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**“Encontré Algo Mejor” / “I Found Something Better”:  
Trans- Perspectives and Raising Critical Consciousness with  
Secondary Bilingual/Multilingual STEM Teachers**

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**ABSTRACT:** This study presents findings from a professional development project that engaged secondary school in-service STEM teachers in transformative perspectives to make sense of theory, practice, and action in multilingual STEM classrooms. In particular, we examine how teachers engaged with translanguaging, transdisciplinarity, and transculturation in critical reflections and course discussions to promote critical consciousness. Findings reveal that trans-perspectives were interconnected and integral in promoting criticality and equity-minded STEM teaching in bilingual contexts. Teachers historicized personal experiences through translanguaged narratives; connected and integrated STEM language and content knowledge through transdisciplinary practices; and grappled with the role of culture in STEM learning through transcultural repositioning.

**KEYWORDS:** Translanguaging, transdisciplinary, transculturation, bilingual/multilingual learners, STEM teacher development

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This study examines how bilingual in-service STEM teachers engage trans-perspectives of translanguaging, transdisciplinarity, and transculturation to promote critical consciousness in bilingual STEM classrooms. Through a professional development (PD) project, secondary school in-service science,

technology, engineering, and mathematics (STEM) teachers were engaged in critically examining issues that are central to bilingual education, including problematizing content and language assessments, equity and achievement patterns in STEM for immigrant children and heritage language learners, and identity formation for bilingual/multilingual learners (BMLs) (Olson et al., 2020). Both secondary school and STEM education remain under-examined schooling contexts for BMLs and their teachers despite long-standing patterns of marginalization through the implementation of inequitable educational policies and practices (Brooks, 2019; Callahan et al., 2021; Mosqueda & Maldonado, 2013; Mosqueda et al., 2021; National Academies of Sciences, Engineering, and Medicine [NASEM], 2018; Solís & Bunch, 2016).

Our analysis engages boundary-breaking perspectives that shape and reflect a form of decolonial pedagogical praxis or *transformative pedagogy* which moves beyond traditional instructional practices involving BMLs in STEM. We draw from three interrelated trans-perspectives (translanguaging, transdisciplinarity, and transculturation) because they offer a productive multidimensional lens for supporting, examining, and transforming dominant epistemologies linked to teacher learning within bilingual/multilingual STEM contexts (Canagarajah, 2022; del Carmen Salazar, 2013; Franquiz & del Carmen Salazar, 2004; Martin-Beltrán, 2014; Poza, 2018; Solís et al., 2024). The analysis builds on cultural and linguistic theories that advance cultural and linguistic fluidity, critical consciousness, innovation, and hybridity in the context of bilingual/multilingual teacher education and professional development. A “trans-” approach offers potential within BMLs’ educational context to engage in “contesting and disrupting the boundaries that have shaped the relationships between language, identity, and culture” related to monolingualism, language-free teaching, and linguisticism (Zaidi et al., 2023, p. 1992).

The present study contributes to the gap in research on approaches where bilingual STEM teachers integrate literacy, language, and culture in critical ways by examining the experiences of participating in-service STEM practitioners who identified as bilingual and joined a professional development project to gain a certification in bilingual education. The *Leveraging Bilingualism and Literacy for Secondary English Learner STEM Content Access* (Project Leverage) underscored the importance of critical sociocultural knowledge-making and STEM biliteracy. The project supported STEM teachers in leveraging BMLs’ lived experiences and full language repertoires to build STEM knowledge and integrate language and literacy into STEM content (Bravo et al., 2022; Mosqueda et al., 2022). As one teacher, Aria, stated in her course reflection (Figure 10) and part of the title of this paper, “encontré algo mejor” (“*I found something better*”), noting that the Leverage PD provided a more humanizing experience than other professional learning opportunities she had encountered before.

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## Conceptual Framework and Literature Review

Our conceptual framework combines three trans-pedagogical perspectives (translanguaging, transdisciplinarity, and transcultural repositioning) for examining how teachers grapple with and orient to language, literacy, and culture in STEM teaching. This intersection of trans-pedagogical perspectives contributes to the emergent literature on bilingual teacher learning and STEM professional development. Moreover, this approach offers a promising lens for investigating bilingual teaching practices as enactments of bilingual identities through an analysis of teacher reflections on their professional development experiences.

### Trans-Pedagogical Perspectives, Bilingual Teaching, and Praxis

Our analysis examined three interrelated trans- perspectives (translanguaging, transdisciplinarity, and transcultural repositioning) as integral for locating how bilingual in-service STEM teachers promote critical consciousness-raising, as well as how they contest and rethink what it means to integrate culture, literacy, and language in STEM contexts. These trans- perspectives are part of an interrelated, multi-layered, non-hierarchized pedagogical orientation as they simultaneously possess the potential to deconstruct/reconstruct macro, meso, and micro-pedagogical practices and policies involving language and culture. We argue that these interrelated trans- perspectives have the potential to decenter harmful raciolinguistic ideologies that silence and undervalue the voices of bilingual teachers of color within teacher education and broader curricular approaches in BML STEM education (Amanti, 2019; Daniels & Varghese, 2020; Flores & Rosa, 2015). Thus, we find trans- perspectives provide a way for educators of BMLs to grapple with the integration of theory and practice by reinventing their praxis, thereby affording STEM teacher theory-making and action (Darder, 2017).

### *Translanguaging as Philosophy and Pedagogy*

Translanguaging is important as both a stance and pedagogical approach, facilitating BMLs' disciplinary learning in STEM contexts. Translanguaging refers to the concept that multilingual language practices are dynamic and fluid rather than autonomous and discrete, emphasizing the interconnectedness across named languages and communicative systems (García & Wei, 2014). From a translanguaging perspective, all linguistic resources are viewed as part of an integrated linguistic repertoire, thus challenging monoglossic and purist language ideologies. When language is viewed as part of a larger communicative and semiotic repertoire, home and community knowledge can be leveraged for STEM learning (Seilstad et al., 2019; Wilson-Lopez & Acosta-Feliz, 2022). Leveraging

students' communicative repertoires through translanguaging legitimizes linguistic resources and, subsequently, supports STEM learning (Charamba, 2020; Seilstad et al., 2021). In this way, translanguaging intersects with transdisciplinarity and transculturation to inform how language, culture, and STEM learning integrate with one another. When instruction fails to legitimize students' translanguaging abilities, students lose opportunities to negotiate meaning in disciplines like science (Britsch, 2020; Zhang, 2016). A translanguaging approach instead allows students' languages to "work together in the same discourse" (p. 342) as a tool for learning.

Translanguaging can refer to a specific pedagogical approach as well as a stance or philosophical approach (Solís et al., 2018; Wei, 2018). A translanguaging stance is a necessary philosophical orientation for building a translanguaging classroom, and fundamental to a translanguaging stance is a strong social justice orientation (Canagarajah, 2013; García et al., 2017; García & Leiva, 2014). Thus, translanguaging involves not just a fluid understanding of linguistic practices but also the centering and valuing of students' linguistic and cultural practices with the goal of working toward a more just society. As García and Wei (2014) explain, translanguaging is not merely the addition of two separate languages but instead "refers to *new* language practices that make visible the complexity of language exchanges among people with different histories" (p. 21, emphasis in original).

### ***Transdisciplinary Practices to Improve Meaning-Making in STEM***

Our approach considers transdisciplinary bilingual STEM teaching and learning as attending to both the mixing and (re)integration of language and the crossing of varied disciplinary content areas with possibilities of reaching a synergistic effect (Buxton et al., 2019). Within STEM education, a transdisciplinary approach can be seen as pushing from within and outside of disciplinary boundaries by questioning normative, standardized ways of working. Here we draw from the notion that STEM transdisciplinarity is "going beyond amalgamation of two or more disciplines, to include the synergistic and reflexive relationship achieved through dialogues among people, practices, and constructs from multiple disciplines" (Takeuchi et al., 2020, p. 239). Moreover, we see the integration of language and literacy development within STEM education as a form of transdisciplinarity. Research on BMLs in STEM has shifted to consider several important transdisciplinary practices to deepen students' understanding beyond STEM content, including disciplinary literacy, culturally responsive teaching, use of translanguaging practices promoting students' full linguistic resources, and maximizing opportunities to learn through an equity and social justice lens (Buxton et al., 2019; Jakobsson et al. 2021). Transdisciplinary learning has argued for a "practice turn" emphasizing "social aspects and material aspects of scientific practice," as well as "practice as the interplay of roles" (Ford & Forman, 2006, p. 24). Such a turn in STEM practices reflects a shift away from traditional decontextualized notions of disciplinary teaching. This view is in line with approaches that focus on language and literacy practices ("ways of thinking,

reading, writing, and knowing”) (Bunch & Martin, 2021, p. 541) as intrinsically interconnected with the nature of the disciplines (e.g., argumentation structures in science; reading visual literacy in mathematics) (Moje, 2015). In addition, incorporating a translanguaging lens into STEM content classrooms bridges everyday practices and foundational disciplinary practices in ways that result in new forms of knowledge that can also promote more equitable learning opportunities for multilingual students (Pierson & Grapin, 2021). This research highlights the interconnectedness of transdisciplinary practices in STEM with translanguaging pedagogy and transculturation. We examine instances that emphasize the potential synergy that is born when teachers present BMLs with access to the language practices of the discipline, providing opportunities for BMLs to become insiders to STEM disciplines.

### ***Transcultural Repositioning***

The third concept of our trans- perspective for bilingual STEM teaching and learning is transcultural repositioning which advances the notion that teachers and students are critical cultural actors. Examining bilingual STEM teachers’ leveraging of BMLs’ sociocultural knowledge is inherently about the transculturation of official, unofficial, and in-between cultural knowledge (Baquedano-López et al., 2005; Gutiérrez, 2008; Gutiérrez et al., 1999; Roth, 2008). Culture and education as they relate to BMLs has received extensive albeit disparate scholarly attention (Delgado-Gaitan & Trueba, 2022; García, 1993; McDermott & Varenne, 1995; Nasir et al., 2020; Ogbu, 2004; Rumbaut & Portes, 2001; Trueba, 2002). However, a relevant focus for our analysis describes how institutional practices and particular actors within schooling institutions produce and reproduce hierarchized cultural knowledge reflective of broader social structures and systems of power (Duff, 2010; Mangual Figueroa, 2017; Mosqueda et al., 2021; Solís et al., 2009). Drawing from previous conceptualizations of transculturation (Ortiz 1940/2019; Pratt, 1991; Zamel, 1997), Guerra (2004; 2007) proposes the use of “transcultural repositioning” as the ubiquitous rhetorical practice enacted by “border dwellers” or members of marginalized communities. Here we draw from Guerra’s (2004) work on transcultural repositioning as the rhetorical ability “to move back and forth productively between and among different languages and dialects, different social classes, different cultural and artistic forms, different ways of seeing and thinking about the increasingly fluid and hybridized world emerging all around us” (p.35). Transculturation arises in the scholarship as a response to essentializing and static conceptions of culture inherent in notions of cultural processes like assimilation and acculturation. Moreover, by linking the rhetorical, discursive identity work of transculturation, Guerra reveals how members of marginalized communities, such as bilingual/multilingual teachers and students, are constantly involved in productive repositioning of their identities and discourses within and across communities and institutions to demonstrate membership. We argue that STEM teachers can similarly “constitute and reconstitute their lives” (p. 161) through rhetorical practices as they participate in and traverse different cultural

communities such as PD communities of practice and their STEM communities.

### **Bilingual Teacher Learning and STEM Professional Development**

There is a strong research base on approaches that emphasize language and literacy integration that allows teachers of BMLs to amplify and leverage critical STEM discourse and literacy practices (Infante & Licona, 2021; Lyon et al., 2018). Research that examines literacy practices in dual language bilingual education contexts shows that these approaches promote students' use of their full bilingual-bicultural repertoire, contributing to deepened conceptual understanding in STEM content courses (Bravo et al., 2024). In science, for example, engaging BMLs in carefully planned small group conversations can support the development of scientific explanations and argumentation and deciphering scientific texts (Ardasheva et al., 2019; Swanson et al., 2014). Attending to cultural and linguistic knowledge in science, such as science funds of knowledge and translanguaging, is important because it allows BMLs to mobilize and embody their bicultural-bilingual repertoire (Britsch, 2020; Infante & Licona, 2021; Seilstad et al., 2019; Wilson-Lopez & Acosta-Feliz, 2022). Similarly, BMLs engaged in mathematical discourse communities develop mathematics registers and gain a deeper understanding of math concepts when teachers focus on mathematical thinking and reasoning through mediation of relevant artifacts, models, and representations (Avalos & Secada, 2019). Teachers can also promote a bidirectional language approach where multiple languages are used to express students' mathematical thinking, mathematical discourse, numeracy, and problem-solving (Rubinstein-Avila et al., 2015). Access to STEM for BMLs requires addressing the complex interplay between sociocultural resources and language and literacy demands presented in STEM lessons (Bravo et al., 2022; Mosqueda et al., 2016; Mosqueda et al., 2022; Stephens & Francis, 2018), suggesting the benefits of a trans-approach in teacher learning.

### **Bilingual Teaching Practice as Enactments of Bilingual Identities Through PD and Critical Reflections**

This paper contributes to approaches that consider bilingual teaching practices as enactments of bilingual teacher identities, particularly through critical teacher reflections on those teaching practices (Bustos Flores & Riojas Clark, 2017; Morales, 2018). Creating spaces for bilingual teachers to critically reflect on their experiences, whether through methodologies such as life-history (Garza, 2019), *autohistoria*, and autobiographies (Ek & Domínguez Chávez, 2015; Harvey-Torres & Degollado, 2021; Herrera, 2022), or narrative approaches (Galindo, 1996; Miller 2017; Morales, 2018; Nuñez et al., 2021) enables bilingual teachers to negotiate their identities within social and institutional contexts. For example, bilingual teachers may reflect on their negative or challenging schooling

experiences related to linguistic oppression, overt racism, and/or negotiating their immigrant status (Espinoza & Kohler, 2022). In revisiting harmful memories, teachers articulate their intentions to be teachers who celebrate and advocate for their students, striving to be role models and providing support and validation to Latinx<sup>1</sup> youth and often bridging their experiences with the lived realities of their students (Garza, 2019; Miller, 2017). Furthermore, revisiting these negative experiences creates openings for bilingual teachers to “reinvent” their memories and heal. The process of critically reflecting, whether through memories, specific school experiences, *testimonios*, or storytelling, creates opportunities for navigating identity tensions, connecting negative experiences to purpose and healing, resilience, and negotiating a positive self-identity (Espinoza & Kohler, 2022). These practices are of particular importance for STEM bilingual teachers who must negotiate these identities and experiences within their STEM content, which often promotes a more “sterile” and “evidence-based” existence.

Furthermore, critical reflections on bilingual teacher PD are essential for bilingual teachers to negotiate their identities as critically conscious advocates for bilingual education (Bustos Flores & Riojas Clark, 2017). This research often reflects processes of “becoming” or developing critical stances as bilingual teachers negotiate what it means to be a *bilingual* teacher (Nuñez et al., 2021). Through ongoing engagement with the process of “looking within,” bilingual teachers reflect on feelings of invisibility and inferiority in their own schooling experiences in order to embrace their bilingualism and develop critical bilingual literacies (Herrera, 2022). In Ek’s and Domínguez-Chávez’s (2015) study, bilingual teachers in a master’s program for Latinx veteran teachers authored themselves as Latinx bilingual teacher-agents and advocated through autobiographies, reflections, and dialogues. Thus, research reflects that the ongoing “journey” to becoming a bilingual teacher involves not just an embrace of bilingualism but also the development of critical consciousness as teacher agents and advocates. Our analysis advances a line of inquiry related to bilingual STEM teacher PD that combines language and literacy integration, the importance of critical teacher identity reflection, and reveals the ways teachers engage with complex, overlapping, and permeable notions of language, disciplinarity, and culture in the STEM classroom.

## Methods

Using a qualitative, descriptive case study methodology (Merriam, 1998) and drawing on a discourse analysis approach (Rymes, 2015; Wortham & Reyes, 2020), we analyze the critical reflections and discussions of 12 in-service STEM

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<sup>1</sup> We use the term Latinx to include a diverse group of people with roots in Latin America who may identify as Latina or Latino, in addition to those who do not conform to gender binary identities.

teachers participating in a Project Leverage course to answer the following research question:

*How do bilingual in-service STEM teachers engage trans-perspectives of translanguaging, transdisciplinarity, and transculturation to promote critical consciousness-raising in bilingual STEM classrooms?*

## **Project Leverage Lens & Context**

Inspired by sociocultural tenets of teaching and learning, Project Leverage used an asset-based bilingual lens that guided the development of in-service teacher PD program activities (Duff, 2007; McKinney de Royston et al., 2020; Moll, 2013; Tharp, 2018). The main project goal for in-service STEM teachers was to examine how they leveraged or planned to leverage students' full social, cultural, and linguistic repertoires as they worked toward an additional teacher credential in bilingual education by employing bilingual teaching practices using disciplinary and transdisciplinary practices. The four asset-based bilingual STEM practices included 1) promoting effective adolescent literacy development, 2) integrating academic content and literacy in bilingual/multilingual secondary school contexts, 3) linking formative and flexible assessments to bilingual instruction, and 4) leveraging the students' home/community languages and sociocultural resources. PD activities primarily addressed adolescent literacy and the integration of academic content and literacy teaching for emergent bilinguals/multilinguals in secondary school contexts (Aguirre & Bunch, 2012; Baker et al., 2014; Kamil et al., 2008; Rubinstein-Avila et al., 2015; Solís et al., 2016; Walqui & Bunch, 2020). In addition to promoting language and literacy in the service of STEM practices, there was a particular emphasis on supporting biliteracy STEM practices that affirmed teachers' and students' lived experiences and identities (Moje, 2002; Seilstad et al. 2021).

## **Context and Participants**

While the PD project activities include four graduate-level courses in bilingual education, this study focuses on one course, Latinx Language and Culture. The course was taught bilingually in Spanish and English. Major themes explored in the course included challenging deficit thinking, avoiding essentializing and understanding diverse experiences, understanding the immigrant experience, and understanding factors impacting education. Another focus was the integration of language, literacy, and STEM. Throughout the course, students were encouraged to think critically about language ideologies and policies on a macro level and in their own local contexts. As part of signature assignments for the course, teachers participated in literature circles, developed a lesson adaptation, and conducted a mini ethnographic narrative.

The participants in this study are 12 in-service STEM teachers from Texas and California participating in Cohort 3 of the PD project (Table 1, all names pseudonyms). The participants met for the Latinx Language & Culture class remotely for 10 weeks for 3 hours each week during the summer of 2023. These teachers were all secondary STEM teachers fluent in Spanish with a mix of teaching experience ranging from novice (1 year) to experienced (more than 10 years). Subject areas include math, science, and STEAM (science, technology, engineering, art, mathematics) across middle and high school settings.

Name	Grade Level(s)	Content Area	Location	Years Teaching
Zara	Middle School/ Early Childhood	Math, Spanish Language Arts	Texas	4+ years
Damian	High School	Science	California	7+ years
Sofia	Middle School	STEAM	Texas	6+ years
Briana	Middle School	Science	California	10+ years
Melany	High School	Spanish	California	10+ years
Amalia	Middle and High School	Science	California	1+ years
Aria	High School	Science	Texas	1+ years
Veronica	Middle School	Science	California	1+ years
Josefina	High School	Mathematics	California	1+ years
Marco	Not Available			
Lydia	High School	Mathematics	California	1+ years
Daria	Middle School	Not Available	California	1+ years

**Table 1**  
*PD Project Cohort 3 Participants*

## Researcher Positionalities

Jorge identifies as a bilingual Chicano scholar and teaches undergraduate and graduate bilingual education theory and methods courses within a large Hispanic-Serving Institution (HSI) in the U.S. Jorge served as co-principal investigator of the project and helped recruit teacher participants and conceptualize PD activities drawing from his research with bilingual K-16 STEM students and teachers. Talia is a bilingual fourth-year doctoral candidate in culture, literacy, and language in south-central Texas and a former secondary classroom teacher. She considers her identity as a critical educator integral to her identity as

a researcher. She observed online sessions of the Latinx Language & Culture course and wrote detailed fieldnotes. Eduardo is a Chicano scholar in the Education Department at an HSI on the West Coast of the U.S. He is a former middle and high school mathematics teacher. His research emphasizes the integration of content knowledge with instructional strategies that promote biliteracy/multiliteracy to improve the mathematics achievement of BML students. Marco is a Latinx scholar who served as a co-principal investigator on the project that produced the data shared in this paper. His work focuses on the synergistic possibilities of language, literacy, and content area instruction, with an emphasis on vocabulary development. He is a former bilingual teacher and currently teaches graduate courses in bilingual methods and reading development.

Thus, we arrive at this work as bilingual, critical educators whose work as both educators and researchers has been informed by critical stance-taking over the course of twenty years in STEM bilingual contexts. Our work has endeavored to challenge canonical epistemologies in education, particularly around language and literacy, and to promote critical consciousness-raising with students and teachers, on which this research centers. These positionalities allowed us to negotiate insider (knowledge of Latinx experience, former classroom teachers, and STEM educators) and outsider (bilingual teacher educators, researchers) identities within teacher PD contexts to collect and analyze the data collected for this study.

## **Data Collection**

Throughout the Latinx Language & Culture course, we collected ethnographic fieldnotes of course observations and video-logs of recorded sessions for seven class meetings. Ethnographic fieldnotes described course activities, participant perspectives and interactions, and salient moments from classes with the goal of inscribing the interactional and social processes of the courses (Emerson et al., 2011). Recorded class sessions were reviewed and processed into video-logs by three authors to more deeply develop fieldnotes, including transcription of participant comments and in-depth description of literacy practices that occurred in interaction with other students and the instructor. In addition to the signature course assignment, a mini-ethnography, students completed a critical reflection at the end of the course in the form of a 4-7 minute video in response to questions about the big ideas of the course and their past, present, and future stances and practices (see Appendix A, Figure A.1). Three participants submitted their reflections in written form and nine participants submitted video reflections, which were transcribed. Most of the teachers translanguaged in their video reflections, moving fluidly from English to Spanish. In this paper, we primarily draw on the reflection data.

## Data Analysis

We began the data analysis process by organizing and transcribing the translanguaging audio and video-recorded data (Rymes, 2015; Solís, 2017; Talmy, 2011). Next, we used a computer-assisted qualitative data analysis software (Dedoose) to code all data, allowing us to collaboratively analyze the data across research sites and multiple rounds of coding. We conducted a preliminary round of coding using both inductive and deductive codes (Maxwell, 2013); this first round of coding was then followed by a second comprehensive round of thematic coding from which we derived major themes, resulting in a total of 6 parent codes (see Appendix A, Table A.1). While we analyzed the entire qualitative data corpus, for purposes of highlighting salient themes, we drew primarily from excerpts of teacher reflections representative of the larger data corpus as well as ethnographic notes to contextualize these reflections in our findings and discussion. Throughout the data collection and analysis processes, we collectively debriefed observations and discussed analysis and interpretations of all data with the course instructor (Eduardo) (Marshall et al., 2022).

## Findings and Discussion

In the following section, we discuss our findings of how bilingual in-service STEM teachers engaged in dialogue and perspective-taking of translanguaging, transdisciplinarity, and transculturation to promote critical consciousness in STEM classrooms within Project Leverage PD activities. Within our findings, major PD topics appear in varied ways in how teachers referred to trans- perspectives (talking *about* STEM education, language, culture) as well as how they made meaning through the use of particular discourse strategies (*how* they talked about STEM education, language, culture). We address how teachers took up each trans- perspective in relation to other trans- perspectives to some extent as these are interconnected, fluid, and permeable practices while sometimes unevenly addressed. Translanguaging as a practice and stance in STEM education emerged as the most salient theme for teachers in our analysis, while instances of transdisciplinarity and transculturation were less pronounced in the data. Nonetheless, teachers took up discourses of transdisciplinarity and transculturation in complex and nuanced ways. Our analysis shows how trans- perspectives are integral for promoting critical reflections and equity-minded STEM teaching in BML contexts.

First, Latinx teachers in Project Leverage often re-historicized their personal-professional experiences through translanguaged narratives of learning language as children and of teaching language to children. Second, there were frequent instances of teachers translanguaging to connect and integrate STEM language and content, which is a distinctive feature of transdisciplinary work. Lastly, transcultural repositioning was a central feature of teachers' grappling with

and making sense of problematic notions of Latinx identities, complexifying the immigrant experiences in the U.S., and rethinking the role of culture in STEM teaching and learning. In order to contextualize our findings, we cite the words of the participants themselves, using illustrative excerpts from the PD activities. All selected focal excerpts are translingual, and the participants used both English and Spanish fluidly; however, in order to preserve readability for monolingual English speakers, we present the original excerpts side-by-side with English translations in italics. We acknowledge that this side-by-side translation nonetheless reinforces the convention in mainstream academic writing that holds monolingual English as the standard (García & Wei, 2014).

### **Translanguaging as Practice and Stance for Student and Teacher Empowerment**

We begin with translanguaging as a pedagogical practice and stance as this theme appears frequently throughout our analysis, entangled with our two other themes of pedagogical transdisciplinarity and transcultural repositioning. Translanguaging was perhaps the most explicitly addressed theme by our STEM teachers in their reflections and class discussions. Throughout the data, teachers talked about translanguaging and the other trans- perspectives while also actively engaging in translanguaging as a practice. Additionally, as they reflected on translanguaging, their own linguistic practices, and the role of language in their classrooms, teachers historicized their experiences, drawing on reflections of their past memories as bilingual learners in schools and reconceptualizing their bilingual identities. STEM teachers frequently explored how new awarenesses of translanguaging as both a stance and a pedagogical practice contributed to shifts in understanding connections between translanguaging, advocacy, critical consciousness, and empowerment for themselves as bilingual STEM teachers (Bustos Flores & Riojas Clark, 2017; García & Leiva, 2014) and for their BML students.

Many teachers expressed new understandings of how advocacy and critical consciousness-raising are tied up in translanguaging. Translanguaging itself created opportunities for the teachers to see and model for students that bilingualism is a source of empowerment and pride. In a telling example (Figure 1), Briana's final PD course reflection compared her past teaching stances to her evolving understanding of the relationship between language, identity, and advocacy. Briana's translingual reflection demonstrates the ways that she, as a science teacher with more than ten years of experience, continues to engage in the process of thinking critically about her own personal, professional, and linguistic identities (Bustos Flores & Riojas Clark, 2017) and how these relate to advocacy, critical consciousness, and translanguaging. Briana begins this excerpt from her reflection by sharing how she feels better prepared to support her bilingual STEM students after completing Project Leverage PD activities.

Original	Translation
<p>Me siento mucho más mejor, um, para poder brindar apoyo, para poderles enseñar de que ellos, para valorarlos, de que ellos traen algo al salón, que pueden contribuir al salón, a <b>que su cultura matters, que su experiencia matters, que su donde sea, donde estén en su lenguaje en su desarrollo como bilingüe, personas bilingües, they matter.</b> Así que incluso yo me valoro más, personalmente siento que el español y inglés es, it's better. Me ha ido, ha ido mejorando y tengo una perspectiva muy positiva. <b>Antes, I would be like 'oh, I was an English learner' and I was like empowering that identidad. Pero ahora digo 'No, yo soy bilingüe.'</b> Y a mucha honra.</p>	<p><i>I feel much better, um, to be able to provide support, to be able to teach them that they, to value them, that they bring something to the classroom, that they can contribute to the classroom, that <b>their culture matters, that their experience matters, that wherever they are in their language in their development as a bilingual, bilingual people, they matter.</b> So even I value myself more, personally I feel that Spanish and English are, it's better. I have been improving and I have a very positive outlook. <b>Before, I would be like 'oh, I was an English learner' and I was like empowering that identity. But now I say 'No, I am bilingual.'</b> And with great pride.</i></p>

**Figure 1**

*“Su cultura matters... they matter”*

Briana's reflection engages in translanguaging to explain how her teaching perspective shifted in relation to how she viewed her own bilingualism, stating, in English, that before she positioned herself as an “English learner” rather than as bilingual. Now, she states decisively in Spanish, “*No, yo soy bilingüe*” (no, I am bilingual). This statement, achieved discursively through translanguaging and in which she historicizes her experience as a bilingual learner in school, indicates a shift in both the way Briana positions her bilingual identity as a language learner and in the way she views her development as a more critically conscious educator. In this manner, translanguaging affords her a way to articulate a translingual pedagogical shift exemplified in her translingual reflection that begins with “su cultura matters” (their culture matters), “su experiencia matters” (their experiences matter), and “they matter” in reference to her bilingual students. Through a humanizing stance that her BMLs' cultures, experiences, and languages matter, she explains feeling better equipped to show her students that they matter as people. Briana then connects this increased critical awareness of her bilingual identity to advocating and supporting her BML and Latinx students in new ways. In Figure 2, Briana goes on to attribute Project Leverage PD as empowering her to address and redress educational inequities faced by Latinx students in STEM.

Original	Translation
<p>Así que <b>I think empowering me as a professional, as a individual, which empowers the professional in me is empowering the students</b> and the experience creating an inclusive environment where I am more open to a variety of language practices and helping them improve their language skills and and along the way also a value the Latinidad, and the struggle and the experiences that they have from their past and them as individuals.</p>	<p><i>So I think empowering me as a professional as a individual which empowers the professional in me is empowering the students and the experience creating an inclusive environment where I am more open to a variety of language practices and helping them improve their language skills and and along the way also a value the Latinidad, and the struggle and the experiences that they have from their past and them as individuals</i></p>

**Figure 2**

*“Empowering me as a professional... is empowering the students”*

Briana relates and connects her pedagogical shift as “empowering” her professionally to create spaces for student empowerment through more inclusive language practices while also lifting and valuing diverse Latinx experiences previously marginalized or denigrated. This new understanding includes a realization that teaching must transcend teaching STEM in a vacuum and must include welcoming a variety of language practices, valuing their “Latinidad” (Latinxness) and their own complex identities. Embedded within this pedagogical stance is an understanding that instruction for BMLs in her science class must transcend disciplinary and cultural boundaries as well as linguistic ones. Like Briana, Amalia translanguages fluidly in her reflection to recall her own experience as a student in bilingual, English language development (ELD), and English-as-a-Second Language (ESL) courses (Figure 3). She reflects on what she now thinks must have been unconscious translanguaging when she was a K-12 student in school and at home with her parents to critically question memories of monolingualism in her past.

Original	Translation
<p>...translanguaging es algo que, como yo <b>crecí también en en clases bilingües de ELD, ESL, nunca se me pasó por la mente que usualmente yo misma inconscientemente usaba translingüismo from going to one language to the other to the other one</b> or what we like to call Spanglish, <b>es algo que yo creo que también en la casa ya lo practicamos, porque mis padres son son de México, ellos fueron los que migraron y ya para ellos poderse comunicar hasta con uno tienen que aprender ciertas palabras, porque a veces ya también a nosotros se nos va la onda de de ciertas palabras.</b></p>	<p>...<i>translanguaging is something that, since I also grew up in bilingual ELD, ESL classes, it never crossed my mind that usually I myself unconsciously was using translanguaging from going to one language to the other to the other one</i> or what we like to call Spanglish, <b>it's something that I think we also already practiced at home, because my parents are from Mexico, they were the ones that immigrated and in order for them to communicate with each other, they have to learn certain words, because sometimes we also lose the sense of certain words.</b></p>

**Figure 3**

*"Inconscientemente usaba translingüismo"*

Amalia makes the point that a sort of unconscious translingualism (*"Inconscientemente usaba translingüismo"*) needed to occur at home as her parents learned English and she herself negotiated two languages. She goes on to compare how, as a teacher, she now sees less language separation as compared to when she was a K-12 student (Figure 4).

Original	Translation
<p>...yo durante toda mi vida académica también hasta la secundaria tuve clases de bilingües y de inglés y <b>ahora me doy cuenta que la forma que fue ese sistema, no fue ahora la adecuada. Yo creo que hemos avanzado bastante porque ahora ya no miro mucho where the other teachers come in and or you have to step out of the classroom to go to a different teacher to do those transitions. Y ahora my language is acknowledged a lot more, my first language.</b></p>	<p>...<i>throughout my entire academic life even through high school I had bilingual classes and now I realize the way, that system, it wasn't adequate. I think we've made a lot of progress because now I don't see as much where the other teachers come in or you have to go to a different teacher to do those transitions. And now my language is acknowledged a lot more, my first language.</i></p>

**Figure 4**

*"Y ahora my language is acknowledged"*

Amalia critically examines bilingual education policies, drawing on her own experience as a bilingual student. She takes a critical stance by considering how her own schooling experiences, which privileged the learning of English and intentionally separated the use of English and Spanish into separate classrooms, were “inadequate.” Furthermore, she points to the importance of translanguaging for her family and at home, which served as a communicative tool and bridge for connecting families across generations. Like Briana, Amalia reflects on her schooling experiences in order to indicate a shift from acceptance of an English-only, language separation perspective to one that takes a translingual stance.

### **Engaging Transdisciplinarity Through Language and Social Justice to Deepen STEM Understanding**

Critical transdisciplinary practices were another dimension contributing to the trans- perspectives observed in teacher reflections and discussions. In particular, teachers in this study described how transdisciplinary, translingual, and transcultural practices changed their pedagogical approach by attending to both STEM literacy and content, allowing their students to communicate in their heritage language and using cultural connections to deepen their conceptual understanding of STEM topics (Buxton et al., 2019; Ford & Forman, 2006; Moje, 2015). Teachers expressed the importance of bringing to bear students’ lived experiences and knowledge from a range of disciplines in STEM education regardless of the location (other countries, children’s home/community) that knowledge was learned to address social inequities and marginalization in STEM education (Britsch, 2020; Celedón-Pattichis, 2008; Civil, 2016; Rodriguez, 2013; Wilson-Lopez et al., 2018). Teachers also discuss the importance of integrating language and literacy development to deepen STEM learning, pushing the boundaries of what is often seen as disciplinary STEM teaching. Moreover, aside from language and literacy integration, teachers also connected STEM learning to other content areas like social studies/ethnic studies as a way to engage in students’ funds of knowledge and use of critical language reasoning (de los Ríos, 2018). Here we share an excerpt from Damian’s reflection (Figure 5). He begins the reflection by stating how language is a primary challenge for BMLs in his science classroom.

Original	Translation
<p>Lo único que los están deteniendo para expresarse realmente es el lenguaje, el idioma. <b>Y pues, yo quiero asegurar que les dé el espacio y la oportunidad que demuestran lo que sí saben, lo que sí han aprendido, y que sí saben cómo aplicar usando todas sus herramientas disponibles lingüísticas.</b> Y translingüismo es algo que los va a beneficiar a todos. Entonces hay que realizar que tiene que ser parte del sistema educativo porque a todos se benefician.</p>	<p><i>The only thing holding them back to express themselves really is language, the language. <b>And so, I want to make sure that I give them the space and opportunity to demonstrate what they do know, what they have learned, and that they do know how to apply all of their linguistic tools at their disposal.</b> And translanguaging is something that is going to benefit everyone. So, it needs to be realized that it needs to be part of the education system because everyone benefits.</i></p>

**Figure 5**

*“Que demuestran lo que sí saben”*

Damian articulates the benefits of transdisciplinary practices for his students, particularly translanguaging, to mitigate linguistic barriers to science learning. Damian affirms that translanguaging supports his students' use of their full linguistic repertoire of skills and, in turn, this helps improve students' learning and understanding (Pierson & Grapin, 2021). STEM teachers in this study also shared that transdisciplinary approaches promoted equity and social justice (Buxton et al., 2019; Jakobsson et al. 2021), particularly for their BML students. Briana, for example (Figure 6), described how she now believes that it is *“injusto”* (unjust) to not validate students' native language and to deny students the opportunity to use their native language to process their thinking in the classroom.

Original	Translation
<p><b>Es injusto no darle el valor del, de lo que los estudiantes tienen como fortaleza de su de su primer lenguaje. Así que ahora trato de ser más consciente de eso, de valorarles, de decirles ‘bueno, usa el lenguaje, que tú te sientas comfortable para procesar, para pensar.’</b> Y luego ‘vamos a trabajar en la escritura, I want you to write this in English, al final.’ So, I do set those strategies in the classroom. That were they able to speak in en el idioma que se sientan más confortables.</p>	<p><i><b>It is unjust not to value the strengths that students have from their first language. So now I try to be more conscious of that, of valuing them, telling them ‘well, use the language that you feel comfortable using to process, to think.’</b> And then, ‘we are going to work on writing, I want you to write this in English, at the end.’ So I do set those strategies in the classroom. That they were able to speak in the language they feel most comfortable with.</i></p>

**Figure 6**

*“Es injusto no darle el valor”*

Briana takes a transdisciplinary stance as she decisively advocates for BMLs by attending to literacy development in STEM learning, which is often seen as outside the responsibilities of STEM teaching. We see this pervasive harmful language ideology that attempts to separate language and literacy from content instruction frequently in secondary content area teaching contexts. In doing so, it is an attempt to “essentialize or represent autonomous discourse communities” within STEM fields (Solís et al., 2024, p.18). Moreover, it is also a way to distance or narrow the role of educators in using students’ sociocultural knowledge. However, Briana advocates for an expansive view of STEM teaching and learning by discussing how she believes that it is an issue of injustice to undervalue students’ resources in their native language because this limits students’ ability to make sense of content (Canagarajah, 2013; García et al., 2017). Briana also notes that once students are able to fully express their understanding of STEM concepts drawing from their full linguistic repertoires, she then has them express their ideas in written English language. Similarly, Amalia describes the importance of translanguaging practices to allow students to demonstrate conceptual understandings of STEM concepts through a culturally responsive lens (Figure 7) (Brown & Crippen, 2016; Solís et al., 2018; Uchenna, 2022).

Original	Translation
<p>Estoy practicing the Science Engineering Practices that we have per California y hacemos muchos modelos for the students to analyze and interpret so what I'm thinking of doing now is um have science models from different countries. <b>So for example, como en México puedo usar el calendario Azteca, puedo usar las pirámides. Y como ustedes que están alineadas al igual que las otras pirámides que están en Egipto, you know based on the stars and throw in some astronomy as well. I feel like with science I might get a lot of advantage as well and making that connection, language connection to the science behind it as well, you know.</b> Y no solamente a México, podemos usar también you know, 'how do seasons happen?' like what it was in my lesson plan. Um, I could just, you know depending on the hemisphere. We're like what's, 'where on earth is your family? In the summertime, winter?'</p>	<p><i>I'm practicing the Science and Engineering Practices that we have in California and we do many models for students to analyze and interpret so what I'm thinking of doing now is um have science models from different countries. <b>So for example, like in Mexico I can use the Aztec calendar, I can use the pyramids. These are aligned with other pyramids, like the ones in Egypt, you know based on the stars and throw in some astronomy as well. I feel like with science I might get a lot of advantage as well and making that connection, language connection to the science behind it as well, you know.</b> And not only in Mexico, we can also use, you know, 'how do seasons happen?' Like what it was in my lesson plan. Um, I could just you know, depending on the hemisphere. We're like, what's, where on the earth is your family in the summertime, in the winter?'</i></p>

**Figure 7**  
 “Language connection to the science”

Amalia's response reflects the interconnectedness of transdisciplinary practices, translanguaging, and transculturation as she describes how culturally responsive practices can enhance student engagement with STEM content, explaining how she will expand on the Next Generation Science Standards (NGSS) Science and Engineering practices that focus on "developing and using models" to make explicit connections between science content and her students' cultures. In this excerpt, we note that Amalia uses a transdisciplinary STEM lens to draw from social science content by emphasizing the possible connections among STEM topics and knowledge of the pyramids in Mexico and Egypt to enhance her students' understanding. Consistent with the aforementioned literature, participating teachers' PD experiences provided a way for teachers to explore transdisciplinarity by highlighting the ways in which integrating STEM content with literacy and other content areas like social studies/ethnic studies could be used to better support BMLs. At the same time, translanguaging and transcultural practices were viewed as approaches that were integrated to further deepen understanding, and teachers recognized that such practices also addressed equity and social justice by expanding access and opportunities for BML students to learn STEM content (Buxton et al., 2019; Jakobsson et al. 2021).

### **Transcultural Repositioning of Latinx Identities and Immigrant Experiences**

Lastly, bilingual STEM teachers discussed how they engaged in transcultural repositioning in their lives as teachers and members of their communities as well as how they renegotiated these practices with other teachers. STEM teachers talked about moving back and forth between languages, cultural models, identities, and social positions to make sense of their world and their students. While there was some initial hesitation from participants concerned about "offending people by bringing culture into class," our analysis found that discussing the role of culture in the classroom was productive, especially when engaging three major topics: rethinking essentialized notions of culture and identity, understanding immigrant experiences in the U.S., and rethinking the role of culture in teaching and learning. These ideas were most pronounced in discussions of varied sociocultural practices across and within Latinx communities, the importance of diverse voices and narratives in education, border crossing of geographic, social, and linguistic boundaries, and making cultural connections in STEM teaching and learning. Activities like the mini-ethnography provided teachers an opportunity to explore themes related to culture in their own communities. Moreover, our analysis found teachers using transcultural repositioning to express, make sense of, and assert an equity-minded perspective of diverse Latinx identities and immigrant experiences.

Teachers reconstructed transcultural repositioning frequently when examining and discussing questions of monolithic and problematic notions of Latinx and other identities. These ideas were most connected in discussions about varied sociocultural practices across and within Latinx communities and the

importance of diverse voices in education and society. Teachers regularly reflected on educators needing to be careful not to generalize students' experiences at home because younger or older children may have different kinds of support and experiences from their families as parents' sociocultural practices change, too, over time. We also noticed teachers acknowledging the importance of not assuming that all Latinx students speak a universal Spanish language and that some bilingual children speak Indigenous languages or other Spanish language varieties. Our analysis of PD observations and teacher reflections show that Latinx teachers re-examined their conceptions of Latinx identity as a way to not only break harmful representations of Latinx experiences but also to advance pluralized Latinx identities that value diverse student experiences. For example, Briana's (Figure 8) reflection shows how STEM teachers engaged in transcultural repositioning to assert a critical pedagogical stance. Here she talks about how PD experiences empowered her as a professional and, by extension, empowered her students and her community.

Original	Translation
<p>...y pues la verdad es que cada estudiante es único, así que trato de traer esa diversidad, ese conocimiento de que los niños puedan traer lo que ellos sepan y hablar desde ese punto <b>sin tener que hacer generalizaciones acerca 'todos los Mexicanos hacen esto,' 'todos los Latinos hacen esto'</b> porque pues yo estuve en ambientes así donde por ser Latina pensaba en que yo tenía ciertas <b>prácticas o entendimientos que pues no tenía</b>, porque pues yo soy Salvadoreña y es un poco diferente en términos de cómo pensamos y hacemos nuestras cosas.</p>	<p><i>...and the truth is that every student is unique, so I try to bring that diversity, that the kids can bring that knowledge they already have and speak from that perspective <b>without making generalizations like 'all Mexicans do this,' 'all Latinos do this,'</b> because well I have been in places like that where <b>being Latina I thought I had certain practices or understandings that I didn't have</b>, because I am Salvadorian and that's a little different in terms of how we speak and how we do things.</i></p>

**Figure 8**

*"Sin tener que hacer generalizaciones"*

Briana acknowledges here the certain, but yet to be determined, experiences that BML children bring to the classroom and the importance of supporting children in positioning themselves and others in that way. In doing so, she acknowledges the pitfalls of essentializing discourses, and how she has sometimes mistakenly engaged in making ethnic/racial generalizations as well.

During class observations, discussions of varied Latinx identities created opportunities for teachers to engage in themes connected to the immigrant experiences of families and children. Unsurprisingly, there are noteworthy examples of teachers relating to understanding the experiences of students "crossing the border" or other boundaries and how these histories highlight

inequities in STEM teaching and learning. Most teachers identified with the immigrant experiences of their students because they were themselves immigrants or were children, grandchildren, or great-grandchildren of immigrants. Teachers moreover often mentioned systemic issues that marginalize immigrant students who, according to one teacher, are “navigating a system that was not created for [them]” (observation, 8/24). Teachers discussed how immigrant or newcomer secondary school BMLs negotiated academic and social identities within constraining systems, as well as how STEM teachers and school educators created or could create safe spaces. This negotiation is important as students may often feel that their immigration status is an undisclosable topic (Mangual Figueroa, 2024). In particular, teachers mentioned students who sometimes don’t know they are undocumented until they begin to apply to colleges or jobs in high school. During the first PD session, a teacher, Aria, discussed the school experience of undocumented students, sharing the following scenario:

They become aware of their status when they’re about to graduate high school as they’re applying for college and jobs... *Se pone en un camino donde se cierran las puertas* (they are put on a path where the doors become shut. (Observation, 7/25)

Teachers talked about ways of supporting undocumented students but also sometimes did not know if students were undocumented or did not want to ask them about their status despite the possibility that their status could significantly affect them legally, socially, and academically.

A final telling example of transcultural repositioning appears when Veronica discusses the results of the PD’s final assignment (mini-ethnography), where she interviewed students about how they learned and maintained two languages (Figure 9). She shared the story of a 15-year-old newcomer student who was tracked into lower-level academic courses and English language development (ELD) courses that were below her language ability despite having a strong background in English.

Original	Translation
<p><b>La segunda participante en particular tuvo una experiencia que me abrió los ojos y a la misma vez me rompió el corazón</b> cuando ella llegó aquí a los 15 años de México. Este, ella llegó sabiendo ya bastante de inglés porque estaba estudiando allá en México, en Guadalajara, y ella pues asistió a una prepa, a una escuela privada. <b>Y cuando llegó a la escuela donde iba a asistir aquí una señora, yo me imagino que era una consejera o algo así. Este, le estaba registrando, ¿verdad? Y le estaba explicando toda la información y le estaba haciendo preguntas y la participante me comentó que estaba muy, se usó ‘overwhelmed’ con toda esta información, que no entendió nada de lo que dijo. Y la señora automáticamente decidió que ella debería de estar, en mi opinión no más, porque no entendió nada. Y pues, ella empezó en ELD 1.</b></p>	<p><b><i>The second participant in particular had an experience that opened my eyes and at the same time it broke my heart about when she arrived here at the age of 15 from Mexico. She arrived already knowing a lot of English because she was studying there in Mexico, in Guadalajara, and she attended a high school, a private school. And when she arrived at the school she was going to attend here, a woman, I imagine that she was a counselor or something like that. She was enrolling her, right? And she was explaining all the information and she was asking her questions and the participant [student] told me she was, she used ‘overwhelmed’ with all that information, that she didn’t understand anything she said. And the lady automatically decided where she should be, just in my opinion, because she didn’t understand anything [in that conversation]. And well, she started in ELD 1.</i></b></p>

**Figure 9**

*“Me abrió los ojos y... me rompió el corazón”*

Here, Veronica shared an emotionally charged story that simultaneously “opened her eyes” and “broke her heart.” This recurring theme highlights how transcultural repositioning can help us understand not only the traversing of different educational institutions and highly consequential schooling practices by BMLs but also how school actors (students, educators) can position/reposition themselves within these stories and school spaces. It is through this repositioning that we can detect what is often seen as a neutral process (language assessments, class placements) as moments that are rather contentious and informed by visible and harmful language ideologies.

### **Balancing an Interconnected & Reflexive Trans-Perspective in Teacher PD**

So far, our findings discussion has shared how teachers take up each trans-perspective theme and, to some extent, in connection to other trans-perspectives. However, here, we offer an illustrative example drawn from our analysis that demonstrates the possibility of teachers engaging in a multilayered, balanced, and interconnected trans-perspective promoting critical consciousness. The following

excerpt (Figure 10) from Aria’s reflection describes how the project changed her orientation to teacher PD.

Original	Translation
<p>...yo misma quería saber cómo ayudarlos [estudiantes] con técnicas. Técnicas que se podían usar como “small grouping etc”. <b>Pero para ser honesta no encontré eso en este programa, encontré algo mejor. Encontré</b> que no tengo una buena “<b>foundation</b>” de las <b>políticas en mi comunidad Latina. Encontré</b>, que mis técnicas que debería de saber es el uso del “<b>translanguaging</b>” y es el uso de tener un buen “<b>rapport</b>” con mis estudiantes. Por ejemplo, tener un mejor “<b>critical conscious</b>” sobre el “<b>engagement</b>” de los papas de mis estudiantes. <b>Tener un mejor entendimiento de las historias de mis estudiantes.</b></p>	<p>...<i>I myself wanted to learn how to help [students] with techniques/strategies. Techniques that could be used like “small grouping, etc”. <b>But to be honest I didn’t find that in this program, I found something better. I found that I do not have a good “foundation” of the politics/policies of my Latina/o community. I found, that my techniques that I should know is the use of “translanguaging” and the use of having better “rapport” with my students. For example, having better “critical conscious[ness]” related to “engagement” of the parents of my students. Having a better understanding of the stories of my students.</b></i></p>

**Figure 10**

*“Encontré algo mejor”*

Aria explains that, while initially seeking to learn new teaching strategies through the PD project, she finds something better in the Project Leverage PD. Repeating the phrase, “I found...” and explicitly calling out specific terms such as translanguaging and critical consciousness, she articulates her awareness of the need to transcend “techniques” in order to engage in teaching practice that integrates language, disciplinarity, and culture. She explains her growing interest in critical pedagogical practices such as knowing more about political contexts and policies surrounding her school, the life experiences and stories of students, ways of strengthening connections with families, and the critical role of translanguaging. Aria’s reflection thus suggests that an integrated trans- perspective in PD allows for going beyond traditional PD, fostering a trans- perspective that is “something better,” a PD that is more than strategies and more than the sum of its parts.

### Implications and Conclusion

Our examination of teacher experiences in Project Leverage PD from the lens of translanguaging, transdisciplinarity, and transculturation illuminated three primary implications for supporting in-service secondary school bilingual STEM teachers through engagement of trans- pedagogical perspectives. First, it is important to note that our participants, who previously saw themselves as bilingual

speakers but not necessarily bilingual teachers, joined the project looking for ways to create community with other STEM teachers and obtain an added certification in bilingual education. A form of “critical transdisciplinarity” in STEM education is important to counter dominant human capital narratives in this field with more humanizing and inclusive views of STEM teaching and learning (Takeuchi et al., 2020). This orientation includes explicitly supporting teachers in “seeing more” of the socio-historical contexts surrounding STEM education for BMLs and linking learning to possibilities for social change beyond the standard acquisition of workforce skills. Within STEM education research, acknowledgment of the “inseparability of disciplinary learning (STEM) and social life” (McKinney de Royston & Sengupta-Irving, 2019, p. 280) resonates with efforts to further connect the experiences of STEM learners within personal and political contexts. Our analysis suggests that it is important to continue to engage in-service STEM teachers as invested, critical educators who have an interest in improving educational experiences and the life-career opportunities of BMLs. We did not approach the implementation of the PD activities with the assumption that the content was necessarily the first exposure of such ideas to our in-service teachers nor that our PD content offered a definite perspective for all teachers and contexts.

Second, our analysis has implications for how we can promote critical and collaborative pedagogical reflections with in-service STEM teachers in the design of Project Leverage PD activities. The Project Leverage PD provided teachers with multiple opportunities to explore the role of culture in teaching and learning by using a set of pedagogical moves that pulled for inclusivity and community. While we acknowledge that school-based PD approaches similarly attempt to create professional learning communities within school settings, teachers frequently noted that school-based PD experiences were driven more by a focus on accountability metrics or administrator goals. Moreover, the PD instructor and teachers regularly translanguaged, often going from Spanish to English and back, in their discussions. The PD instructor explicitly modeled disclosing vulnerabilities in content and language knowledge, frequently expressing to in-service teachers “cómo se dice esto” (how do you say this), where teachers often picked up on these moves to create other translanguaging moments.

Third, our analysis has implications for how PD with in-service teachers using the trans- perspectives (translanguaging, transdisciplinarity, transculturation) can support BML teachers in confronting pedagogical tensions in STEM education. Teaching tensions are ever-present potentialities in meaning-making. Such tensions, when identified, can lead to the productive adaptations of teacher roles between interlocutors and between apparent disparate bodies of knowledge (Lara et al., in press; Solís et al., 2009; Solís et al., 2017). For this project, PD experiences created spaces and opportunities for grappling with and mediating tensions within the PD learning community. Through reflective action-oriented engagements, Project Leverage teachers made sense of tensions arising from competing pedagogical models and from applying trans-pedagogical practices in their classroom contexts. Teachers repeatedly described connections to classroom learning, connecting or comparing intergenerational family practices

or socialization patterns, and leveraging diverse sociocultural practices across communities.

In summary, this paper has illustrated how translanguaging, transdisciplinarity, and transcultural perspectives act as dynamic and interconnected forces in bilingual STEM teacher professional development. This critical lens can foster deeper connections across linguistic, cultural, and disciplinary divides, allowing bilingual STEM teachers to experience an identity and pedagogical transformation. This is made possible when teacher and student knowledge production is situated at the intersection of these three constructs. As teachers engage in trans- perspectives critically, their pedagogical approaches deepen students' conceptual understanding of STEM topics.

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## Appendix A

### Methods Supplementary Information

Instructions. Please record a video of 4-7 minutes independently reflecting on the prompt below.

Reflection Prompt: Reflect on the big ideas we've discussed in class: challenging deficit thinking, avoiding essentializing and understanding diverse experiences, understanding the immigrant experience, and understanding factors that may impact access in education.

- How did you understand these ideas before this course?
- How have discussions in the course shaped your thinking, beliefs, and teaching practices?
- How did you see yourself as an advocate for EB students before this course?
- How have discussions in the course shaped how you see yourself as an advocate for EB students?
- Reflecting on your ethnographic narratives, do you think that you will approach language and culture differently in your future teaching? Why or why not?

**Figure A.1**

*Final Reflection Prompt*

Codes	Parent Codes
<ul style="list-style-type: none"> <li>● Avoiding essentializing/understanding diverse experiences</li> <li>● Challenging deficit thinking</li> <li>● Understanding factors impacting education</li> <li>● Understanding immigrant experiences</li> </ul>	Big Ideas From PD Course (Deductive)
<ul style="list-style-type: none"> <li>● Past stance incorrect/different than now</li> <li>● Past understanding true/reinforced</li> <li>● Future actions different or new</li> </ul>	Comparing Stances Over Time (Deductive)

<ul style="list-style-type: none"> <li>● Activity: Discussion/dialogue</li> <li>● Activity: Multimodal</li> <li>● Activity: Lecture</li> <li>● Modeling: Adaptations in instruction</li> <li>● Topic: Education rights history</li> </ul>	PD Topics/Activities (Deductive)
<ul style="list-style-type: none"> <li>● 'Como se dice,' solicit brokering</li> <li>● Referring to scholarship/research/history</li> <li>● Translanguaging</li> <li>● Use of quoted speech</li> </ul>	Discourse Features (Inductive)
<ul style="list-style-type: none"> <li>● Bilingual identity</li> <li>● Historicizing personal experience as bilinguals</li> <li>● Linguistic identity</li> <li>● Personal identity</li> <li>● Pride in bilingualism/bilingualism as empowering</li> <li>● Racial/ethnic identity</li> <li>● Teacher identity</li> <li>● Teacher identity shaped by prior experiences</li> <li>● Teachers modeling identity for students</li> </ul>	Identity (Deductive and Inductive)
<ul style="list-style-type: none"> <li>● Advocacy</li> <li>● Importance of community in cohort/PD</li> <li>● Moving away from purist language ideology</li> <li>● Policies - critical, questioning, comparing</li> <li>● Rejecting English-only perspective</li> <li>● Rethinking role of culture</li> <li>● Rethinking role of language</li> <li>● Shift to translanguaging</li> <li>● Unsure/have questions/want to learn more</li> </ul>	Knowledge, Thinking, Beliefs, and Practices (Deductive and Inductive)

**Table A.1***List of Codes and Parent Codes***Author Contact**

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