriate to apply than another."

Information on Informed Consent or any Data Privacy Statements

Informed consent from the participants was obtained before the study started.

Author Contributions

The first author took the lead in data collection, writing, and reviewing the manuscript throughout the process. The second and third authors made substantial contributions by participating in the writing and revision of the manuscript. In particular, they were actively involved in the editing stage to ensure its accuracy and clarity.

Conflict of Interest

The authors have no conflicts of interest to declare.

Ethics Board Approval Statements

The University of Georgia Institutional Review Board reviewed and approved PROJECT00009530.

References

Adler, J., & Sfard, A. (Eds.). (2016). *Research for educational change: Transforming researchers' insights into improvement in mathematics teaching and learning.* Routledge. https://doi.org/10.4324/9781315643236

Aguirre-Muñoz, Z., Pando, M., & Liu, C. (2024). Enhancing bilingual/ESL teachers' STEM instruction with targeted content and disciplinary literacy professional development: A study on knowledge and practice outcomes. *Education Sciences, 14*(7), 745. https://doi.org/10.3390/educsci14070745

Alberto Mora, R., Tian, Z., & Harman, R. (2022). Translanguaging and multimodality as flow, agency, and a new sense of advocacy in and from the Global South. *Pedagogies: An International Journal, 17*(4), 271–281. https://doi.org/10.1080/1554480X.2022.2143089

Allensworth, E., Cashdollar, S., & Cassata, A. (2022). Supporting change in instructional practices to meet the Common Core mathematics and Next Generation science standards: How are different supports related to instructional change? *AERA Open,* 8, 23328584221088010. https://doi.org/10.1177/23328584221088010

Ángeles, S. L. (2025). "I wasn't trained for ELD": The experiences of bilingual content-area teachers. *Bilingual Research Journal, 48*(1), 43–57. https://doi.org/10.1080/15235882.2024.2385407

Arzarello, F., Paola, D., Robutti, O., & Sabena, C. (2009). Gestures as semiotic resources in the mathematics classroom. *Educational Studies in Mathematics, 70*(2), 97–109. https://doi.org/10.1007/s10649-008-9163-z

Blanchard, S., & Muller, C. (2015). Gatekeepers of the American dream: How teachers' perceptions shape the academic outcomes of immigrant and language-minority students. *Social Science Research,* 51, 262–275. https://doi.org/10.1016/j.ssresearch.2014.10.003

Bui, K. N. (2023). *Multimodal meaning-making resources in teaching mathematics to multilingual learners in high school ESOL classrooms* [Doctoral dissertation]. University of Georgia. UGA Open Scholar.

Bui, K. N., & Harman, R. (2019). Teaching mathematics to English learners: The interplay between gestures and discourse in explaining mathematical concepts. In F. E. Obiakor, J. P. Bakken, & A. F. Rotatori (Eds.), *Handbook of research on assessment practices and pedagogical models for immigrant students* (pp. 18–40). IGI Global. https://doi.org/10.4018/978-1-5225-9348-5.ch002

Buxton, C., Harman, R., Cardozo-Gaibisso, L., & Dominguez, M. V. (2022). Translanguaging within an integrated framework for multilingual science meaning making. In *Translanguaging in science education* (pp. 13–38). Springer International Publishing. https://doi.org/10.1007/978-3-030-82973-5_2

Chen, C. L., & Herbst, P. (2013). The interplay among gestures, discourse, and diagrams in students' geometrical reasoning. *Educational Studies in Mathematics, 83*(2), 285–307. https://doi.org/10.1007/s10649-012-9454-2

Council of Chief State School Officers. (2010). *Common Core State Standards.* http://www.corestandards.org

de Araujo, Z., Roberts, S. A., Willey, C., & Zahner, W. (2018). English learners in K–12 mathematics education: A review of the literature. *Review of Educational Research, 88*(6), 879–919. https://doi.org/10.3102/0034654318798093

de Oliveira, L. C., & Westerlund, R. (2022). Scaffolding for multilingual learners: Concepts and practices. In L. C. de Oliveira, & R. Westerlund (Eds.), *Scaffolding for multilingual learners in elementary and secondary schools* (pp. 1–6). Routledge. https://doi.org/10.4324/9781003196228

Di Sarno-García, S., & Gimeno-Sanz, A. (2025). The pragmatic function of translanguaging in a bilingual telecollaboration project. *Journal of Research in Applied Linguistics.* Advance online publication. https://doi.org/10.22055/rals.2025.48683.3446

Esquinca, A. (2012). Socializing pre-service teachers into mathematical discourse: The interplay between biliteracy and multimodality. *Multilingual Education, 2*(1), 4. https://doi.org/10.1186/2191-5059-2-4

Evans, M. A., Feenstra, E., Ryon, E., & McNeill, D. (2011). A multimodal approach to coding discourse: Collaboration, distributed cognition, and geometric reasoning. *International Journal of Computer-Supported Collaborative Learning, 6*(2), 253–278. https://doi.org/10.1007/s11412-011-9113-0

Farsani, D., Lange, T., & Meaney, T. (2022). Gestures, systemic functional linguistics and mathematics education. *Mind, Culture, and Activity, 29*(1), 75–95. https://doi.org/10.1080/10749039.2022.2060260

Finlay, L. (2008). Reflecting on 'reflective practice'. *Practice-based Professional Learning Journal, 3*(1), 35–50.

García, O. (2009). Education, multilingualism and translanguaging in the 21st century. In A. Mohanty, M. Panda, R. Phillipson, & T. Skutnabb-Kangas (Eds.), *Social justice through multilingual education* (pp. 140–158). Multilingual Matters. https://doi.org/10.21832/9781847691910-011

García, O., & Wei, L. (2015). Translanguaging, bilingualism, and bilingual education. In W. E. Wright, S. Boun, & O. García (Eds.), *The handbook of bilingual and multilingual education* (pp. 223–240). Wiley. https://doi.org/10.1057/9781137385765

Gibbons, P. (2006). *Bridging discourses in the ESL classroom: Students, teachers and researchers.* A&C Black.

Halliday, M. A. K. (1978). Ideas about language. *Arts: The Journal of the Sydney University Arts Association, 11,* 7–14.

Halliday, M. A. K., & Martin, J. R. (2003). *Writing science: Literacy and discursive power.* Routledge. https://doi.org/10.4324/9780203209936

Halliday, M. A. K., & Matthiessen, C. M. I. M. (2014). *Halliday's introduction to functional grammar* (4th ed.). Routledge. https://doi.org/10.4324/9780203431269

Hammond, J., & Gibbons, P. F. (2005). Putting scaffolding to work. *Prospect, 20*(1), 6–30.

Harman, R., & Burke, K. (2020). *Culturally sustaining systemic functional linguistics praxis. Embodied inquiry with multilingual youth*. Routledge.

Harman, R., Buxton, C., Cardozo-Gaibisso, L., Jiang, L., & Bui, K. (2020). Culturally sustaining systemic functional linguistics praxis in science classrooms. *Language and Education*, *35*(2), 106-122. https://doi.org/10.1080/09500782.2020.1782425

Harman, R., Fu, S., & Chang, S. J. (2025). SFL as a socially accountable praxis: who and what are we working for?. *International Review of Applied Linguistics in Language Teaching*, *63*(1), 235-257. https://doi.org/10.1515/iral-2024-0072

Harman, R., & Khote, N. (2018). Critical SFL praxis with bilingual youth: Disciplinary instruction in a third space. *Critical Inquiry in Language Studies*, *15*(1), 63-83. https://doi.org/10.1080/15427587.2017.1318663

Huang, J., Normandia, B., & Greer, S. (2005). Communicating mathematically: Comparison of knowledge structures in teacher and student discourse in a secondary math classroom. *Communication Education, 54*(1), 34–51. https://doi.org/10.1080/03634520500343310

Jodairi Pineh, A. (2022). Exploring nominalization use in EFL students' argumentative writing over a genre-based teaching and learning approach. *Journal of Research in Applied Linguistics, 13*(1), 110–122. https://doi.org/10.22055/RALS.2022.17429

Kamilla Yurievna, Y., Alexandrovna Korneyeva, T., & Damirovna Markova, T. (2023). Investigating the inclusion of linguistic and regional materials in teaching English and informing students about the cultural heritage of their country. *Journal of Research in Applied Linguistics, 14*(3), 128–132. https://doi.org/10.22055/rals.2023.19468

Kim, S., Park, J. Y., & Zhao, M. (2024). Content teachers' beliefs and attitudes toward working with multilingual learners through integrative approaches. *Frontiers in Education, 9,* 1282936. https://doi.org/10.3389/feduc.2024.1282936

King, S. G., & Powell, S. R. (2023). Language proficiency and the relation to word–problem performance in emergent bilingual students with mathematics difficulties. *Learning Disabilities Research & Practice, 38*(4), 263–273. https://doi.org/10.1111/ldrp.12325

Krause, G. H. (2023). Worlds and words: Entangling mathematics, language, and context in newcomer classrooms. *ZDM–Mathematics Education, 55*(6), 1139–1150. https://doi.org/10.1007/s11858-023-01516-0

Kress, G., & Van Leeuwen, T. (2020). *Reading images: The grammar of visual design* (3rd ed.). Routledge. https://doi.org/10.4324/9781003099857

Lee, O., & Stephens, A. (2020). English learners in STEM subjects: Contemporary views on STEM subjects and language with English learners. *Educational Researcher, 49*(6), 426–432. https://doi.org/10.3102/0013189X20923708

Martin, J. R. (1992). *English text: System and structure.* John Benjamins.

Moschkovich, J. (2015). Academic literacy in mathematics for English learners. *The Journal of Mathematical Behavior,* 40, 43–62. https://doi.org/10.1016/j.jmathb.2015.01.005

Moschkovich, J., & Scott, J. (2021). Language issues in mathematics word problems for English learners. In A. Fritz, E. Gürsoy, & M. Herzog (Eds.), *Diversity dimensions in mathematics and language learning* (pp. 331–349). De Gruyter. https://doi.org/10.1515/9783110661941-017

Moses, R. P. (1982). *The Algebra Project.* The Algebra Project, Inc. https://algebra.org

Nasir, N. I. S., Hand, V., & Taylor, E. V. (2008). Culture and mathematics in school: Boundaries between "cultural" and "domain" knowledge in the mathematics classroom and beyond. *Review of Research in Education, 32*(1), 187–240. https://doi.org/10.3102/0091732X07308962

National Council of Teachers of Mathematics. (2014). *Principles and standards for school mathematics.* NCTM.

O'Halloran, K. L. (2005). *Mathematical discourse: Language, symbolism and visual images.* Continuum.

O'Halloran, K. L. (2007). Systemic functional multimodal discourse analysis (SFMDA) approach to mathematics, grammar and literacy. In A. McCabe, M. O'Donnell, & R. Whittaker (Eds.), *Advances in language and education* (pp. 75–100). Continuum.

O'Halloran, K. L. (2008). Systemic functional-multimodal discourse analysis (SF-MDA): Constructing ideational meaning using language and visual imagery. *Visual Communication, 7*(4), 443–475. https://doi.org/10.1177/1470357208096210

Oikonomidoy, E., Salas, R. G., Karam, F. J., Warren, A. N., & Steinmann, T. (2019). Locating newcomer students in educational research in the US: A review of the literature from 2000–2017. *Pedagogy, Culture & Society, 27*(4), 575–594. https://doi.org/10.1080/14681366.2018.1542539

Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher, 41*(3), 93–97. https://doi.org/10.3102/0013189X12441244

Paris, D., & Alim, H. S. (Eds.). (2017). *Culturally sustaining pedagogies: Teaching and learning for justice in a changing world.* Teachers College Press.

Patel, S. G., Bouche, V., Thomas, I., & Martinez, W. (2023). Mental health and adaptation among newcomer immigrant youth in United States educational settings. *Current Opinion in Psychology,* 49, 101459. https://doi.org/10.1016/j.copsyc.2022.101459

Poza, L. E. (2018). A disciplinary perspective on translanguaging. *Bilingual Research Journal, 44*(3), 318–334. https://doi.org/10.1080/15235882.2021.1970657

Rittle-Johnson, B., & Schneider, M. (2015). Developing conceptual and procedural knowledge of mathematics. In R. C. Kadosh & A. Dowker (Eds.), *The Oxford handbook of numerical cognition* (pp. 1118–1134). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199642342.013.014

Schleppegrell, M. J. (2007). The linguistic challenges of mathematics teaching and learning: A research review. *Reading & Writing Quarterly, 23*(2), 139–159. https://doi.org/10.1080/10573560601158461

Sharpe, S. T., Mauntel, M., Butler, R., Choi, B., Aswad, M., & Amedu, J. (2024). A systematic review of the effectiveness of algebraic teaching interventions: A meta-analysis and meta-synthesis. *Nordic Journal of Systematic Reviews in Education, 2,* 207–228. https://doi.org/10.23865/njsre.v2.6355

Shin, H., Sanchez, S., & Gebhard, M. (2023). More than vocabulary: Verbal scaffolding of mathematical word problems with elementary emergent bilinguals. In *In pursuit of a multilingual equity agenda* (pp. 163–184). Routledge. https://doi.org/10.4324/9781003162575-7

Siffrinn, N. E., & Harman, R. (2019). Toward an embodied systemic functional linguistics pedagogy. *TESOL Quarterly*, *53*(4), 1162-1173. https://doi.org/10.1002/tesq.516

Sugarman, J. (2023). *Recent immigrant children: A profile of new arrivals to U.S. schools.* Migration Policy Institute. https://www.migrationpolicy.org/research/recent-immigrant-children

U.S. Census Bureau (2019). *Georgia quick facts.* https://www.census.gov/quickfacts/fact/table/GA/RHI725218

U.S. Department of Education, Institute of Education Sciences, Regional Educational Laboratory Appalachia. (2021). *Algebra I and college preparatory diploma outcomes among students in Virginia (REL 2021–038).* U.S. Department of Education. https://ies.ed.gov/rel-appalachia/2025/01/report

Walters, K., & Nucci, D. (2025). *Coherent approaches to early algebra advance students' high school course-taking opportunities.* WestEd. https://www.wested.org/resource/coherent-approaches-early-algebra-advance-high-school-course-taking-opportunities/

White, D. Y., Crespo, S., & Civil, M. (Eds.). (2016). *Cases for mathematics teacher educators: Facilitating conversations about inequities in mathematics classrooms.* IAP.

Yrigollen-Robbins, M. S. (2024). Finding evidence of community cultural wealth in Georgia: Testimonios of Latina immigrants on navigating cultural, social, and economic barriers. In E. G. Murillo Jr., & S. Velarde Pierce (Eds.), *Advocacy and policy change for undocumented student success* (pp. 185–201). Routledge. https://doi.org/10.4324/9781003542001

Zahner, W., Calleros, E. D., Wynn, L., & Pelaez, K. (2024). Transforming learning opportunities in linguistically diverse secondary classrooms through promoting discussions: Results of an intervention. *Mathematical Thinking and Learning, 26*(1), 1–22. https://doi.org/10.1080/10986065.2024.2383803

Zolkower, B., & Shreyar, S. (2007). A teacher's mediation of a thinking-aloud discussion in a 6th grade mathematics classroom. *Educational Studies in Mathematics,* 65, 177–202. https://doi.org/10.1007/s10649-006-9046-0

Zygouris-Coe, V. (2012). Disciplinary literacy and the common core state standards. *Topics in Language Disorders, 32*(1), 35–50. https://doi.org/10.1097/TLD.0b013e31824561a2

© 2025 by the authors. Licensee Shahid Chamran University of Ahvaz, Iran. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution–NonCommercial 4.0 International (CC BY-NC 4.0 license). (http://creativecommons.org/licenses/by-nc/4.0/).