Experiencing Multilingualism in the Math Classroom: A Conversation Starter with Teacher Candidates

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Abstract

This article invites readers into an abbreviated version of the "Experiencing Multilingualism in the Mathematics Classroom" (EMMC) activity as they read about teacher candidates' responses and reflections. The EMMC activity was designed as a conversation starter for teacher candidates to build their awareness and help them consider how to support emerging multilingual students in the mathematics classroom, including sensory, graphic, and interactive support strategies. Our teacher candidates' reflections demonstrate the importance of building awareness and understanding of linguistic diversity in the mathematics classroom. They also suggest the need for more conversations and supports for teacher candidates to move beyond awareness.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. Have you ever been in a situation where you had to navigate an unfamiliar language or culture? What resources helped you communicate in those situations?

2. What are some instructional strategies that you have found effective for teaching emergent multilingual students in the mathematics classroom?

3. Reflect on the following statement by a teacher candidate. What does it communicate about emerging multilingual students? What kinds of experiences would support this teacher candidate's learning about the roles and responsibilities of the mathematics teacher?

   "The only ELL student [...] does not speak at all. He keeps to himself and copies his neighbors' notes because he cannot keep up. My mentor teacher says that you can only do so much, which I completely agree with."

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Experiencing Multilingualism in the Math Classroom: A Conversation Starter with Teacher Candidates

Laura M. Kennedy and Sandra Crespo

As educators committed to supporting students with diverse language backgrounds, we [Laura and Sandra] have been working to design experiences that help teacher candidates (TCs) at our institution, who tend to be white, monolingual, middle- and working-class young women, explore the linguistic resources of emergent multilingual[1] students. Our goal is to help our TCs recognize students' linguistic diversity as an asset to their learning of mathematics rather than an issue that has to be overcome.

Our assumption is that taking an asset orientation towards multilingualism in the mathematics classroom entails (1) understanding that mathematics is not language free, nor is it a universal language, (2) the language of instruction will have different language demands at the word, sentence and discourse levels for all students (WIDA, 2012), and (3) the language demands of a lesson exist on a continuum based on how similar the student's primary language is compared to the language of instruction. This work is consistent with the National Council of Supervisors of Mathematics (NCSM) and TODOS-Mathematics for All (2016) joint position statement's call for eliminating deficit thinking. Our experiences working with TCs have taught us that some of them bring deficit thinking about students who are different from themselves into our teacher preparation program and their field placements. The TC statement we offered in the pre-reading is an all-too-common perspective we have encountered every year in our program.

Knowing that in the U.S. the primary language of instruction privileges students from White, middle class, English-speaking backgrounds, we have designed a simulation activity to help our TCs engage with issues of inequity in the mathematics classroom. Specifically, how English monolingualism in the mathematics classroom disenfranchises students of diverse linguistic backgrounds. We seek to disrupt the invisibility of language in the mathematics classroom and the role it plays in creating categories of students' mathematical ability that shortchanges emerging multilingual students. As the NCSM-TODOS (2016) position statement explains:

> Deficit thinking implies students lack knowledge and experiences expected by the dominant group. Deficit thinking ignores, dismisses, or casts as barriers mathematical knowledge and experiences children engage with outside of school every day. A social justice approach to mathematics education assumes students bring knowledge and experiences from their homes and communities that can be leveraged as resources for mathematics teaching and learning (Civil, 2007; Gonzalez et al., 2005; Leonard & Martin, 2013; Turner et al., 2012). It also means broadening participation and engagement of children in light of the varied cultural, linguistic, and mathematical competencies they bring to the classroom (p. 2).

In this article, we will first take our reader through the activity, sharing in detail how we launch and facilitate this discussion. Then we share our TCs' insights and wonderings that emerged when interacting and reflecting on the EMMC activity.

The Simulation Activity

As emergent multilinguals ourselves, we have experienced learning in multiple languages firsthand. As educators who have studied and taught in non-English speaking parts of the world, we recognize the importance of experiencing language diversity as critical for English

[1] While labels of "English Learner" or "English Language Learner" are commonly used in education research and policy, we are choosing to use the phrase "emergent multilingual" here, as others have done (Association of Mathematics Teacher Educators, 2017), because "emergent multilingual" de-centers English as a dominant language, recognizes linguistic diversity as a strength in the mathematics classroom, and acknowledges that students often speak two or more languages.

monolingual TCs who strive to teach emergent multilingual students with awareness and from an asset-based perspective. This work has been a collaboration between a mathematics educator [Sandra] and an English language educator [Laura] since 2016, making it possible to address and sustain this very important domain of access and equity with many cohorts of TCs.

The "Experiencing Multilingualism in the Mathematics Classroom" (EMMC) simulation activity is an innovation for the teacher preparation program at our institution, which is similar to many other programs in that it has tended to focus more on developing content knowledge for teaching than instructional methods for supporting emerging multilingual students. The EMMC activity draws from work that our institution's world language and TESOL programs have been doing with world language TCs. We see this work as contributing to the ongoing conversation in the field and to the growing literature of mathematics teacher educators committed to asset-based mathematics teaching and to supporting linguistic diversity in the mathematics classroom (e.g., de Oliveira, 2011; Ewing, 2017; I & Stanford, 2018; Kenney & de Oliveira, 2015; Roberts & Truxaw, 2013).

The way we launch the EMMC activity is by asking TCs to complete an open response online survey (1) indicating what languages they speak, (2) rating their level of fluency with each of these languages, and (3) naming the home languages of the students within their field placement classrooms. There are multiple reasons for launching this activity with a language survey. First, we wanted to trouble the myth of monolingualism both within our own teacher education classroom as well as their field placement classroom. Unless prompted to the contrary our TCs identify primarily as English monolinguals. This framing, and how the literature in teacher education often speaks about the lack of language diversity in the teaching force in the U.S., fails to recognize classroom teachers' potential for leveraging prior formal and informal language learning experiences to support emergent multilingual students. Thus the second reason for the survey was to help TCs begin to leverage their own language learning experiences and take an asset perspective when they frame their own language abilities. And finally, the third reason was a logistical one: the survey allowed us, as we will discuss later, to form small groups during the EMMC activity.

In the following class, we then engage in the EMMC activity. Before sharing the rest of the EMMC activity, we invite you to work on the following task in three languages: first Korean, then German, and finally Spanish. Pay attention to the language demands as you work on the same task across these three languages. What are you able to figure out and not figure out on your own?

> 다음 방정식이 해가 없도록 하는 값을 찾아 빈 칸을 채우세요:
> $8x - 3x + 2 - x =$ _____ $x +$ _____

Now consider the task in German:

> Schreiben Sie eine Nummer in jeder Zeile das erstellt eine Gleichung mit keine Lösung:
> $8x - 3x + 2 - x =$ _____ $x +$ _____

The cognitive demand of the task (Smith & Stein, 2018) remains the same, but it is important to consider whether your strategies varied when the task was posed in multiple languages. How are the language demands of these two tasks different? Did you attempt to solve either of these problems? If so, what linguistic resources did you use? And now attempt the same problem in Spanish:

> Escribe un número en cada raya para crear una ecuación sin soluciones:
> $8x - 3x + 2 - x =$ _____ $x +$ _____

Regardless of whether or not you are familiar with the three languages above, you have probably already worked out a solution to the problem. But, would your response be considered correct? Without being able to understand the directions, you cannot be sure, can you? This hesitation, this feeling of uncertainty that you are now experiencing is the same one that we worked to create with the EMMC activity.

The EMMC Activity with Teacher Candidates

The EMMC activity we use with TCs is similar to the one we have shared above but consists of five algebra tasks—sample standardized 8th grade mathematics test questions provided by the Michigan Department of Education. The five tasks were chosen because they represented different mathematical content (e.g., slope, (ir)rational numbers) as well as different question forms (e.g., multiple choice, fill in the blank). We present the activity in three phases as detailed next.

Phase I

In the first phase of the activity, we create three groups of four or five TCs (depending on the size of the class) each based on their linguistic expertise. This of course varies depending on the TCs' linguistic repertoires. For example, we might organize the class as follows: Group 1 is familiar (to varying degrees) with Spanish; Group 2 has studied other European languages (e.g., German, French, Portuguese, etc.); and Group 3 is a combination of candidates who identify as English monolingual or familiar with one of the myriad Asian languages (e.g., Japanese, Mandarin, Tamil, etc.).

Each group receives the same five math questions. The only difference is that the language of the test is different for each group. Continuing with the example above, Group 1 receives the German version of the test; Group 2 the Korean version; and Group 3 the Spanish version. Candidates are instructed to attempt each problem and treat this activity as a quiz, working independently for the first five minutes.

When the TCs are asked to silently and independently work on the five math problems in their assigned language, invariably all of the groups we have worked with over the years—despite being directed explicitly to work on the task as if it were a quiz—have started talking with one another almost immediately as they (1) try to figure out what the questions are asking, (2) express confusion, and/or (3) look to their classmates for clues.

Initial reactions from TCs have included to seemingly freeze, put their pencils down, push away from the table, and/or flip the two-sided handout over as they quickly and repeatedly scan the five questions. "I should know how to do this!" is a common statement TCs make as they recognize that these are 8th grade algebra questions. Regardless of the language mediating their task, TCs have tended to gravitate towards the questions that include multiple representations such as graphs, tables, and equations. They also tackle the multiple-choice questions before they attempt the more open-ended tasks.

When time is called, members of the groups are invited to debrief with one another. While the discussion often begins with candidates commiserating about the challenge of the activity, they are asked to also consider three questions:

1. What was your level of access in this activity?
2. What strategies did you use when attempting to solve the problems?
3. How did you physically and/or emotionally react to the activity?

Phase II

Following this small group discussion, we have the TCs reconstitute groups and now form groups that include TCs who attempted the task in all three languages. Posing the same three questions to the new groups, candidates are given time to share their experiences, hear from those who had engaged in the activity in other languages, and compare strategies across languages.

Once the TCs have time to talk across languages in small groups, we invite the class to come back together. Based on their reading of Celedón-Pattichis and Ramirez's (2012) "Consejos from ELL students" as well as their experiences in the EMMC activity, we launch into a discussion of the following:

1. What, if anything, made you successful when attempting the five questions in an unfamiliar language?
2. What, if any, other forms of support could have made you more successful in these tasks?

Over the years, these debrief sessions have taught us that a main takeaway for TCs is the realization that it is impossible to consider mathematics as either language-free or as a universal language (Arnold & Davis-Wiley, 2015). It is equally impossible to separate math learning from language learning (Moschkovich, 2016). TCs also discuss the importance to provide emergent multilingual students with opportunities to use their dominant language as a resource and to make connections across languages when learning mathematics.

In the debrief session, TCs discuss the wide variety of strategies they tried and the varying degrees of success for each. For example, those TCs who work on the German and Spanish tests—languages with which our TCs are generally more familiar—tend to look for and recognize cognates (similarly written and/or pronounced words) such as the German word for square (quadrates) and the Spanish words for rational or irrational (racional ó irracional). In one instance, a TC who was working on the Korean test asked Laura, who studied Korean for a number of years, to read the Korean questions aloud in hopes that she [the TC] would hear cognates—a strategy that proved successful for the word problem asking TCs to calculate the area of a square given that the Korean word for centimeter is 센티미터 [sentimiteo].

We connected our TCs' conversations of support strategies with some of the tenets of the WIDA English Language Development Standards (2012), which speak to emergent multilingual students' academic language development and teachers' instructional supports in content area classrooms. In the above example, the WIDA standards helped frame this instance as an illustration of how attention to cognates can support academic vocabulary use and comprehension while communicating that a students' primary language can serve as a resource for learning mathematics. In addition, we also discussed other categories of support aligned with the WIDA framework.

Phase III

The in-class debrief of the EMMC activity is then continued through an online discussion forum with a focus on relating the in-class experiences with their field placement observations. In particular, TCs are asked to focus on the norms and practices that support and challenge emergent multilingual students in the mathematics classroom.

Teacher Candidates' Insights and Wonderings

> *I think it is important to understand that as explained in class last week, every student is an English language learner [...] Even if it is their first language, there may be diversity in their understanding of English that could help or hinder their mathematical understanding.*

As the above quote from one of our TCs illustrates, there are many insights and wonderings that are made possible by participating in the EMMC activity and the subsequent discussions. These include, but are not limited to, building awareness, understanding language demands, and developing strategies that support emergent multilingual students and are illustrated and discussed next.

Building Awareness

One of the critical questions for math (teacher) educators today is how to build awareness of emergent multilinguals' experiences in the mathematics classroom because without explicit attention to linguistic diversity in the mathematics classroom, chances are that teacher candidates and math educators in general would not pay much attention to the language demands of mathematics teaching and learning (Celedón-Pattichis & Ramirez, 2012; de Oliveira, 2011). This was also true in our course. Although there were some conversations early on that focused on issues of access and equity, none were specifically focused on supporting emergent multilingual students in the mathematics classroom. For example, when our TCs were asked to reflect on their first impressions after their initial week in field placement classrooms, their reflections focused on classroom structure, technology, grading practices, and the teaching of mathematical content. It was only after experiencing the EMMC simulation activity followed by specific prompts to look for linguistic resources and instructional strategies in their field placement classroom that TCs began to notice the myriad ways in which their mentor teachers were supportive of emergent multilingual students.

The discussion prompt—posted on the online discussion board one week prior to the simulation activity—directing TCs to investigate and list the languages other than English that their students were familiar with or had as their first language generated a rich opportunity for TCs to develop awareness about students' linguistic diversity and how it can be a resource in the mathematics classroom. As one candidate recounted in his weekly reflection on the discussion board:

> *The first thing I noticed while I was walking around my teacher's classroom was a world map in the back of the classroom. Being that it was a mathematics*

> *classroom, I found it strange that this would be there. Looking closer I realized there were pins all over the map, recording where students call home. This gave me an idea of the diversity of the school and the various languages that are circulating [in] the school.*

Even we were surprised when our TCs reported that students within their school placement classrooms spoke 19 different first languages, including Hmong, Somali, Spanish, Urdu, and Vietnamese. Additionally, TCs began noticing emergent multilingual students' physical location within the math classroom and the (lack of) interactions between emergent multilingual students and their English monolingual classmates and/or teacher. For example, one TC, connecting his experiences in the field placement classroom to his reading of Celedón-Pattichis and Ramirez (2012), noted that similar to the student in the reading, an emergent multilingual student in his placement classroom "*sit(s) in his chair without talking or with his head down while the rest of the class is discussing problems and figuring things out.*"

Understanding Language Demands and Resources

Another critical question for math educators is how they can better understand and assess the language demands within their classroom. The EMMC activity brought this question to the forefront and as the TCs carried this lens into their field placement they began to ask questions about the language supports and linguistic resources that were (or were not) made available to the students in the math classroom. For example, in response to another TC's post about the ways in which their mentor uses visual representations to teach definitions, one TC simultaneously (1) recognized that teaching definitions is a high language demand activity in the math classroom, and (2) wondered whether the potential benefit of visual resources would be enough to support emergent multilingual students. He writes:

> *I can see how [your mentor teacher's use of] visual representations could help someone who did not understand a verbal explanation, but how does your mentor teacher's use of a lot of definitions assist in an ELL student's understanding?*

Another TC questioned the strategy of grouping students based solely on shared linguistic backgrounds, given her experiences in the simulation activity. By noticing that she had been unsuccessful when attempting to use similar strategies, this TC also wondered about other opportunities that are not afforded to the emergent multilingual students in her field placement classroom. She writes:

> *Our teacher allows our two Spanish-speaking students to sit next to each other in class so that they can support each other's learning and understanding with help from their home language...I notice that these two learners employ strategies such as collaborative studying and learning, note-taking, and using procedural math knowledge to get them through problems whose context they may struggle to understand (much like we tried to do, unsuccessfully, with several of the problems on the [simulation] test during last Wednesday's seminar). Unfortunately these students don't often get the opportunity to communicate their ideas about mathematics during class time instead they wait until after the lesson is finished to ask our teacher for any additional help.*

Strategies that Support Emergent Multilinguals

> *To assist the ELLs in the classroom, my mentor teacher tries to provide as many visuals and definitions as possible. This allows these students to look back and see the definitions and make connections with the pictures instead of having to ask the teacher every time they get tripped up.*

As the reflection above shows, the TCs also engaged with a third critical question for math educators—what strategies can they use to support emergent multilingual students (Chval & Pinnow, 2016; Kalinec-Craig, 2016; Roberts & Truxaw, 2013)? The TCs we have worked with over the years have noticed many resources and supports in their mentor teachers' classrooms. These resources align well with the WIDA standards, which outline three categories of instructional support for language development: sensory, graphic, and interactive. In Table 1, we have mapped onto the WIDA categories our TCs' online discussion posts and the strategies of support they were identifying within their field placement classrooms. This mapping illustrates our TCs' ability to see the

mathematics classroom from an emergent multilingual student's perspective, and their awareness of various instructional support strategies that can be employed in the mathematics classroom. Because of time constraints we did not share this mapping with our TCs, however, we can see the potential it offers for reflection and deepening their understanding. We can also imagine asking our TCs to use the WIDA categories to make sense of their mentor teachers' instructional moves and to support their future conversations about teaching linguistically diverse students in their mathematics classrooms.

Final Reflections

We argue for the importance of experiences like the EMMC simulation activity to help TCs consider the important role of language in the mathematics classroom. We also discuss how continuing the conversation online after the EMMC simulation activity was important to help our TCs build further awareness of how language matters in students' mathematics learning and connect the university classroom content with their field placement classroom. Their willingness to engage with these ideas suggests that the simulation activity is a good way of starting the conversation about multilingualism in the mathematics classroom, which, as de Jong and Harper (2011) noted, is a conversation that needs to become more common in teacher preparation and teacher professional development work more broadly.

Table 1

Teacher Candidates' Discussion Posts Mapped onto WIDA Categories of Support

WIDA Categories	TC Discussion Board Excerpts	Strategies Named in TCs' Posts
Sensory Support: Ways of representing information	*"Visual representations that you mentioned are a huge piece, as those can help students to ascertain the meaning of words without explicitly defining them. These visuals are also beneficial to native English speakers, so it should be a net positive for everyone involved.*"	• Posters • Multimodal instructions • Definition word walls • Drawings and illustrations • Gestures
Graphic Support: Ways of organizing information	*"All of our lessons are taught from printed note packets, which provide fill-in-the-blank style definitions and exercises for students to also use as a resource to access mathematical language."*	• Graphs • Number lines • Graphic organizers • Tables • Guided notetaking
Interactive Support: Ways of communicating	*"Our teacher allows our two Spanish-speaking students to sit next to each other in class so that they can support each other's learning and understanding with help from their home language, and she often lets them take tests and quizzes to the school ESL teacher's room during lunch or after school if they need more time to work on them."*	• In pairs or partners • In small groups • With the math teacher • With an ESL educator

Although the EMMC activity started many productive conversations, it is also clear that one experience is not enough. Some of the TCs' post-activity reflections still reflected deficit perspectives and problematic attitudes towards emergent multilingual students. In the third pre-reading question, for example, we asked you to reflect on a TC's statement (let's call the TC Chris): "*the only ELL student [...] does not speak at all. He keeps to himself and copies his neighbors' notes because he cannot keep up. [My mentor teacher] says that you can only do so much, which I completely agree with.*" This is a statement that one of our TCs made after participating in our EMMC activity. This points to the challenge that lies ahead for TCs as they continue learning to teach across difference (e.g., Zavala, 2016), as well as the challenge for teacher educators facilitating these kinds of experiences with TCs.

In reviewing the discussion board posts, we noted moments where TCs were ever so slightly pushing back on other TCs' use of deficit language regarding emergent multilingual students and what they were (not) able to do in the mathematics classroom. Returning to Chris' reflection specifically, we see their post as a missed opportunity and a place where we, the teacher educators, needed to intervene more explicitly and draw attention to the importance of troubling deficit perspectives and the need for an asset-oriented lens on language diversity in the mathematics classroom. We could have, for example, brought back to class statements made that reflected deficit or asset-oriented perspectives on language diversity and asked our students to engage in a discussion about the importance of and strategies for challenging deficit perspectives for themselves and their peers. We can imagine that this conversation could then lead to a deeper layer of discussion about language privilege, oppression, and suppression in U.S. schools today. We can also imagine bringing into this conversation the TCs' mentor teachers to widen the circle for professional learning about how to not only support emergent multilingual students but also position their linguistic diversity as a resource in the mathematics classroom.

Although the EMMC activity extended beyond the one classroom activity to include connections with course readings and field placement activities, a single class experience is still not enough. Many more of these conversations are needed in order to support candidates' and even experienced teachers' learning of new strategies and new ways to support emergent multilingual students. We invite readers to continue the conversation with colleagues using this activity and the DARE questions below. To close, we share the English version of the initial task to help readers reflect on what we shared in this article. Did you have a clear understanding of the math task? Would you stick to your initial response or would you change it? Although the symbolic equation remains the same across the tasks, reading the task in a more familiar language makes visible aspects of the question that may not have been accessible or clear in the other languages. Finally, we now invite you to take a moment to imagine yourself as the teacher of an emergent multilingual middle school student. We hope that the ideas we have shared in this article can help you to be more aware of the language demands of this task and to consider the sensory, graphic, and interactive support strategies that can help you support emergent multilingual students' learning of mathematics.

Write one number on each line to create an equation that has no solution:

$8x - 3x + 2 - x =$ _____ $x +$ _____

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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. How would you have responded to Chris?

2. How might we extend the conversation about linguistic diversity in the mathematics classroom in a way that builds on the simulation activity that is shared in this article?

3. What challenges and opportunities might you anticipate when using the "Experiencing Multilingualism in the Mathematics Classroom (EMMC) activity with either teacher candidates or practicing teachers?

4. Consider the following two examples from the original EMMC activity and reflect on the language demands of each. What kinds of resources and strategies might students use in order to engage meaningfully and mathematically with these different tasks?

EMMC Task #1

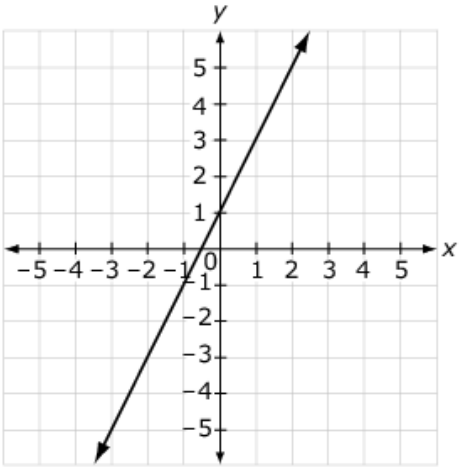
측면의 길이가 *s* 인 정사각형의 면적이 324 제곱 센티미 터이다. 이 정사각형의 측면의 길이는 몇 센티미터인가?

Ein Quadrat mit einer Seitenlänge *s* hat eine Fläche von 324 Quadratzentimeter. Was ist der Seitenlänge des Quadrates in Zentimetern?

Un cuadrado con un lado de longitud *s* tiene una área de 324 centímetros cuadrados. ¿Cuál es la longitud del lado de dicho cuadrado en centímetros?

A square with side length *s* has an area of 324 square centimeters. What is the side length of the square in centimeters?

EMMC Task #2



다음 방정식 중 그 기울기가 주어진 그래프의 기울기보다 큰 것은 무엇인가요?

Welche Gleichung hat eine Veränderungsrate größer als die Veränderungsrate für diese Linie gezeigt?

¿Cuál ecuación tiene un ritmo de variación que es mayor que el ritmo de variación en la línea mostrada?

Which equation has a rate of change greater than the rate of change for the line shown?

A. $y = 3x - 1$ B. $y = x/2 + 4$ C. $y = 2x + 2$ D. $y = x/3 - 3$