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## Facilitating Pre-service Teachers to Learn the Mathematical Practices and Engage English Language Learners

*Jim Ewing*

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The Common Core State Standards in Mathematics have established Mathematical Practices that describe how students should be doing mathematics from kindergarten to high school (Koestler, Felton, Bieda, & Otten, 2013). The Practices emphasize solving real-world word problems and developing reasoning skills that require students to communicate their understandings with others. With the burgeoning population of English language learners (ELLs), it is imperative that pre-service teachers (PSTs) learn to teach all students, including ELLs, to engage in the Mathematical Practices. However, the literature is scant as to *how* ELLs can be taught to engage in these Practices.

In spite of the recent attention to multicultural teacher education, most teachers are not prepared to instruct ELLs (Zeichner, 2005). Lucas (2011) argues that many teacher educators are not preparing PSTs to recognize the importance that language plays in teaching ELLs and calls for more studies. One study, by de Oliveira (2011), found that PSTs empathized with ELLs after she taught two mathematics lessons in Brazilian Portuguese to English speaking PSTs. She claimed that PSTs would be more likely to accommodate ELLs' needs if they empathized with them. For her first lesson, she did not use gestures and talked at a normal rate. The PSTs in her study commented that in her second lesson, when she talked slowly and used other strategies, they had more access to the mathematics.

In an adaptation of de Oliveira's study (2011), I present here a lesson in which

PSTs are taught a division lesson in Spanish. Not only do the PSTs empathize with ELLs, they also learn Mathematical Practice 1 (Making sense of problems and persevere in solving them) and Mathematical Practice 3 (Construct viable arguments and critique the reasoning of others) more deeply when they are taught a division lesson in Spanish.

### Methods

I taught the mathematics lesson in Spanish to elementary PSTs in a private university in northeastern United States. The PSTs attempted to complete a worksheet but were denied access because they did not understand the Spanish symbols for long division. In addition, the directions were in Spanish, and I did not use gestures or visuals in my oral instructions. Still another way that the lesson was confusing for the PSTs was that instead of using a comma to separate three-digit groupings, I followed the Spanish and Latin American practice of using a decimal point. (The worksheet is included in the appendix.) The PSTs reflected that this simulation helped them empathize with how ELLs might feel when they do mathematics if the teacher did not assist them with the English. Some of the PSTs said that they had thought that mathematics was a universal language, but after this simulation, they realized that not understanding the language of instruction was a major disadvantage.

After being taught in Spanish, the PSTs divided into groups of four and the discussions were audiotaped. Unlike de Oliveira's study (2011), this lesson was not followed up with the model lesson; instead I asked the PSTs to identify strategies that would have allowed them access to the content and enabled them to engage in the Mathematical Practices.

Lastly, in their template for planning mathematics lessons in the field, I asked the

PSTs how they would facilitate ELLs to engage in Mathematical Practices 1 and 3. I also asked the PSTs to reflect on how successful they had been in facilitating their students, including ELLs, to engage in the Practices.

I used a multiple-case study with qualitative methods to serve my purpose of describing how PSTs experienced the process of preparing to engage ELLs and other elementary students in Mathematical Practices 1 and 3. I used purposeful sampling to select PSTs as participants who had an apparent ELL connection. I selected the two PSTs who had ELLs in their placements, a PST who had ELLs in their previous placement, and two PSTs who had reported in the survey that they spoke a language other than English at home. In an attempt to contrast the five participants with possible ELL connections, I also selected five PSTs who had no apparent ELL connection—five whose backgrounds varied widely. Eight of the ten PSTs chose to participate in the study.

This case study included collecting: open response surveys (pre-and post), group discussions, homework reflections, lesson study, lesson plans, supervisors' reports, and semi-structured interviews with pre-service teachers, their host teachers, and their university supervisors. I separated the data into eight sections—each section included all the data from each PST and their corresponding university supervisor and host teacher—to set up my data analysis. First I analyzed each case individually to focus on each PST's data in an attempt to learn how each PST's beliefs and practices may have differed. Then I put the eight cases together for a cross case analysis to look for how the PSTs' beliefs and practices were both similar and different (Miles & Huberman, 1994).

## **Findings and Discussions**

### **Elementary Mathematics Methods Course**

Some of the strategies that the PSTs suggested were for me to speak slowly, use visuals, gestures, translate strategic words, and allow them to speak in their own language (English). The PSTs suggested that just as the strategies that they had generated may have helped them understand the content when I spoke Spanish to them, the same strategies might be helpful for ELLs learning mathematics who have limited English proficiency.

The PSTs stated that they could better empathize with ELLs after the experience of being taught a mathematics lesson in Spanish. Below is a homework reflection written by one PST after being taught a lesson on long division in Spanish:

In our class on Tuesday, we were given a division worksheet in Spanish. Some students did not even try to figure out what we were supposed to be doing and just gave up. In the end, we realized that math is NOT universal. We decided that if a few action words were translated into English, like "divide," then we could have actually attempted the problems. We also suggested that the teacher could model a similar problem on the board to help. In the end, we discovered the struggle that ELLs face when teachers do not have the training to modify their lessons.

The reflection above offers support for teaching monolingual PSTs in another language to empathize with ELLs (de Oliveira, 2011; Lucas & Villegas, 2013). The PST realized that mathematics involves language. In Fernandes' (2011) study PSTs also learned that mathematics was not universal and that ELLs benefit from guidance to solve problems. In an interview

with a Peruvian member of the class, an incidental value of speaking in another language becomes evident.

I don't usually get to contribute a part of myself. Like, I can speak Spanish and my Peruvian culture—that's why it [the course] stuck out to me the most because I was able to take something I knew and I had an advantage over everybody and normally I feel like I don't have the advantage because minority wise, there are not that many Latinos in the education program.

Kersaint, Thomson, and Petkova (2009) encourage teachers to learn at least a few words in their ELLs' native language in order to make them feel more welcome in the class. As the PST shared above, she also felt valued when spoken to in Spanish and vowed to help Latina/o students in the future.

### **Applying Strategies to Placements with ELLs**

One PST wrote in a lesson plan reflection that he had attempted to accommodate ELLs in his lesson:

I made sure to add pictures to my agenda and presentations to help my English Language Learners understand what I was teaching. There are many things that I have learned in class which I have applied to this lesson. The first thing that I learned was the use of visuals, which is something that I would not have thought of before.

The PST mentioned that he had learned strategies to help ELLs that he applied to his lesson in his placement.

Another PST described in her lesson plan reflection how an ELL had engaged in Mathematical Practices 1 and 3. She strategically placed BL (an ELL) and CM (a non-ELL) together to support one another:

He [BL] exhibited MP3 [Mathematical Practice 3] amazingly by backing up all of his actions or ideas with reasonable support. He critiqued his entire group, but respectably [respectfully], and helped them to see how things should go on the graph. He was a huge help to his group, especially, CM, which is why I put them in the same group. I think CM owes a lot of his success to engaging in MP3 to BL. He [BL] showed MP1 beautifully, and shows this in his 10 out of 10 post-assessment; he persevered through all of the explores and ultimately learned from them, showing that he understood the concept of bar graphs that I was teaching. Drawing out all of the graphs and using the cubes the first day interested him and gave him an easier time explaining himself. He used the graphs his group made and his cubes to back up his reasoning.

The above quote suggests that the PST not only understood the Mathematical Practices but also used strategies to facilitate her students to engage in them. Pinnow and Chval (2014) report that it is the teacher's responsibility to encourage ELLs to participate. By positioning her students strategically, and providing manipulatives to help the ELL justify his answers, the PST facilitated the ELL to engage in Mathematical Practices 1 and 3.

### **Applying Strategies to Placements without ELLs**

A PST mentioned in an interview that the methods course was useful even though she did not have any ELLs in her placement. She said that she could apply the strategies learned for ELLs to other students: "Even though a lot of us didn't have technically English language learners we could still use

what we learned in the classroom and make it a more effective classroom.”

Another PST agreed that strategies learned in the methods class could be used with non-ELLs. She used gestures to allow some of her non-ELLs in her placement to make sense of problems. She shared in an interview that the mathematics lesson taught in Spanish had been beneficial in preparing her for ELLs, but it would have been even more useful if she had had ELLs in her placement so she could apply the strategies that she learned:

I think it was interesting to talk about ELLs—it doesn't have to be for ELLs. You can use the strategies to help others. You don't recognize what it's like to have ELLs until you actually do... I wish I had had the experience but it was nice to have talked about it so when I do get the experience, it's not like a blank slate.

### Conclusion

Rather than asking PSTs to memorize the Mathematical Practices, teaching a lesson to the PSTs in another language is an opportunity for teacher educators to introduce Mathematical Practices 1 and 3. In this study, after experiencing that they could not engage in the Mathematical Practices when they were taught in Spanish without accommodations, the PSTs were motivated to accommodate their ELLs in the field.

This preparation in an elementary mathematics methods course is not intended to be the only preparation that PSTs receive for working with ELLs; preparation should be infused throughout teacher education programs (Athanases and de Oliveira, 2011). An attempt was made to address Lucas' (2011) call for preparing PSTs to value language when teaching ELLs. I encourage teacher educators to consider these techniques and adopt them as appropriate. In

any case, we must prepare PSTs to facilitate ELLs, as well as non-ELL students, to engage in the Mathematical Practices from the Common Core State Standards.

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## Appendix

Nombre .....

*Resuelve los siguientes problemas<sup>1</sup>:*

1:

$$1485 \mid \underline{45}$$

2:

$$5525 \mid \underline{85}$$

3:

$$4592 \mid \underline{56}$$

4:

$$18.936 \mid \underline{24}$$

5:

$$15.375 \mid \underline{125}$$

6:

$$10.870 \mid \underline{110}$$

7:

$$11.700 \mid \underline{180}$$

8:

$$12.615 \mid \underline{87}$$

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<sup>1</sup> Solve the following problems: