

Learning & Teaching

Mathematics Teacher: Learning and Teaching PK-12, is NCTM's newest journal that reflects the current practices of mathematics education, as well as maintains a knowledge base of practice and policy in looking at the future of the field. Content is aimed at preschool to 12th grade with peer-reviewed and invited articles. *MTLT* is published monthly.

ARTICLE TITLE:

AUTHOR NAMES:

DIGITAL OBJECT IDENTIFIER:

VOLUME:

ISSUE NUMBER:

Mission Statement

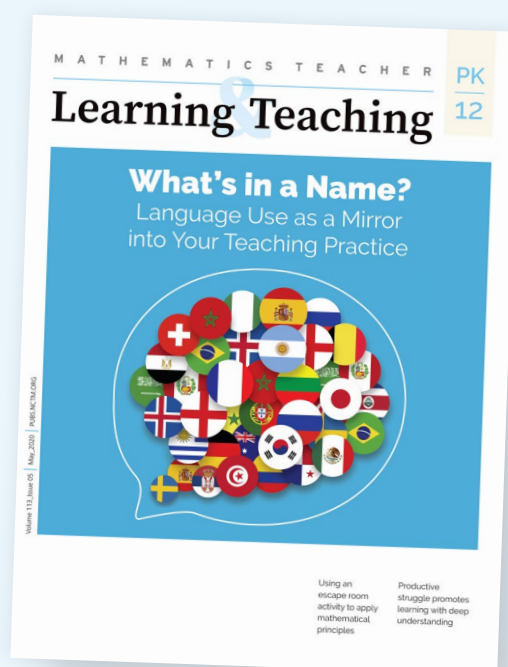
The National Council of Teachers of Mathematics advocates for high-quality mathematics teaching and learning for each and every student.

Approved by the NCTM Board of Directors
on July 15, 2017.

CONTACT: mtlt@nctm.org



NATIONAL COUNCIL OF
TEACHERS OF MATHEMATICS





Access digital content at
nctm.org/mtlt11711g9.



Translanguaging for Linguistically Proud Mathematics Classrooms

Using translanguaging, we empower emergent bilinguals to express themselves and engage in rigorous mathematics. We highlight how translanguaging supports linguistic identities, creates inclusive environments, and enhances learning.

Jiyeong Yi, Jasmine Sourwine, Coskun Erden, Shristi Shrestha, and Betsy Araujo Grando

In a high school Algebra 1 classroom, a teacher projects a slide on the whiteboard that includes a mathematics task in multiple languages after watching a video about car depreciation (see supplementary material [link online]). Then, the teacher, Ms. Rojas (all names are pseudonyms), continues by inviting students

to read the question, “Will the car be \$0 after three years?” aloud in their various home languages.

Ms. Rojas: [After reading the English sentences on the top] Who’s going to read the next one? Can anyone read Swahili?

Amara: I want to read the first one [English].
Ms. Rojas: Okay, you read again the first one. Go ahead.
Amara: Will the car be \$0 after three years?
Ms. Rojas: Thank you. Who's going to read the second line? Anyone?
Imani: Je, gari litakuwa \$0 baada ya miaka 3?
Students: Awesome!
Ms. Rojas: Awesome! [To another student] Do you want to read the Spanish?
Hugo: ¿El auto costará \$0 después de 3 años?
Ms. Rojas: Thank you! Who wants to read the next one? Vietnamese. Go ahead.
Nhi: Chiếc xe sẽ là 0 đô la sau 3 năm?
Ms. Rojas: Great! Next, who is going to read this one?
Students: [To Student 5] French. French, go ahead.
Fatima: La voiture sera-t-elle à \$0 après 3 ans?
Students: Awesome!

Following this multilanguage interaction, the teacher prompted students to share their initial thoughts on the question, guiding them to justify answers using mathematical methods like exponential function graphs and equations. In groups, some drew tables, while others calculated annual car prices through internet searches.

The observation occurred in a high school Algebra 1 class exclusively composed of emergent bilingual students, commonly known as English language learners, originating from diverse regions across Asia, Africa,

and Latin America. Despite the district's emergent bilingual students' population exceeding 20 percent and representing over 100 languages, resources for mathematics teachers were inadequate. To address this gap, we collaborated with Algebra 1 teachers who exclusively taught emergent bilingual students, implementing research-based strategies through monthly sessions focused on co-planning, co-teaching, and co-reflecting. Translanguaging emerged as a particularly effective strategy for enhancing student participation and mathematical comprehension. This article introduces basic strategies for teachers initiating translanguaging pedagogy for emergent bilingual students in mathematics classrooms.

WHAT IS TRANSLANGUAGING?

Translanguaging is the dynamic process in which multilingual speakers use their entire linguistic repertoire to communicate, make meaning, and learn, naturally leveraging their linguistic and cultural resources (García & Baetens Beardsmore, 2009). Instead of separating languages, translanguaging integrates all language knowledge flexibly, allowing bilingual/multilingual individuals to express themselves effectively and engage in content learning, challenging monolingual standards (García, 2011). Languages in bilinguals' systems are intertwined, forming a holistic repertoire, in which mixing languages within sentences reflects

Jiyeong Yi, she/her, jiyeongi@iastate.edu, is an associate professor of mathematics education at Iowa State University. She taught mathematics and science for diverse students in urban areas and has done research about emergent bilinguals, mathematical modeling, teacher education, and culturally sustaining pedagogy.

Jasmine Sourwine, she/her, jasmines@iastate.edu, is a former high school teacher and graduate student at Iowa State University pursuing her PhD in mathematics education. She is interested in fostering learning environments that encourage girls and young women to develop positive relationships with mathematics.

Coskun Erden, cerdent@gmail.com, earned a PhD with mathematics education emphasis from Iowa State University and has over 15 years of high school teaching experience across five countries. He teaches mathematics at Centennial High School, Atlanta, GA.

Shristi Shrestha, she/her, shristi@iastate.edu, is pursuing an MS in human computer interaction at Iowa State University, with a focus on generative AI in education. She is dedicated to creating human-centered technology and champions inclusive innovation.

Betsy Araujo Grando, betsya@iastate.edu, is a PhD candidate in human computer interaction at Iowa State University, studying the use of educational technology and AI for teaching mathematics to emergent bilinguals. She has experience teaching mathematics abroad and working as an instructional designer.

doi:10.5951/MTLT.2023.0333

proficiency (García, 2011). Restricting bilingual students to one language creates artificial boundaries and hinders synergistic bilingual development (Fu et al., 2019).

Implementing translanguaging in classrooms also challenges the rigid monolingual principles inherent in current mathematics education policies, curricula, and practices. It entails sharing teachers' authority with students, equalizing learning opportunities between English speakers and emergent bilingual students and transforming monolingual norms into a diverse linguistic environment. In a translanguaging classroom, bilingual/multilingual students use their full non-separating linguistic repertoire, enabling teachers to understand their mathematical reasoning comprehensively (Gomez et al., 2020). Additionally, monolingual English-speaking students broaden their worldviews, enhancing their awareness and knowledge of other cultures and languages, and fostering an appreciation for linguistic and cultural diversity (Fu et al., 2019).

Moreover, translanguaging plays a pivotal role in fostering the co-construction of identity, a critical factor in academic success (Reyes & Vallone, 2007). For instance, within multilingual immigrant Latinx communities, translanguaging is integral to identity formation and a sense of belonging (Noguerón-Liu & Warriner, 2014). Through translanguaging, educators can validate and celebrate emergent bilingual students' positive bilingual identity, recognizing their capacity to use multiple languages as a source of pride and self-identity (García-Mateus & Palmer, 2017). This affirmation sets the stage for more empowering and immersive educational experiences.

While translanguaging classrooms create dynamic learning environments that honor emergent bilingual students' bilingual identities (García et al., 2017), implementing translanguaging pedagogy challenges educators, especially those without a bilingual background. It goes beyond translation, and simply using bilingual materials may not be enough (DiNapoli & Morales, 2021). Furthermore, sourcing academic resources in multiple languages may strain teachers. Hence, this article proposes strategies for starting a translanguaging mathematics classroom, empowering emergent bilingual students to take pride in their linguistic diversity while gaining access to a rigorous mathematical education.

In developing initial strategies, we adhered to three key principles of translanguaging practice (Fu et al., 2019):

1. *Individuals possess a unified linguistic repertoire.* Teachers should respect emergent bilingual students' use of their first/native/heritage language or English in whichever mixed ways they can convey meaning effectively.
2. *Teachers are co-learners in the classroom.* Responsibility for finding and selecting academic resources is shared with the entire class community, valuing students and their families as experts in their cultures and languages. In translanguaging classrooms, teachers embrace learning from students, rather than solely possessing knowledge.
3. *Translanguaging practice is purposefully integrated into instructional planning.* Teachers should design and prepare translanguaging strategies and instructional materials in advance. Merely encouraging students to use their language for every task may not effectively or safely invite participation.

The following section outlines how our project applied translanguaging strategies in line with these principles.

BEGINNING TRANSLANGUAGING STRATEGIES

We introduce four translanguaging approaches, consistently applied across multiple high school Algebra 1 classes, comprising entirely emergent bilingual students with diverse English proficiency levels, grades/ages, and prior mathematics knowledge. These strategies were developed without extensive preparation, were implemented daily, and were better responded to by students over several months, adapting to the linguistic dynamics of each class. The timeline and frequency were adjusted according to the existing language atmosphere of each class; some classes already embraced a comfortable space for emergent bilingual students to use their native languages, while others needed more time for establishment.

Present Mathematics Tasks in All Students' Languages

Ensuring mathematics accessibility is essential when teaching emergent bilingual students, as further learning and discussion hinge on grasping mathematics tasks. To enhance accessibility, teachers must offer emergent bilingual students pathways toward understanding content construction, leveraging their

cultural and linguistic strengths rather than simplifying texts (de Oliveira, 2012; I, 2019; I & Martinez, 2020).

To help emergent bilingual students access the mathematics tasks, we displayed the translation slide (see supplementary material [link online]) of mathematical problems in the students' native languages, using tools like Google Translate, with support from district interpreters and proficient bilingual students. As detailed in the introduction excerpt, students from diverse linguistic backgrounds were invited to volunteer, reciting problem statements in their native languages. This translanguaging approach underscores the value of students' cultural and linguistic assets as intellectual resources (Celedón-Pattichis & Ramirez, 2012), engaging all students linguistically to ensure effective comprehension of mathematical challenges (DiNapoli & Morales, 2021) and affirming their roles as valuable classroom contributors.

This strategy fosters a safe linguistic environment in classrooms. As students read aloud in their native languages, smiles and encouraging remarks like “That’s cool” boosted confidence, evident in speakers holding their heads higher with pride. Previously quiet students eagerly volunteered to read sentences in their language, becoming more involved in the tasks. Teachers capitalized on this opportunity to instill respect for speakers, fostering an atmosphere in which students value each other’s contributions. Creating a translanguaging slide with Google Translate took a minute, and students spent under five minutes reading problems aloud in their native languages. Considering Google Translate’s imperfections, we encourage students to verify accuracy, recognizing their language expertise. For languages not supported by Google Translate, we sought assistance from district interpreters or proficient bilingual students.

This strategy fulfills all three tenets of translanguaging practice. It engages emergent bilingual students in English and their native language, fostering a culture of knowledge sharing. Teachers need to know their emergent bilingual students’ primary languages to prepare the translation slide and learn from their students, co-learning with those who speak different languages.

Students’ Use of First Language for Group Discussions

After understanding the mathematics problems, emergent bilingual students worked to solve them

in groups using translanguaging, known to enhance engagement and text comprehension (Mbirimi-Hungwe, 2021). We occasionally organized students into language-based groups to encourage using their native languages during discussions. For example, in one class, Spanish and French/Swahili speakers formed language-specific groups, facilitating using their primary language alongside English. This approach eases the dual pressure of English and mathematics, allowing bilingual students to express and understand ideas seamlessly. Each group was given chart paper for collaborative notetaking, allowing all members to communicate through writing and drawing while discussing mathematics.

In the following example, a group composed of two Spanish speakers (Miguel & Carlos) and one student fluent in Swahili/French (Omar) collaborated to solve the problem: “How long would it take to help all students in our high school if we do a good deed for four people and ask them to ‘pay it forward’ to four others in need?” (see supplementary material [link online]). The students were provided the school’s total population of 950. They iteratively multiplied by the given growth factor (4) and recorded when the number exceeded 950.

Miguel: So, this is the total population that we have [circles 950]. So, I think the people are gonna be helped two times, I think. They will repeat again.

Omar: It will be increased?

Miguel: I think if we keep going.

Omar: Yeah, it’s going to be a bigger number.

Miguel: [Draws a line above 1,024 on his table] We are kind of one thousand.

Carlos: Oye, aqui tengo doscientos cincuenta, no es mil veinticuatro, no quinientos doce (Hey, here I have two hundred and fifty-six, it’s not one thousand twenty-four, not five hundred twelve).

Miguel: Multiplicado por cuatro (multiplied by four).

Carlos: ¿Por que le pusiste quinientos doce? (Why did you put five hundred twelve?)

In the discussion above, students demonstrate flexible language use, employing English and Spanish to communicate, comprehend the task, and accommodate varying language proficiencies. Miguel, fluent in both languages, facilitated the discussion between Omar, who does not understand Spanish, and Carlos, who often used Spanish because of his low English fluency. While each student created a table of

powers of four, Miguel suggested that some students received help twice because his calculation (1,024) exceeded the student population (950). However, Carlos noticed a mistake in Miguel's table when comparing it to his own and queried in Spanish why Miguel included 512, which is not a power of four. Then, Miguel, who had been using English, explained in Spanish his method, "multiplicado por cuatro (multiplied by four)," without realizing his mistake.

Following this, a teacher visiting their group inquired about their approach, prompting Miguel to explain his table in English. The teacher encouraged them to justify their solution in the context, suggesting, "Why don't you graph the table?" Later, the students rectified the mistake using exponential graphs and equations. Leveraging their collective linguistic repertoire, the students modeled the exponential situation, questioned, reasoned, and communicated their understanding of the problem. This strategy requires minimal daily effort and time to implement.

Many students expressed gratitude and comfort regarding this strategy during interviews. In the following excerpt, a student attributed her improved group performance to using her first language in discussions: "It's more easy for me it's explain to other classmates in my language. Like I know how to say. But in English, I have to translate and display others. And also because the other classmates they learning English, it's hard too. It's double hard." Despite being "double hard," students also use English to communicate with the English-only teacher and peers. One student explained, "When the teacher is walking around us, we speak English so she can understand."

This strategy embodies the first tenet of translanguaging practice, allowing students to use their full linguistic repertoire during mathematical discussions without language restrictions. Careful grouping before the lesson considered the synergistic relationship between students, mathematical knowledge, and their fluent languages, satisfying the third tenet.

Students' Presentation in Native Languages

To nurture positive bilingual identities among emergent bilingual students (Bucholtz et al., 2017), we implemented group presentations in students' native languages. During a lesson featuring the problem "Which bank account (savings or CD) is a better plan for you?" students used their native language for group presentations. Initially hesitant to present in languages

unfamiliar to the teacher, students gained confidence after the first author demonstrated a presentation in Korean, realizing that visual aids and gestures aided understanding, even if the language was unfamiliar. They also observed positive reactions from peers and enjoyed presentations in unfamiliar languages. A similar sense of pride and admiration arose when the first volunteer from Africa shared her group's solution strategy in French.

This strategy may require several attempts before students feel comfortable sharing their mathematical ideas in their native language. Teachers should allocate at least five minutes for groups to prepare their presentation, such as searching for mathematics terms in their native language. Large paper or a display for student work can serve as a visual reference while presenting, allowing presenters to point out critical steps. This approach can be implemented daily, adjusting the number of presentations as needed. To streamline the process and enhance comfort levels, a gallery walk can be used, with students sharing questions and feedback via Post-Its in their preferred language. To provide feedback and involve other students, teachers can restate and explain students' solutions in English, serving as an anchor language.

Allowing students to present in their native language upholds all three tenets of translanguaging pedagogy. They can use verbal and nonverbal communication methods to showcase their comprehension of the concept, irrespective of correctness (Bucholtz et al., 2017). This approach fosters pride, instills social belonging, and positions students as authorities in both language and mathematics. Devoting time to this strategy allows multiple participants to demonstrate their understanding and flexible language use, fulfilling the third tenet.

Writing Journals in Native Languages

Translanguaging is deemed the most effective method for enhancing emergent bilingual students' writing competencies (Kiramba, 2017; Velasco & García, 2014). Our final translanguaging strategy involved allowing students to write journals in their preferred languages. For instance, in a lesson with the objective "I can graph a quadratic function given in the factored form," students were asked to explain why an answer was incorrect. Students could answer in their home language. For example, a Spanish-speaking student in Algebra 1 wrote their explanation in English (see Figure 1). Many completed their journal responses in their

native language (Translation: “Because the signs are reversed: The correct answer is . . .”), while others used English or a combination of both.

The flexibility alleviates the social and emotional pressures emergent bilingual students consistently face in English-speaking academic environments. In English-only classrooms, emergent bilingual students must navigate additional steps to process and express their thoughts, including internal translation and conceptualization (Celedón-Pattichis & Ramirez, 2012). By embracing multiple modes of communication, we empower them with flexibility in expressing understanding and allow more time for mathematical tasks, rather than translation. Students’ responses are clear and often include mathematical notations, demonstrating their grasp of mathematics. Additional measures—such as leveraging tools like Google Translate—can ensure students have a solid understanding. Teachers can implement this strategy without requiring extra material preparation. This approach also facilitates quicker responses during class and is suitable for daily use in formative assessments and exit tickets.

This strategy strongly upholds the first and third tenets of translanguaging practice by enabling students to employ their entire linguistic repertoire in written responses. It was carefully planned and executed to ensure students had sufficient time in the lesson to engage with the written task and demonstrate their understanding effectively.

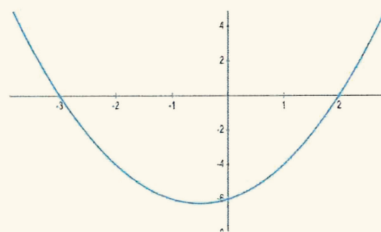
FINAL RECOMMENDATIONS

Our final recommendation emphasizes patience with students while upholding an asset-based view and trust in their capability. Initially, we noticed some hesitancy among students when we introduced translanguaging strategies. However, with consistent implementation and demonstration, we observed a gradual increase in student participation. For instance, many students initially declined to read problems aloud in their native languages. However, numerous previously hesitant students volunteered without prompting by the end of the year. This was often the only time we heard their voices in the classroom, making it a crucial opportunity to share their language. Witnessing a student confidently speaking in their first language and volunteering to read the main problem was genuinely gratifying, as it empowered them to engage actively in mathematical discussions. These small successes highlight the effectiveness of translanguaging and underscore the value of perseverance.

Teachers may face challenges when implementing translanguaging, including identifying suitable resources, allocating time for translanguaging in lessons, and assessing student understanding in languages the teachers may not speak. To address these challenges, we propose four beginning translanguaging strategies suitable for both monolingual and multilingual teachers. These strategies require minimal preparation and class time, offering flexible

Figure 1 Journal Entry Written in English

2. [REDACTED] was trying to graph $y = (x - 3)(x + 2)$. Her graph is to the right. She thought the x-intercepts were 3 and -2. Why is she wrong?



Explain:

Porque los signos estan cambiados - La respuesta correcta es =
 $y = (x - 2)(x + 3)$

support for students while maintaining high expectations. While some strategies—such as encouraging students to discuss and write journals in their native languages—can be integrated daily, others may require more time for full implementation. Additionally, we suggest implementing the first strategy when teaching real-life word problems to ensure translated questions are free of jargon. Although our visits to Algebra 1 classes were occasional, hindering the execution of more rigorous translanguaging strategies, we encourage teachers who effectively apply these initial steps to explore further, long-term translanguaging practices. These may include sourcing academic resources relevant to students' cultures and languages and fostering cultural and linguistic diversity in the classroom to promote community and collaboration.

Highlighting translanguaging practices shifts the perception of these students as capable individuals who adeptly confront challenges and assume responsibility for their learning. In a translanguaging classroom, students whose everyday language practices may not typically be valued in school find themselves at the forefront (Durán & Palmer, 2014; Palmer et al., 2014).

This environment underscores emergent bilingual students' bilingual identities as they engage with mathematics, presenting a perspective that emphasizes the restoration of humanity and inclusiveness for all students within the group (DiNapoli & Morales, 2021). The teacher's remark during the exit interview illustrates the rehumanizing process with students' pride in the translanguaging classroom:

If there's somebody speaking in their own language, he's proud. He's proud of his language. He's proud of his accent. He's proud of everything it sounds. Because it's his language, [his] mother language. And others learn how to respect when you're talking.

In translanguaging classrooms, embracing linguistic diversity boosts linguistic pride among emergent bilingual students, strengthening their positive bilingual identities (García-Mateus & Palmer, 2017). Celebrating languages and leveraging them for academic progress are crucial for fostering confidence in using multiple languages. This significantly enhances educational success and personal development. —

REFERENCES

- Bucholtz, M., Casillas, D. I., & Lee, J. S. (2017). Language and culture as sustenance. In D. Paris & H. S. Alim (Eds.), *Culturally sustaining pedagogies: Teaching and learning for justice in a changing world* (pp. 43–59). Teachers College Press.
- Celedón-Pattichis, S., & Ramirez, N. G. (Eds.). (2012). *Beyond good teaching: Advancing mathematics education for ELLs*. National Council of Teachers of Mathematics.
- de Oliveira, L. C. (2012). The language demands of word problems for English language learners. In S. Celedón-Pattichis & N. G. Ramirez (Eds.), *Beyond good teaching: Advancing mathematics education for ELLs* (pp. 195–205). National Council of Teachers of Mathematics.
- DiNapoli, J., & Morales Jr., H. (2021). Translanguaging to persevere is key for Latinx bilinguals' mathematical success. *Journal of Urban Mathematics Education*, 14(2), 71–104. <https://doi.org/10.21423/jume-v14i2a390>
- Durán, L., & Palmer, D. (2014). Pluralist discourses of bilingualism and translanguaging talk in classrooms. *Journal of Early Childhood Literacy*, 14(3), 367–388. <https://doi.org/10.1177/1468798413497386>
- Fu, D., Hadjioannou, X., & Zhou, X. (2019). *Translanguaging for emergent bilinguals: Inclusive teaching in the linguistically diverse classroom*. Teachers College Press.
- García, O. (2011). Educating New York's bilingual children: Constructing a future from the past. *International Journal of Bilingual Education and Bilingualism*, 14(2), 133–153. <https://doi.org/10.1080/13670050.2010.539670>
- García, O., & Baetens Beardsmore, H. (2009). Assessment of bilinguals. In O. García (Ed.), *Bilingual education in the twenty-first century: A global perspective* (pp. 366–378). Wiley-Blackwell.
- García, O., Johnson, S. I., Seltzer, K., & Valdés, G. (2017). *The translanguaging classroom: Leveraging student bilingualism for learning*. Caslon.
- García-Mateus, S., & Palmer, D. (2017). Translanguaging pedagogies for positive identities in two-way dual language bilingual education. *Journal of Language, Identity & Education*, 16(4), 245–255. <https://doi.org/10.1080/15348458.2017.1329016>
- Gomez, C. N., Jones, S. R., & Tanck, H. (2020). “Whenever my mom speaks Spanish at home, it helps me understand more in math”: Reflections on the testimonios of bilingual Latinx students. *Teaching for Excellence and Equity in Mathematics*, 11(2), 43–51.
- I, J. (2019). Preservice teachers' mathematics task modification for emergent bilinguals. *School Science and Mathematics*, 119(3), 127–141. <https://doi.org/10.1111/ssm.12325>
- I, J., & Martinez, R. (2020). *Teaching math for emergent bilinguals: Building on culture, language, and identity*. Iowa State University Digital Press. <https://doi.org/10.31274/isudp.2020.57>
- Kiramba, L. K. (2017). Translanguaging in the writing of emergent multilinguals. *International Multilingual Research Journal*, 11(2), 115–130. <https://doi.org/10.1080/19313152.2016.1239457>
- Mbirimi-Hungwe, V. (2021). An insight into South African multilingual students' perceptions about using translanguaging during group discussion. *Applied Linguistics*, 42(2), 252–268. <https://doi.org/10.1093/applin/amaa012>
- Noguerón-Liu, S., & Warriner, D. S. (2014). Heteroglossic practices in the online publishing process: Complexities in digital and geographical borderlands. In A. Blackledge & A. Creese (Eds.), *Heteroglossia as practice and pedagogy* (pp. 179–197). Springer.
- Palmer, D. K., Martínez, R. A., Mateus, S. G., & Henderson, K. (2014). Reframing the debate on language separation: Toward a vision for translanguaging pedagogies in the dual language classroom. *The Modern Language Journal*, 98(3), 757–772. <https://doi.org/10.1111/modl.12121>
- Reyes, S. A., & Vallone, T. L. (2007). Toward an expanded understanding of two-way bilingual immersion education: Constructing identity through a critical, additive bilingual/bicultural pedagogy. *Multicultural Perspectives*, 9(3), 3–11. <https://doi.org/10.1080/15210960701443433>
- Velasco, P., & García, O. (2014). Translanguaging and the writing of bilingual learners. *Bilingual Research Journal*, 37(1), 6–23. <https://doi.org/10.1080/15235882.2014.893270>