

No le Enseñes Sobre los ELs: Infusing Language Into Professional Development and Mathematics

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Abstract

This paper shares our experiences providing professional development to secondary mathematics teachers in a school district looking for ways to meet the needs of their increasingly diverse student population. Our professional development focused on building teacher language awareness by addressing the language domains that Lindahl (2019) outlines as the teacher domain, user domain, and analyst domain. Further explanation of what each domain entails will be discussed and recommendations on how to engage teachers within these domains are shared.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. Teachers should seek out professional development related to English learners (ELs) (Pettit, 2011). What experience do you have receiving professional development? Have you been able to choose topics that interest you?
2. Have you received professional development (or other experiences) that specifically addressed mathematics and English learners? What was it like? What did you learn from the experience? Did you implement or use any of the strategies? What did you find challenging about the experience?
3. How would you describe the relationship between mathematical content and language?

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Introduction

Professional development (PD) for mathematics teachers needs to strategically address what the demands of language are in mathematics. When PD focuses on building teacher language awareness (TLA) it helps mathematics teachers see themselves as language teachers. TLA is defined as, "the interface between what teachers know, or need to know about language and their pedagogical practice" (Andrews & Svalberg, 2016, p. 2). It recognizes that all educators, regardless of their content areas, are users, analysts, and teachers of the language. In order to do these three roles successfully, teachers need "well-developed language proficiency plus conscious (declarative) TLA and the ability to draw on that declarative knowledge when enacting the curriculum in the language classroom" (Andrews, 2007 p. 232).

Lindahl (2013) discusses TLA in the teacher, user, and analyst domains, with each domain sharing similarities with the other. The *teacher domain* is composed of the knowledge teachers have of pedagogy, including L2 (second language) theory knowledge, and the empathy they might have towards the EL student experience. The *user domain* takes into consideration the teacher's language proficiency and the implicit and procedural knowledge they have about language. The *analyst domain* considers the teachers' knowledge about the language (forms and functions). It also accounts for their metalinguistic awareness and their knowledge of the linguistic sub-fields. The domains of TLA interrelate with each other to include features such as attitudes, beliefs, awareness of EL interlanguage, ability to solve language problems, teacher's life experiences, and their sensitivity towards the EL experience. Readers wanting more detail on the TLA domains and the relationships among them may consult the figure on page 32 of Lindahl and Baecher (2015).

Creating PD that specifically targets TLA development in mathematics teachers is important because it helps them understand how they can teach

language and mathematics in the content area. Through this article, we are going to discuss how we built TLA into the PD for a group of secondary in-service mathematics teachers. Initially the PD was to be offered to educators at a large urban campus but was ultimately delivered to educators at a smaller rural campus. The PD did not need to be significantly altered, which we feel demonstrates the adaptability of the content proposed here.

No le Enseñes Sobre los ELs/ Don't Teach Them About ELs

We were initially encouraged by a friend and EL coordinator to put together PD for the mathematics teachers at her large, urban high school. During a planning meeting, we were told by school representatives, "Actually we don't want you to talk about ELs because then the math teachers won't be receptive to the PD. Can you just talk about math stuff?" Our plan to provide PD at this campus fell through, but about the same time an EL coordinator in a rural school district invited us to present to her secondary mathematics teachers and we agreed. Thus, our PD took place in a school district with a population of just over 10,000 students. About 31% identified as Hispanic and almost 10% of the whole are classified as ELs.

A Focus on Mathematics and Language

The National Council of Teachers of Mathematics' (NCTM, 2014) *Principles to Actions: Ensuring Mathematical Success for All* encourages classrooms where all students engage with mathematical content both orally and in writing. The Common Core State Standards for Mathematics (2010) include the standards for mathematical practice at all grades which expect that student will make sense of problems, reason, construct arguments and critique others. Aguirre and Bunch (2012) note that an emphasis on the five language modalities in English-- that is reading, listening, speaking, writing, and representing-- can be an advantage for ELs, "because it

facilitates students' mathematical learning and English language development" (p. 192).

Our position is that mathematics teachers who still claim that their content area isn't about language aren't adhering to the expectations for current classrooms as outlined by NCTM and the Common Core State Standards for Mathematics (CCSSM). Schütte (2018) said, "It is certainly desirable for all participating children to be introduced to formal and subject-specific mathematical language aspects, and for the teacher to act explicitly as a linguistic role model" (p. 34). The subject of mathematics is known to employ its own register. "Registers are specialized uses and meanings of a specific language for mathematical purposes (e.g., specialized meanings and purposes for vocabulary (words, phrases or expressions) as well as grammatical structures) that can be chosen by an individual to fit a situation or a context" (Schütte, 2018, p. 26). We believe a mathematics teacher is the best person to model this mathematical register. Mathematics teachers cannot expect the English department or EL support staff to be the sole responsible party to make it possible for their students to engage in the language of mathematics. Pettit's (2011) literature review found that in classrooms where EL students were successful in learning the content, the content teachers assumed responsibility for teaching all students, including ELs.

The language demand of mathematics can be significant, full of phrases not used elsewhere in school such as x -intercepts, hyperbola, modulo, and commutative (Aguirre & Bunch, 2012). Even native English-speaking children are regularly encountering new words in the mathematics classroom. To increase the confusion, students are also challenged by non-mathematical words that have alternative definitions in mathematics (such as differentiate, slope, range, and kite) as well as false cognates. Even word problems which might not contain much academic language at all can challenge students, and has long been a focus for mathematics education researchers (Pimm, 2018). It takes multilingual students 5-7 years to master academic language so we should be prepared for their challenges in mathematics by making accommodations proactively for their language needs (Wright, 2015). In addition, research shows a focus on language in the mathematics class

benefits all the students in the class (Vogt, Echevarría, Short, & Amy, 2013).

Our Professional Development

Our PD consisted of three one-hour segments in one day that addressed one domain per segment. We began by sharing free and low-cost resources for teaching mathematics. Some of these included websites such as Khan Academy in Spanish (es.khanacademy.org), the Math Twitter Blog-o-Sphere MTBoS (mtbos.org) and Youcubed (youcubed.org). Afterwards, we shared upcoming local and national professional development opportunities that included conferences hosted by Nevadans Teaching English to Speakers of Other Languages (NVTESOL), National Association of Bilingual Education (NABE), National Council of Teachers of Mathematics (NCTM), TODOS: Mathematics for ALL, and Research Council on Mathematical Learning (RCML). As we were in a more rural part of the state, we also shared virtual PD opportunities like free book study materials offered by NCTM which are perfect for professional learning communities. We then shifted our focus to working with English learners by first sharing research findings from Pettit (2011), de Araujo, Roberts, Wiley and Zahner (2018), Sorto, Mejia Colindres and Wilson (2014), Yoon (2008), Penfield (1987), and Boaler (2016). Originally, when delivering the PD, we planned to delay talk of ELs since this was recommended by the EL coordinator. We also hoped that what we said about mathematics, language, and English learners would be fresh in their minds as they reflected on the PD during the closure. We decided to create one strategy for each of the three TLA domains: teacher domain, analyst domain, and user domain.

Teacher Domain: This first strategy discusses the teacher domain of the TLA. This domain addresses pedagogical knowledge that includes "general knowledge, such as how to manage a classroom or pace a lesson, as well as pedagogical content knowledge, which is your ability to present lessons in and about English in such a way that your students understand them and are engaged in your class" (Lindhahl, 2015, para. 4). Additionally, part of the TLA teacher domain addresses the empathy that teachers have for the experiences EL students have. Because of all

of the layers that the teacher domain has, we developed an activity that would help teachers build empathy and observe pedagogical practices that help with language acquisition through the content area. We started our lesson by giving the teachers the following story problem only in Spanish. (We were inspired to do this after experiencing mathematics in Vietnamese as presented by Kien Pham (2014) at a regional NCTM conference.) “Pedro compró un auto a 16,430 pesos y despues de 3 años lo vendió a 12,315 pesos. ¿Cuánto dinero se devaluó su auto?” [“Pedro bought a car for \$16,430 and after three months he sold it for \$12,315. How much value did the car lose?”]. We wanted to demonstrate what language scaffolding looked like when done successfully (and not so well). For the first attempt, we gave the teachers the story problem and began to teach the lesson in Spanish with no scaffolding. Throughout the five minutes we gave them to work independently on this exercise, we were explicit that time was running out and that they needed to “hurry”. After the time was up, we collected the papers. For the second part of this strategy, we gave the teachers a new story problem also untranslated. “En un aeropuerto aterriza un avión cada 10 minutos. ¿Cuantos aviones aterrizan en un día?” [“At an airport, a plane lands every 10 minutes. How many planes land in one day?”]. The second story problem was written on a piece of paper with the cognate words in Spanish underlined as shown in

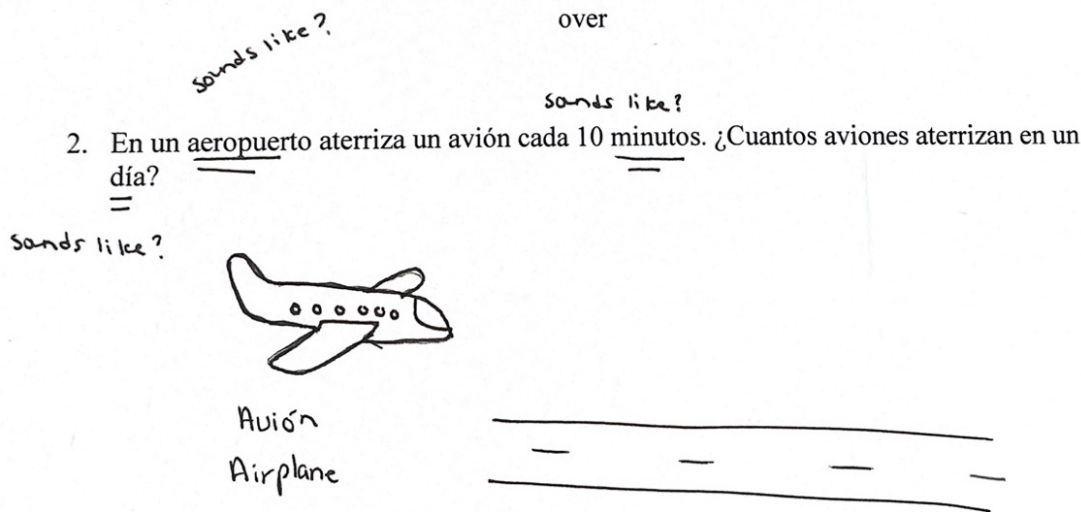
Figure 2. It also had drawings that we made to represent what was going on in the problem.

We started the lesson by using total physical response (TPR) strategies that connected the vocabulary to their surroundings. For example, we modeled a plane landing with our hands and arms and then encouraged them to also model it with their bodies. With TPR, students are reacting physically to verbal cues or commands (Hounhanou, 2020). Additionally, we gave them access to an online dictionary they could use and many opted to use Google Translate. We learned from the first modeling that three out of the ten participating teachers understood Spanish. So, we paired the participants that understood Spanish with others that did not and asked them to provide support.

During this second attempt, the teachers completed the task with greater accuracy and confidence. We had a discussion of what were the language and pedagogical supports we provided the second time that allowed them to be successful. The teachers were able to point out many of those supports and discuss as a group how they could use similar ones to teach English in the content area. Even though this was a short exercise, it served as a way to build empathy for the EL students’ experience in English only classrooms. Further, the experience prepared them to delve into the topic of this PD that had been problematized in the school culture.

Figure 2

Example of word problem given to teachers to model best practices and scaffolding



Analyst Domain: The second strategy helped teachers identify the language demands of their lessons. This activity addresses the analyst domain of TLA. Lindahl and Watkins (2015) defines the analyst domain as including, "knowledge about language, both its forms and functions. It encompasses (but is not limited to) knowledge about the structure of English, its phonemic systems, how context can change the meaning of certain words, or the way different expressions are used in context" (p. 782). Additionally, this domain includes metalinguistic awareness, which is defined as an ability to reflect on language use, compare features across two or more languages, or develop different language learning strategies (p. 179). In order to address the language demands of the analyst domain, we developed an activity where teachers analyze and reflect on a sample lesson plan, then transfer what we did to their own lesson plans. The teachers, working together with their colleagues, determine the language demands of their own lessons.

We first introduced them to Aguirre and Bunch's (2012) Language Demand in Mathematics Lessons Tool (LDML) and facilitated how to evaluate the language demands of a mathematics lesson. The LDML tool is a template that allows educators to reflect on the reading, writing, speaking, listening and representing demands on students during the launch, explore and summary of a math lesson. The Aguirre and Bunch chapter comes with downloadable materials including a sample mathematics lesson with a completed LDML. As a whole group, we discussed what language demands could look like in a mathematics classroom including how we can over rely on some modalities of language. Now that they were familiar with this tool, we asked them to use it in their own lesson plans.

The teachers brainstormed individually about a lesson plan that they had developed previously for their class. We asked them to use the same LDML tool to evaluate the language demands of their own lesson. As further language support, we also provided them with the "LO (language objectives) Menu" developed by Lindahl & Watkins (2014). With this "LO Menu," the teachers can plan lessons with reading comprehension, grammar, and writing conventions taken into account. This is a reference they can continue to use and share after the PD is over because it details language demands and possible student needs. It also described how to write LO for each level of student language needs. With the LDML and LO tools,

the teachers worked in groups and supported each other in developing language objectives for their lessons. We believed that having the teachers consider lessons using the LDML tool would allow them to reflect more deeply on their students and the opportunities to interact with language that they experience in the classroom. From this experience, we learned that many of the teachers had never written or considered language objectives before, which led to an interesting discussion amongst the group as to why they are important.

User Domain: The final strategy addresses the user domain of the TLA. This domain "centers on your ability to use the language, or your language proficiency. It also includes all that goes along with being able to use a language proficiently, including knowing the sociocultural norms of the language, the different registers of the language, and how the context of some utterances can change their meaning" (Lindahl, 2015, para. 2). For this domain of the TLA, we chose to show the participants a video from our personal collection. We chose to do this because we felt this video would exemplify the domain, as well as provide another opportunity for discussion with peers. After all, we would be leaving, and they would return to relying on each other for feedback and advice. We also chose to show the video clip because it gave them a chance to see excellent language support for ELs in action and also to hear a voice other than our own.

The video we chose was from a seventh-grade mathematics classroom studying unit rate. Most of the students and the teacher are bilingual in Spanish and English. The teacher uses common grocery items to demonstrate what unit rate is and how it is calculated. In our video clip, the students ponder, in a whole class discussion, the unit rate per serving for two different sized containers of a chocolate drink mix. This video allows viewers to witness a teacher facilitating discussion with students at all levels of English language acquisition. This video prompts a discussion about how we can help students when we do not speak their language and how we can support them when we are explicitly told not to speak their native language as is often mandated in some school districts. This video highlights students struggling with words that have multiple meanings and false cognates. This video also features a teacher who speaks Spanish but struggles with academic vocabulary and has

to tease out meaning with her students. A brief excerpt appears below which demonstrates the teacher and students making meaning from language in a mathematics class. What appears in square brackets is our translation.

Teacher: So look at this 21 servings, what does servings mean? Servings, servings, servings. What does it mean? Carlos, que quiere decir servings?/ [Carlos, what does serving mean?] This one says 38 servings, ¿Qué quiere decir, servings?/ [What does serving mean?]

Carlos: [mumbles]

Teacher: ¿Qué palabra? [What word?] Carlos is from Honduras, right? Carlos is from Honduras and sometimes the words that he says in Spanish even me sometimes I don't recognize them because some words are different right. Ok, son diferentes las palabras. [Ok, the words are different].

Students: Gramos. [Grams]

Teacher: Gramos , ok gramos está acá, pero [Grams, ok but grams are over here] this is 38 servings. ¿Qué piensas tú? Mira esta,[What do you think? Look at this one], this one says 21 servings. 38 servings, 21 servings. What do you think it is, Carlos? Betti, ¿qué piensas tú? [Betti, what do you think?]

Betti: ¿Es el contenido? [Is it the content?]

Teacher: El contenido [The content]

Betti: Sí. [Yes]

Teacher: Más specific [more specific]

Betti: Um, es como todo lo quiere lleva en la caja. [Um, it's like everything that it fits in the box.]

Teacher: The word servings, servings. Ser-...

Students: Servi, servidas/ servings (note that servidas is a false cognate and it was a word made up by the teacher and students. They were referring to porción/servings)

Teacher: ¿Servidas? Treinta y ocho. ¿Servidas?/[Servings? Thirty-eight servings?]

Betti: No. [this student acknowledges that the word *servidas* is not a Spanish word]

Teacher: It says 38 servings and this one says 21 servings. Do you understand what it means? Lo entiendes? Quiere decir...[Do you understand? It means...]

Betti: ¿Yo se es que el contenido, no? [I know it is the content, right?]

Teacher: El contenido y cuantas personas puedes tú, you can serve [The content and how many people you can serve.]

Betti: Si las personas que puede service con las...[If the people can service with the...]

Teacher: There you go. Servings and servicio [service] are similar.

Betti: Sí. [Yes]

Teacher: Awesome. You see and that is what happens in a lot of the words, a lot of the words the meaning the translation is almost identical.

After watching the video, a few teachers commented that they were not bilingual and therefore could not see themselves offering the supports that the teacher offered the students in the video. We knew this would be a comment and showed a subsequent video of another teacher who spoke only English. In this video, the mathematics teachers focused explicitly on mathematical terminology and how to apply it to the mathematics problem on the board. We were also able to connect this to our earlier activity solving mathematics story problems in Spanish and what strategies were helpful. At this point of the PD, other teachers felt comfortable enough to join the conversation and discuss supports they considered important for the student. The belief that to be a good language teacher you have to be bilingual is both unrealistic and difficult to overcome. We like to remind teachers that with over 7,000 languages in the world, we would not expect them to know them all. Teachers usually laugh at this, but this realization is often forgotten. At this point we found it useful to share the user-friendly CUNY-NYSIEB (2021) web series of video demonstrations for teachers to peruse and critically examine later on their own time.

We found the video we showed helpful to the teachers, but it is not available to the public so here are some video resources to consider in order to encourage critical observations among educators of ELs: jeffzwi.org, colorincolorado.org, videomosaic.org, ellps.squarespace.com, and meld.sdsu.edu. Searching under the following queries on youtube.com will also yield good results; “teaching math to English learners” and “Classroom examples of English learners.” In our experience, finding high quality videos that highlight classroom strategies continues to be a challenge for PD providers.

Reflection

During the three hours of professional development, we shared numerous resources with the teachers such as NCTM's *Catalyzing Change in High School Mathematics* and *Beyond Good teaching: Advancing Mathematics Education for ELLs*. We also looked at NCTM's process standards (NCTM, 2000) and ways we encourage or discourage them through our instructional choices. Then we proceeded with the three strategies outlined in this chapter. As facilitators we felt that the teachers were respectful and interested. They appreciated the resources we shared with them which included many freely available resources from Instagram and Twitter. The teachers reported not actively utilizing social media as a way to learn about teaching resources and current research. For example, few of the teachers were familiar with growth and fixed mindset (Boaler, 2016), which has been trending in schools and mathematics for several years.

The teachers were given time to provide anonymous, written feedback to the facilitators about this PD experience. Several teachers specifically praised the opportunity to watch videos of teachers working with students, mathematics, and language. One participant asked for, "even more examples of teachers doing 'good' things." The teachers also appreciated being able to work with peers in their discipline area which was not a common practice at their campus. Another teacher shared, "I appreciate the gentle reminder that we are not teaching a subject; we are teaching students." This comment speaks directly to teacher beliefs and Yoon's (2008) findings.

Teaching mathematics equitably and maintaining high expectations for all students is at the core of the field of mathematics education. The eight Mathematics Teaching Practices allow for this and require rigorous application of language to mathematics as evidenced in, "Facilitate meaningful mathematical discourse," and, "Pose purposeful questions," just to name two (NCTM, 2014, 2018). The notion of equitable practices and high expectations is particularly emphasized for teachers of multilingual students (Pettit, 2011). Now it is time for teacher educators and administrators to have high expectations for the capacity of secondary STEM teachers

to connect with their ELs. We believe that providing PD opportunities around TLA is of utmost importance. Teachers must have opportunities to think about language critically and consider the implication that it has in the classroom.

We also recognize that developing TLA takes time and is an ongoing process. We understand that one PD is not enough to fully acknowledge all areas of TLA. It is important to continue providing PD using this framework as a base and understanding what other areas of key need our teachers have. TLA also touches upon areas such as beliefs and empathy that one PD cannot address. On reflection, we also recognize how important it is to continue to frame linguistic resources as positive and additive skills our students have. Schütte (2018) explains

It seems that one future task of mathematics teaching will entail using children's linguistic resources positively, for example allowing them to switch into their first language during group work, as well as providing them with opportunities to build linguistic competences in the principal teaching language. (p. 34)

With the current shift we are seeing in the field towards normalizing translanguaging in the classroom, we will be addressing this in future PDs. Translanguaging is defined by Garcia and Wei (2014) as "extend[ing] our traditional definitions of language and bilingualism. It refers to the ways in which bilinguals use their complex semiotic repertoire to act, to know, and to be" (p. 137). It accounts for the multiple language practices that students bring into the classroom and provides value to each of them. Translanguaging was the topic of a recent *TEEM* special issue of this journal.

An important takeaway was that this PD was applicable to our new group of secondary STEM teachers in a rural school district. This demonstrates the wide applicability of this PD to not only different school districts, but also to potentially different content area teachers and grade levels. Continuing the discussion on TLA and preparing teachers using this framework is the goal that we aim to further develop with our future PDs. We continue to learn from each PD given and look forward to modifying our content to better suit our teachers.

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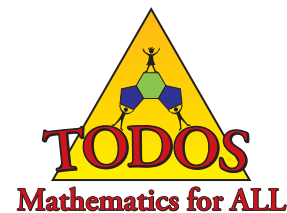
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Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. Which language skills do you find that your EL students need the most support within mathematics? What do you do to address this?
2. In *Harry Potter and the Sorcerer's Stone*, Dumbledore says, “There are all kinds of courage. It takes a great deal of bravery to stand up to our enemies, but just as much to stand up to our friends” (p. 306). How can we engage with colleagues that express negative attitudes towards teaching English learners?
3. The six principles of NCTM (2000) are Equity, Curriculum, Teaching, Learning, Assessment, and Technology. How can the needs of ELs be addressed in each principle?
4. Do you feel like you now have a good understanding of the three TLA domains? What can you do to develop them further?
5. The authors refer to being inspired by a powerful experiential ELL empathy demonstration at an NCTM regional conference. What can you learn from related demonstrations that have been published in *TEEM* (e.g., p. 24 of the Winter 2020 issue, p. 28 of the 2015 issue, or p. 10 of the 2013 issue)?

“DARE to Reach ALL Students!”



Still TEEM-ing With Enthusiasm: A History of TODOS' esTEEMed Journal

Lawrence M. Lesser

As we celebrate TODOS' 20th anniversary this year, it's fitting to recall the evolution of its refereed journal, *Teaching for Excellence and Equity in Mathematics* (TEEM). Current Editor-in-Chief Marta Civil asked me to write this since I'm the only one who's had the pleasure and privilege of involvement with every issue, either as Editor or Associate Editor.

So far, *TEEM* spans 15 years, 14 volumes (one covered two years), 17 issues, 68 articles (not counting editorials, notices, poetry, etc.), and 730 pages! Beyond the numbers, *TEEM* has always been qualitatively distinctive by aligning with the TODOS mission, targeting diverse stakeholders (researchers, practitioners, and administrators of all levels), offering DARE questions for professional development, and attracting submissions from distinguished veterans in the field as well as from those early in their careers.

Also notable is how *TEEM* editors have made it a point to welcome queries, explicitly solicit submissions from teachers as well as researchers, welcome contributions in Spanish (see page 28) as well as English, and offer (via a TODOS Live session and workshops at the most recent several TODOS conferences) not just information about *TEEM*'s process but also feedback on attendees' article ideas.

So how did it start? Cynthia Anhalt, Michael Matthews and I (we were then co-Editors of *Noticias*) submitted a proposal to the TODOS board in 2008 to launch a peer-reviewed journal for educators (since a separate monograph series had just launched for researchers) and then-President Nora Ramirez relayed that the Board was "in total favor." The proposed title was actually *Mathematics Teaching for ALL: A TODOS Journal for Quality and Equity* before my later inspiration of *TEEM*, which was more concise, catchy, and (we hoped) welcoming to teachers by eschewing the word "Journal."

And so, *TEEM* was born with Cynthia, Miriam Leiva, and I as its founding Editors. Cynthia and I handled editorial matters (with Cynthia also utilizing her graphic design talents to do layout/production) while Miriam made key contributions as a liaison to the Board and using her contacts as TODOS' founding president to secure initial funding from Pearson as well as create a database of referees. We were grateful that other TODOS publications helped build *TEEM*'s foundation. The monograph series targeted only researchers, but established precedent for TODOS sponsoring high-quality peer-reviewed scholarship. Also, each issue of *Noticias* generally contained a featured article that went through a review process, and competitively-selected adapted versions of these actually comprised *TEEM*'s debut issue (published 10/21/2009) while we launched a call for new papers to be double-blind reviewed for subsequent *TEEM* issues.

The years have brought various changes in editors as well as in policy for the submission window/process, increased page limits, which issues are accessible to the public, starting an Editorial Board (in 2011), accepting papers in Spanish, and adding special issues (so far: social justice, multilingual learners, and antiracism). *TEEM* is in a period of growth, with multiple issues in 2020 and 2021 (despite the pandemic!) and will gain additional support on the Open Journal Systems platform: <https://journals.charlotte.edu/teem>.

TEEM has been one of my most meaningful involvements ever for professional and personal reasons (see my 2015 *TEEM* piece) and for our shared TODOS imperative to support excellence and equity together (for inspiration, reread the quotes inserted throughout issue #1). It's synergistic that I joined TODOS the same year (2004) I joined UTEP, the only R1 university in the US to maintain a 100% undergraduate admission rate while building research excellence. This journal is a wonderful example of how diverse educators and scholars come together with their professionalism and passions and – without paid staff – produce a journal of such high quality and fast-growing impact. It has truly taken a village and I offer my huge gratitude to all editors, authors, and reviewers, who have served (or will serve) as terrific "teem" players! Also, advance thanks to readers who we hope will dare to share with us how they've used *TEEM* articles. Onward!