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Culturally Responsive Professional Development for One Special Education Teacher of Latino English Language Learners With Mathematics Learning Disabilities

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This study describes the word-problem solving instruction of one elementary special education teacher of Latino English Language Learners (Latino ELLs) with mathematics learning disabilities (MLD) in an urban school setting. This study was situated in a culturally responsive teaching framework. In investigating this instruction with Latino ELLs with MLD, this study focused on how one teacher's knowledge of mathematics pedagogy influenced her instruction, and how her instruction changed once provided professional development. Findings resulted in three major themes that were aligned with the current education literature in this area: Mathematics is More Than Numbers, Endowing Children with Linguistic Mathematics Capital, and Mathematics Comprehension a Cognitive Adventure. The results indicated that the success of ELLs with MLD at the elementary education level might be dependent on how well the special education teacher receives professional development related to problem solving comprehension.

Keywords: **culturally responsive teaching, professional mathematics development, Latino English language learners, mathematics learning disabilities, case study research**

English language learners (ELLs) are the fastest growing demographic segment in U.S. public schools, with an estimated 11.2 million students enrolled (Aud et al., 2011). The challenges for many ELLs are not only overcoming a language barrier, but also achieving academically (Garcia & Cuéllar, 2006). Spanish-speaking ELLs make up a large percentage (73.1%) of the ELL population (Batalova & McHugh, 2010), and represent a substantial number of students who do not demonstrate proficiency in mathematics. According to The Nation's Report Card (National Center for Education Statistics [NCES], 2011), the average mathematics score for a White fourth-grader was 249 with only 9% of the White student population scoring below basic in mathematics skills, while the average mathematics score for an ELL fourth grader was 219 (with 42% below basic). By eighth grade, this gap widened with a White student averaging 293

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(17% of the population scoring below basic) and an ELL averaging 244 (72% of the population below basic). This poor mathematics achievement places many ELLs with mathematics learning disabilities (MLD) at risk for mathematics failure because of the range of instructional needs they require. The question of how to achieve equitable mathematics outcomes at high levels of performance for ELLs with MLD continues to plague U.S. schools. The central premise of this study was based on the foundation that in order to solve this challenge and enhance mathematics achievement in ELLs with MLD, teachers must be able to apply culturally responsive evidence-based mathematics practices.

Students with MLD are often unable to learn to problem solve because word problems are unforgiving in terms of the constant need to build specific working mathematics and English knowledge that is dependent on reading comprehension (Fuchs et al., 2015). These students also demonstrate characteristics of inactive learners who do not monitor their learning or use strategies effectively (Geary, 2013). They have not developed the cognitive awareness necessary to assess their understanding as they read and to recognize when their comprehension has broken down. Evidence-based mathematics research continues to indicate that teaching students with MLD how to use mathematics strategies improves their word problem solving efficiency. Many of the mathematics strategies associated with the highest comprehension gains for improving students' with MLD mathematics achievement directly and explicitly teach students strategies, provide them with extensive practice with these strategies, provide instruction feedback, and provide students with opportunities to ask and answer questions and think aloud about the problem solving process (Gersten et al., 2009).

According to Gersten et al. (2009) instruction for students with MLD should include: (a) methods of explicit and direct instruction that teaches conceptual knowledge necessary for understanding mathematics concepts and principles of a word problem; (b) visualizing techniques designed to bridge a connection from verbal information to symbolic understanding by creating a mental model; (c) providing immediate and academically oriented feedback with peer assisted learning strategies during instruction; and (d) small group instruction, instructional modeling, corrective feedback, and student verbalizations. In addition, comprehension appears to be enhanced when it occurs in contexts that are socially and linguistically meaningful and students' languages and experiences are centrally included in classroom curricula and teaching activities (Baca & Cervantes, 2003; Gay, 2010). Previous culturally responsive special education research suggests that classroom instruction must be culturally affirming and culturally responsive (Atweh, Forgasz, & Nebres, 2001; Orosco & O'Connor, 2014; Ortiz, 2007). From this culturally responsive research, mathematics educators go beyond "just plain good teaching" that does not address students' cultural and linguistic experiences, in which they make the focused effort in their teaching to incorporate students' cultural and linguistic knowledge with authentic student-centered learning experiences (Atweh et al., 2001).

Although there is a great deal of evidence that supports the value of MLD strategies, much less is understood about how to instruct teachers to use them with ELLs with MLD. While many elementary special education teachers feel confident, they can help English-speaking students with MLD comprehend content in their mathematics lessons, they feel less confident that they have sufficient expertise to carry out strategy instruction to ELLs with MLD. We do not yet know the professional development model best suited to helping special education teachers with ELLs with MLD. Much of the diversity training implemented in public schools to date has focused on culture-specific or surface aspects of culture, language inclusion, and community involvement— little attention has been given to the hidden dimensions of culture that can pose learning difficulties for ELLs with MLD. Given the sophisticated knowledge base and skills needed to solve word problems and the continued mathematics difficulties many ELLs with MLD experience, there is a great need for special education teachers at the elementary level to receive professional development with proven mathematics strategies with academic language development that can be utilized to support ELLs. This article describes the findings of a study that was conducted with one elementary school special education teacher who participated in professional development activities on implementing word problem solving strategies for ELLs with MLD. The purpose of this study was to support one elementary school special education teacher in developing the knowledge, skills, and dispositions to implement mathematics strategies with word problems for ELLs with MLD. This research was guided by the following questions.

1. How does one special education teacher implement word problem solving instruction for Latino ELLs with MLD?
2. How does one special education teacher's understandings, beliefs, judgements, professional development, and training affect word problem solving instruction with Latino ELLs with MLD?

Conceptual Framework

This study's professional development model was built on a culturally responsive special education (CRSPED) foundation (e.g., Baca & Cervantes, 2003; Klingner et al., 2005; Ortiz, 2007). Culturally responsive special education provides teachers with the support needed to implement evidence-based mathematics practices and interventions with student's cultural and linguistic experiences. In addition, this conceptual framework prepares special education teachers to make a concentrated effort in classrooms to incorporate students' cultural and linguistic experiences with authentic student-centered learning activities (Orosco & Klingner 2010; Orosco, 2014). Finally, culturally responsive special education instruction provides teachers with a social constructivist process that allows them to move on beyond typical knowledge transfer networks (e.g., rote memorization) to their students, by providing them with a pedagogy that fosters higher comprehension-thinking skills (Vygotsky, 1978).

Methodology

This study used a case study design. The case study method provides a research tool for researchers to study phenomena within classroom contexts that are too complex for quantitative methods to capture (Yin, 2008). Within this methodology, case studies can be a valuable descriptive tool because it allows researchers to keep track of teaching movement in classrooms by providing an in-depth understanding such as special education teachers instructing ELLs with MLD. In this study, this approach allowed the investigator: (a) to provide an in-depth approach of mathematics instruction with ELLs with MLD; (b) to select the major themes that addressed the purpose of the study; (c) to triangulate key observations for interpretations; and (d) develop generalizations from the findings.

Setting and Participants

El Rancho elementary school (ERES) is located in a southwestern urban school district. This school's population consisted of 453 students (55% Hispanic [all Latino ELLs], 22% African American, 14% White, 5% Asian, and 4% other). The school was considered a high-poverty school, as it had approximately 75% of its population in the free or reduced-price lunch program. The term Latino English Language Learner is used because the student population had been identified as coming from Latin American descendants (e.g., Mexican, Mexican American), and they were acquiring English as a second language. The English level of the participants was categorized by their state's English language development test as English Language Learner intermediate. That is, students at the intermediate level were able to understand the main ideas and some details of mathematically extended discourse in English. Because the focus of this study was on the teacher and not the students, the participant's school did not disclose native language proficiency scores. Therefore, the student's level of bilingualism could not be determined. The student sample consisted of students: (a) who had individualized education plans related to MLD (e.g., language and reading comprehension difficulties related to word problems); (b) who spoke Spanish as their native language, as determined by the school's home language survey; (c) had been classified as English Language Learner by their state development test; and (d) parent consent. Pseudonyms are used for the participant, children, and school referenced in this article.

The teacher, Mrs. Casemiro, was selected by school administration recommendation because (a) she had displayed strong instruction based on her school district's teaching evaluations, (b) she was implementing mathematics instruction with Latino students applying ESL instructional methods, (c) she had received professional and graduate training (Masters of Education) in Special Education and was a state certified Bilingual, Cross-cultural Language and Academic Development (BCLAD) Teacher, (d) she had taught Latino ELLs with MLD for 9 years, and (e) she was bilingual in English/Spanish. Mrs. Casemiro's mathematics instruction consisted of 50 minutes per day in English using a standards-based mathematics curriculum. In addition, she was chosen because school administration felt that "she was a good teacher…but we (the school) fall short of providing her sufficient professional development in mathematics to make her a better teacher, and she needs help in this area like many of our other teachers." This comment illuminates the common professional development problems and challenges many schools face of mathematics teaching for ELLs with MLD.

Mrs. Casemiro had her own special education resource room. Classroom observations indicated she instructed 15 students per day on mathematics comprehension. During this study's classroom observation's, her instructional sessions were provided in three small groups (4–5 students with similar IEP mathematics needs) and lasted for an average duration of 30 minutes per session depending on the grade level she was teaching and time allocation required by students' IEPs. The researcher did not have access to the students' IEPs due to privacy concerns protected by federal law (Public Law 94-142, Education of All Handicapped Children Act).

Procedures

The focus of this study was to learn about the teacher's mathematics knowledge of her struggling students, and her instructional practices as a framework upon which to identify professional development that would help address her teaching needs and student learning needs. The participant was interviewed prior to the professional development to get an understanding of her knowledge about her instructional mathematics practices and her students.

During an interview, the participant had identified word problems as an area in which she needed assistance. Mrs. Casemiro, "I just do not know how to connect basic mathematics skills with higher-order learning such as understanding and reasoning in word problems for my students." Thus, professional development targeted word problem solving support. Professional development was provided in two 2-hour workshops on common mathematics strategies provided by the research literature. These strategies focused on (1) teaching mathematics concepts and vocabulary, (2) teaching the strategies, and (3) collaborative learning group activity or student pairing. The first author (an expert in ESL/Bilingual mathematics development with ELLs with MLD) provided the professional development sessions. The participant received two 2-hour workshops from the researcher in which she saw mathematics strategies modeled, and had opportunities for extensive hands- on practice. The participant needed to see concrete examples of how mathematics strategies relate to her students and their circumstances. The participant was taught not only *how* to implement mathematics strategies, but also *why*, so that she would have an understanding of the underlying conceptual rationale for each of the strategies and collaborative based teaching components that made up this professional development. The researcher provided the participant with all the necessary materials for implementation in her classroom. After training, the teacher was involved in the strategic planning in which the participant received monthly booster workshops in which the researcher reviewed mathematics strategy components, shared observation data collected, allowed the participant to share her successes and frustrations, and share student experiences along with demonstrations and discussions of next steps to improve instruction (NMAP, 2008; NRC, 2001). Since the instructional practices have been validated in other studies with students with mathematics learning disabilities (see Orosco, Swanson, O'Connor, & Lussier, 2013 for a description), only a brief description follows.

Professional development. The first phase included showing the participant how to model by direct and explicit instruction specific mathematics concepts, vocabulary, and terminology using word problems as practice with students. Direct and explicit instruction has been found effective with students with MLD because students are cognitively engaged throughout the teaching process and have opportunities throughout the lesson to self-monitor and direct their own learning and participation (Gersten et al., 2009). This modeling activity included using 3 x 5 inch index cards with mathematics language by holding up a card, providing a definition through contextualization, writing this vocabulary on chart paper, and then applying this word in a mathematics problem. On the card, the participant was asked to write the word, write a friendly definition of the word, and write a mathematics example (so that they can practice these words). The second phase included modeling for the participant how to teach a common problem solving strategy (*Know it*, *Find it*, *Set it up*, *Solve it*, and *Check it*; e.g., Kong & Orosco, 2016; Orosco, 2014; Orosco et al., 2013). In addition, the participant was shown how to use these phases collaboratively among students, which allowed students to practice this method. Collaborative based learning has been found effective because it reinforces to what students with MLD have been introduced during the teacher's direct and explicit instructional phase. In this phase, one student was assigned to a leadership role and imitated the teacher's role in leading a discussion about mathematics concepts and solutions to problems introduced during the direct/explicit phase (Kong & Orosco, 2016). Within this process, the student talked with other students through the strategy, generated, and asked questions to check for understanding, while the teacher monitored for understanding. The students then solved the problem and checked to see if it was answered correctly. If answered incorrectly, the problem-solving process was repeated between the teacher and students again, to see where mistakes were made. As they reviewed, the teacher monitored student effectiveness by providing probes as needed (e.g., reading words, clarifying mathematics concepts, or reminding students of a strategy skipped). If word problem solving challenges persisted, the teacher then retaught specific strategies until the student(s) comprehended (Gersten et al., 2009).

Data Collection and Analysis

As in previous studies (Orosco & Klingner, 2010; Orosco & O'Connor, 2014), the strategy of inquiry for this study was a case study approach (Yin, 2008). Observations were conducted 15 times over a five-month period. The purposes of these observations (five observation sessions) were to describe mathematics instruction prior to the teacher receiving professional development, during training (five observation sessions), after training (five observation sessions) and to develop an understanding of the educational context the participant instructed with Latino ELLs with MLD. Descriptive field notes were taken to capture how mathematics instruction was being implemented and in what context it occurred, what instructional methods were being used, and how ELLs' with MLD instructional needs were being accounted for during the teaching process. The researcher recorded through field notes the classroom environment, what was seen and heard during instructional activities and to document the influence of teaching factors that facilitated or hindered instruction. Using analytical notes, the researcher recorded impressions and questions or issues that need further investigating (Patton, 2005).

Interviews. A pre- and post-interview (30 minutes each) was conducted with the participant (Orosco & Klingner, 2010; Orosco & O'Connor, 2014). The purpose of the interviews was to gather information that sought to understand how the participant interpreted mathematics instruction with ELLs with MLD. The interviews were guided by a protocol of questions, such as the following:

Describe your teaching philosophy.

What are the greatest challenges you face teaching mathematics?

Do you think that the training influenced understanding of word problems?

How did you like the training?

Classroom conversations focused on asking the teacher's perceptions of classroom instruction that were observed, by prompting the participant to share her instructional experiences during that lesson. The interviews and discussions explicated the participant's thinking about instruction (i.e., prompted the participant to share her instructional experiences, educational, and professional development), but also established the conditions for her teaching reflections (i.e., this dialogue not only allowed her to describe her instructional methods but also allowed us to validate research data collected). As an example of this validity, during one conversation she commented on her thoughts about teaching word problems:

> For many of my students, word problems are quite challenging and perplex them to the point of frustration. They give up; I give up. It is easier to teach calculation skills because they are number based not language and reading based. My students love to do calculation problems!

Statements like this were verified by classroom observations of her word problem solving instruction prior to receiving professional development. That is, the participant was consistently observed providing computational skills procedures, in which she showed students how to choose the operations needed, decided on the numbers to use, and do the necessary calculations for solving the word problem. But she left out the *direct and explicit instruction* (i.e., breaking down teaching tasks into small steps, constantly probing, providing modeling, administering frequent feedback, and asking questions to confirm that ELLs with MLD understood her instruction) that would have helped students to develop the problem solving skills necessary to understand more challenging word problems they would encounter down the line.

Artifacts and documents. Documents related to instruction were reviewed, such as mathematics curricula, school demographics, and professional development documents (Orosco & Klingner, 2010; Orosco & O'Connor, 2014). Document analysis of classroom materials, lesson plans, and student work provided the evidence to support this study. A specific focus was put on the analysis of instructional materials and classroom observations, to see if they coincided with the participant documented interviews and discussions.

Data analysis. The first author conducted initial data analysis, and his research team reviewed and checked for accuracy all coded data that followed Strauss and Corbin's (1998) inductive analysis process. This method had been used in previous qualitative studies (e.g. Orosco & Klingner, 2010; Orosco & O'Connor, 2014). Emerging codes and themes were discussed and agreed upon by the parties involved on a monthly basis as data analysis progressed. Field notes of classroom observations were analyzed line by line and as a whole by examining the types of activities and interactional patterns within the mathematics experience. Each code was developed in consideration of the study's research questions, guided by the literature, and then was operationalized with a clear definition of what data could and would not fit into a particular code. As codes were revised, all previously reviewed data were then recoded to reflect any modifications that were made.

As in previous studies (e.g. Orosco & Klinger, 2010; Orosco & O'Connor, 2014), during the initial coding process, data was chunked from initial interviews and observations, which identified preliminary codes. As this study progressed, data codes went through multiple iterations that were continuously refined and modified as necessary. As additional data were collected, inductive analysis continued and the preliminary codes were iteratively refined to discrete codes, which reflected emerging patterns of convergence and divergence (Strauss & Corbin, 1998). As examples, two codes that were developed and then integrated because further evidence collected did not support separate codes were *participant's strong beliefs on teaching basic mathematics skills* (interview data) and *calculation skills focus in the classroom* (classroom observation data and student worksheets). These two codes became *mathematics instruction is based on calculation skills.* Next, discrete codes were grouped into conceptual categories that reflect commonalities among codes. This is called "axial coding," reflecting the concept of clustering the open codes to specific "axes" or points of intersection. Axial coding in this study consisted of specifying a category in terms of the conditions that give rise to it; the context (its specific set of properties) in which it is embedded; the action and/or interaction by which it is handled, managed, or carried out; and the consequences of those strategies. For example, the *mathematics instruction is based on calculation skills* code was categorized into *basic mathematics instruction.* At this stage, the properties were identified interpretively through the lens of the researcher (Harry, Sturges, & Klingner, 2005). The final step was "selective coding," meaning that at this point, we handled various code clusters in a selective fashion, deciding their relation to each other and what stories they told. This is known as "thematic" building. As an example, the *basic mathematics instruction* category became integrated into the theme *mathematics is more than numbers.* As interrelations between themes became apparent, a coherent story began to emerge. For example, the themes *mathematics is more than numbers*, and *mathematics comprehension a cognitive adventure*, the causal condition was that the participant's classroom mathematics instruction was mainly focused on basic mathematics skills, the action was that the participant needed professional development with culturally responsive mathematics comprehension instruction, and the consequences or phenomena were that Latino ELLs with MLD became more engaged and learned to solve word problems.

Reliability and validity. This study followed several strategies (e.g., observation, participant debriefing, member checking, thick description) to improve on the reliability and validity of the study (Merriam, 2002). Triangulation of qualitative data sources were consistently compared and crosschecked with information derived at different times and by different means. As an example, during classroom meetings, the researcher and the participant discussed findings, put forward ideas, and possible themes (Glaser & Strauss, 1967). The interaction between the researcher and participant was ongoing and recursive which resulted in complete agreement of the study's findings. We believed that our diverse backgrounds, experiences, training, and views on instruction, ultimately allowed for deeper and thorough analysis of our data. The first author had specialized in Bilingual/ESL Special Education, and had been a teacher in this area. The participant brought to this study an extensive background in effective special education instruction at the elementary level. In addition, the first author met periodically with the participant and discussed the findings (e.g., review of classroom findings and observations) of the study; the participant provided her perspective and expertise developed over her years of teaching service. The benefit of this triangulation was that it insured the accuracy and credibility of this study's data. All these strategies were incorporated and served as guiding principles throughout this study. It was through this synthesis and analysis of these varied research strategies that the themes and conclusions of the study evolved.

Findings

The findings included the following three entwined themes: Mathematics is More Than Numbers, Endowing Children with Linguistic Mathematics Capital, and Mathematics Comprehension Is a Cognitive Adventure. These themes were interconnected and functioned to establish a word problem-solving model. The picture that resulted from this study was that the participant was able to provide instruction that promoted student's word problem solving development.

Description of El Rancho Elementary School

El Rancho Elementary School (ERES) is situated within a large southwestern city that is in a heavily industrialized, largely populated area. As one drives into the ERES community, one can see the brightly colored citrus trees in peoples' yards. The ERES community has been home to waves of Latino immigrants, and has produced one of the most entrenched and stable first and second-generation working-class Mexican/Mexican-American Spanish speaking communities in the United States. The children from the LE community are often the first English-speaking members of their extended family. Parents work multiple jobs to "make ends meet," and many families have experienced financial hardship from the last economic downturn.

Instructional Approach

Prior to receiving professional development, in regard to teaching word problems, Mrs. Casemiro understood that her ELL students with MLD needed more than the traditional approach of directly teaching symbols, mathematics facts and the standard problem solving process. However, she was struggling with this because of how she had been taught and trained:

> I grew up with the belief that learning mathematics was directly taught to you centered on memorization of facts and content knowledge. When I became a teacher, I was trained in a similar fashion in which we followed the traditional mathematics program with direct instruction in which we focused on teaching basic number skills, relations, operation on numbers, and showing students how to memorize steps to answer word problems. I was taught that this approach was about teaching automaticity so it could free up memory to comprehend abstract concepts in latter grades. I still use this method today. But, I know I need to do more with my students; I never show them to understand.

Her teaching approach consisted of recitation script applying a standards-based mathematics curriculum. Classroom observations indicated that Mrs. Casemiro followed a two part instructional approach to teaching word problems. In the first part, she modeled problem solving (e.g., setting it up for problem solving and then performing the calculation), by working with 2 to 3 word problems, and the students observed passively; in the second part, the students worked independently with word problems, with Mrs. Casemiro or a paraprofessional monitoring their work or giving feedback. Although the students were observed working at their desks passively (well behaved), many of the word problems that were assigned were solved incorrectly or never completed because the students had not learned problem-solving skills. Students often faced unknown vocabulary and/or challenging passage comprehensions. Mrs. Casemiro (grimacing with frustration), said that,

> There is just too much mathematics needs to help everyone on a daily basis. I do well teaching them how to setup the problem solving such as calculation with numbers, but when it comes [to] actually making them comprehend word problems, I struggle.

This perspective changed once she received professional development to complement her teaching skills.

After receiving professional development Mrs. Casemiro began, transitioning from a skills-based instructional approach to one that followed a more interactive teaching approach that focused on building students' problem-solving development seamlessly with skills-based instructional practices. That is, she applied a sociocultural problem solving approach with collaborative based mathematics skills instruction that reinforced students' background knowledge that encouraged them to draw on their personal experiences in their own words as they related it to word problems.

Mathematics is More Than Numbers

Mrs. Casemiro was learning how to apply a teaching approach that integrated students' background knowledge. Her instruction was beginning to be firmly situated within the literature that believes instruction can be effective when students' background knowledge is incorporated. She was learning how to provide clear, direct, and explicit instruction that incorporated students' previous learning and at the same time addressed word problem solving learning challenges that was appropriate for students' mathematics, reading, and language levels. Mrs. Casemiro stated that "mathematics comprehension is more than building mathematics skills, but involves a dynamic process that requires students to think about what they already know, and experienced (especially with mathematics and language)." This teaching style not only included explicit instruction in teaching core mathematics skills but at times also reading elements (e.g., phonological awareness, phonics, vocabulary, comprehension, and oral language) matched with student background knowledge with peer-learning opportunities, cooperative learning, and gradual release of responsibility models in a language-rich environment.

In the following example (Table 1), Mrs. Casemiro reads the problem with the students, asks them to work out the problem by themselves quickly, and then, working as a class, she teaches them "challenging" mathematics words. As she circulates around to see if students are working independently, she begins to notice that many of her students are struggling with certain concepts/words in the assigned word problem. Mrs. Casemiro asks them to stop and pay attention to her. [She is at the dry erase board.]

Table 1. ***Mathematics is More Than Numbers***

Mrs. Casemiro: Do you remember when Luis and Paz's mothers came in and showed us how to make sopapillas (round fried pastry made from sopapillas) like the ones you ate for our reading lesson? Those were good! [Several students share their background knowledge with this previous experience.] Does somebody remember what shape they were?

David: They were round like a circle.

Mrs. Casemiro: Nice job! Yes, round like a circle. [Teacher draws a big round circle on a dry erase board.] Today, we are going to learn new mathematics words: numerator, denominator, fraction, one-half, one-third, one-fourth, one-fifth, one-sixth, equal, unequal, and whole. [She has written words on a vocabulary card.] First, we need to practice pronouncing them. I will say the word and then I would like you to repeat it. [Mrs. Casemiro with clear enunciation.] "Numerator."

Students: Num…era…tor. [Mrs. Casemiro: Let's read and say it one more time.]

Students: Numerator. [Pronouncing the word more fluently. Students also practice their fluency by pronouncing *denominator* and *numerator*.]

Mrs. Casemiro: Okay, now these next words can be difficult to say. The *h* sound in Spanish is silent, and because of this it can be difficult to say in English. While, the *th* sound does not exist in Spanish. So, I really need you to listen. Okay, here goes. [Holding up a flash card with the mathematics term one-half]. One ha…lf (stretching the *h* sound), your turn. [Teacher listening very carefully.]

Students: Struggling with the pronunciation of *h* sound… [really making an effort to say the h sound] one-ha…lf, one-ha…lf. Teacher helps them by saying words again.]

Mrs. Casemiro: Okay one more time. One-ha…lf, one-ha…lf, one-ha…lf. Please repeat.

Students: One-half, one-half, one-half.

Mrs. Casemiro: We will keep working on this sound and mathematics words with it. Okay, let us work on the *th* sound. [Carefully enunciating th sound.] Th…th… th. Please repeat. [Students repeat this sound.] Okay, here is another word [holding up the one-third vocabulary card, and carefully enunciating the th sound]. One th… ird, one th…ird, one th…ird. [Mrs. Casemiro does the same activity with the other words.] Now, I want you to take these cards and practice these words by teaching each other in pairs. [Giving each pair of students a set vocabulary cards with the words: numerator, denominator, one-half, one-third, one-fourth, one-fifth, one-sixth, equal, and unequal]. [I circulate around and listen to student's practice. All students are practicing this activity and are improving their pronunciation skills.]
Mrs. Casemiro: Now, let's take this mathematics language and think about it with fractions. [She has designed a cloth circle with interchangeable pieces that stick to the board]. Now, let us look at the sopapilla I have made with six equal pieces. Okay now we are going to practice our vocabulary showing and naming the parts of this sopapilla. Look at the sopapilla with all six pieces. What in the shape represents the whole? The sopapilla pieces represent the whole. How many equal pieces are there?

Sean (raising his hand): (pause)…There are six equal pieces.

Mrs. Casemiro: Very good, you are smart! Now, let's look at this word problem, and think about what it is asking? Mrs. Rosales made sopapillas for his friends. He served part of one sopapilla. What part of the sopapilla was served? What part was left? We will use the fraction to name the sopapilla slices served and the slices left. First, we need to learn what a fraction is, please listen (writing the following sentence on the board). A fraction, such as one-sixth (pulling 1 slice from the diagram) names equal parts of a whole. I can write the fraction to name the one equal piece of sopapilla served by using the mathematicsematical terms numerator/denominator. In this case, I served one slice out of six slices or one-sixth of the sopapilla. Can someone model for the class another fraction? [Students are hesitant…Amy volunteers].

Mrs. Casemiro: Okay Estrella, let's say that you have a whole sopapilla or eight equally cut pieces. How many pieces would you like to serve?"

Amy: I would like to serve five pieces.

Mrs. Casemiro: How would you say and write the fraction?

Amy: My numerator would be eight and my denominator would be five [writing 8/5 on the board].

Mrs. Casemiro: Let's check your work, and look back at the numerator and denominator definitions. Your numerator is the number of pieces served, which are five. For the denominator, you would use the total (with emphasis) number of pieces in the whole. How many total pieces did you have?

Amy: [looking at her problem…thinking]. Oh, I have eight total pieces and not five. I served five eighths [erasing 8/5 and writing 5/8]. This is my fraction.

Mrs. Casemiro: Great job! [Mrs. Casemiro gives others students the opportunity to demonstrate that they understand the concept of a fraction that she taught. She then gives them word problems to first practice independently and then collaboratively with the same concept. I circulate and all students are getting the concept of a fraction.]

In the excerpt above, Mrs. Casemiro provided instructional scaffolding, which included clear, direct, and explicit instruction that supported student problem solving success by allowing for student contextualization, engagement, and oral language development. In addition, she allowed students to respond spontaneously, because her instruction bridged background knowledge with new knowledge. Finally, she gave her students the opportunity to contextualize instruction by allowing them to filter new learned knowledge through collaborative based experiences with peers.

Endowing Children With Linguistic Mathematics Capital

Mrs. Casemiro was fondly aware of her students' need for academic language development and the challenges teaching language. Mrs. Casemiro, "My students really struggle with understanding the specialized language in word problems. I can teach the mathematics symbols to do mathematics, but I just don't understand how to teach mathematics language to explain word problems and use this to carry out the mathematics procedures for solution." While teaching word problems, teachers must show students how to use specialized vocabulary and mathematicsematical concepts, so that they can use this language to contextualize, communicate, and reflect upon to bolster their understanding. Teaching difficult vocabulary during word problem lessons can clear up misconceptions that may cause linguistic barriers to developing strong problem solving skills, and can help teachers recognize what students do and do not understand. Prior to this lesson (Table 2), Mrs. Casemiro was provided professional development that taught her on how mathematics learning is mediated through language, and then provided teaching examples in helping how her students develop their English language proficiency and word problem solving comprehension. As a result, when students were taught language, the outcome was not only the creation of new word entries that not only promoted the growth of vocabulary but also improved word problem solving efficiency.

Table 2. ***Endowing Children with Linguistic Mathematics Capital***

There were 25 apples and 40 plums in two bins in the market. Louie bought 26 plums and 14 apples from the market. He gave away 8 apples and 9 plums to his friend, Lisa. How many apples and plums does Louie have left?

Mrs. Casemiro: Sometimes, when I work on word problems I make up a list of words or concepts I do not understand. In this word problem, I came up with the following word list: total, 25 apples and 40 plums in two bins, gave away 8 apples and 9 plums, how many apples and plums does Louie have left? Okay, has anyone been shopping to the store for food and bought fruit?

Samuel: Yes, I went to el mercado (store) on Saturday to shop for food with my dad and mom. We bought some mangos and papaya. [Other students also express their shopping experiences.]

Mrs. Casemiro: Good, I see everyone has been shopping for fruit. Do you know what we sometimes call the shelves that we put or store fruit and vegetables in. [No students reply.] These shelves are sometimes called bins. In this word problem, the apples and plums were put into two bins. [She draws a picture representing two bins, and labels them apple bin and plum bin.]

Mrs. Casemiro: I am thinking about the concept *gave away* [writing this on the board]. What do the words *gave away* mean?

Laura: During Navidad (Christmas), we gave away presents. [Other students give similar input.]

Mrs. Casemiro: So when you gave away presents, you gave them away free or no charge. In this sentence, *Louie gave away 8 apples and 9 plums* to his friend Lisa for free. In mathematics *gave away* can mean to subtract or take away. [Writing these words with the minus symbol on the board.]

Mrs. Casemiro: I am thinking about the sentence, *how many apples and plums does Louie have left*? I know the word *left*. It means the opposite of right (waving her left and right hand). And, I know that when we go to the cafeteria for lunch, we need to go out of my classroom door and turn left, it is the opposite of a right turn. However, I do not think that these thoughts make sense in this sentence. I also know that when I spend I spend money; the cashier gives me back the change I have left, meaning that I have some money remaining. [She models this with students using money and fruit.] Maybe in this word problem, left means remaining. If Louie had 25 apples and he gave Lisa 9 apples, he had 16 apples left or remaining (25-16=9). That makes sense to me. Now can you figure out how many plums Louie had left with your mathematics buddy? [I circulate around and students are getting the concepts taught by Mrs. Casemiro. All students were able to problem solve that Louie had 40 plums and he gave 9 plums to Lisa (40-9=31). Louie had 31 plums left.]

In the mathematics activity above, Mrs. Casemiro used explicit instruction and modeling with challenging language to improve their word problem solving abilities. First, she helped students interact with mathematics concepts by helping them connect new mathematics language to their own personal experiences. Next, she began to build mathematics language in them by modeling for them vocabulary. Modeling language for students is a good way to help improve mathematics understanding, especially with students who have trouble with mathematics and reading (as opposed to mathematics deficits alone) and who have difficulty with word problems. Finally, she allowed students to collaborate (to check for understanding) with each other in meaningful language practice to produce comprehension.

Mathematics Comprehension Is a Cognitive Adventure

In the following word problem solving activity (Table 3), Mrs. Casemiro uses an interactive teaching approach to improve the word problem solving comprehension of her ELLs with MLD. First, she helps students interact with the word problems in meaningful dialogue by helping them connect new information to their own personal experiences. Next, she begins to show them the idea behind a well-tested comprehension strategy called questioning. Questioning is a good way to help determine how well students understand a word problem and can engage students to become more involved with a question. Finally, she uses an instructional tool (that is often overlooked), the number line, to illustrate and provide foundational representations of benchmark fractions. For many students, learning to problem solve (especially fractions) involves more than just providing direct and explicit instruction; but also helps them conceptualize with tools what the word problem represents.

Table 3. ***Mathematics Comprehension a Cognitive Adventure***

Lisa keeps sports cards in 3 drawers. Each drawer contains exactly 12 cards. In each drawer, 2/3 of the cards are baseball cards, and 1/3 of the cards are football cards. If Lisa decides to trade 1/4 of her football cards, how many cards will she trade? [Word Problem is on a chart for all students to see.]

Mrs. Casemiro: Okay, let us read this word problem together. [She reads the word problem aloud with students.] Can someone tell me what this (football card) is? My son collects football cards of his favorite players. [She passes cards around for students to touch and see.]

Denise: It is a football card. My dad collects soccer cards from Mexico.

Mrs. Casemiro: You are correct! What are his favorite player cards?

Denise: His favorite player cards are from Las Chivas de Guadalajara [Mexican Soccer Team].

Mrs. Casemiro: [Pointing to the word problem.] In today's problem, Lisa likes to collect cards from two sports: Football and Baseball. Can someone tell me what a drawer is? [No students reply.] Using realia (she pulls out a drawer from her desk and places cards in it), Mrs. Casemiro helps the class understand the concept of Lisa keeping *12 cards* in *3 drawers* each. [She goes on to teach other key concepts (e.g., 2/3, 1/3, 1/4 how many; please see the theme on background knowledge for descriptive examples) from this word problem. Key vocabulary and concepts with definitions/illustrations are written on chart board for reference.] Okay, so we understand the concepts. Now, let's think about how we are going to solve the problem. [Thinking out loud, tapping her forehead.] If Lisa has 3 drawers and each drawer has 12 cards, how many cards does she have in total?

Tomas: 36.

Mrs. Casemiro: How did you come up with that calculation? Please explain.

Tomas: I multiplied 3 by 10 and got 30. I than took 30 and added 6, and got 36

Mrs. Casemiro: I really liked how you multiplied by a base of 10. Nice job! Now, let's solve the problem using a number line. [She rereads the problem aloud.] She asks the students, what are we solving for? [She gives them time to think, and asks the question again.]

Socorro: Lisa is trying to trade ¼ of her football cards.

Mrs. Casemiro. Good, this is relevant or important information (circling ¼). Word problems always have relevant information. Now, let's look at the number line I have drawn on the board it has 36 equally divided lines. Each line represents 1 card, and so my number line has 1-36 cards. If 1/3 of Lisa's cards are football, than 1/3 of 36 are 12 (shading in lines 1-12). I can check this by counting by 12s (12, 24, 36), one-third of 36 are twelve. Now, if we know she has 12 football cards, and she needs to trade ¼ of these, how many does she need to trade? [She gives students a minute for think time.]

Saul: I think she needs to trade 3 cards.

Mrs. Casemiro: That is right. How did you figure this out?

Saul: If Lisa had twelve football cards, she needed to trade ¼ of 12. Three times four is twelve; there are four threes in twelve (counting by threes on the number line), the first one is three.

Mrs. Casemiro: I liked how you used multiplication and the number line to figure out how ¼ of 12 is three. [Transition to independent/collaborative based practice applying instructional method just taught.]

ELLs with MLD often struggle and are the poorest in terms of word problem solving comprehension. For teachers of ELLs with MLD, word problem solving comprehension not only means connecting basic mathematics skills with higher-order learning (such as understanding and reasoning) but also academic language development. ELLs with MLD need constant support in this area, because the word problem levels of some texts may be too challenging for them. Typically, little attention has been paid to teaching ELLs with MLD word problem solving strategies, because many teachers struggle with how to teach comprehension. Once given professional development, Mrs. Casemiro went beyond this challenge by making an effort to this in her instruction. First, she understood that ELLs with MLD comprehend word problems better that connect to their background knowledge. Providing culturally familiar materials is a strong way to activate background knowledge; this has been found to improve problem solving. Next, she asked students to think about what they already knew about the problem. She provided explicit instruction to help students make connections between word problems and prior learning. Finally, by making problem-solving connections utilizing their background knowledge and experiences, she taught and modeled mathematics strategies (e.g., questioning) using an instructional tool, checked for understanding, and provided feedback.

Discussion

This case study describes the word problem solving instruction of one elementary special education teacher (Mrs. Casemiro) with Latino ELLs with MLD in an urban setting. This study was situated within a culturally responsive special education (CRSPED) framework. A CRSPED framework to improve the mathematics achievement of ELLs with MLD must attend to both what teachers should teach (explicit strategies that students can apply across a range of problems that encourages active participation and mathematical talk) and how teachers should instruct ELLs with MLD (attending to their need for acquiring, reading, and rehearsing the academic language of mathematics and collaboration). In describing this teacher's word problem instruction, a focus was placed on how well this teacher's knowledge of direct explicit mathematics instruction affected her teaching. Findings resulted in three themes (*Mathematics is More Than Numbers, Endowing Children with Linguistic Mathematics Capital, and Mathematics Comprehension Is a Cognitive Adventure*) that were entwined to create a problem-solving framework. Mrs. Casemiro' s instruction after receiving CRSPED was in line with what the literature suggests that interactive sociocultural teaching approaches can provide practitioners with an important backdrop that focuses on providing ELLs with MLD (a) direct and explicit instruction that provides modeling and academic language development with evidence-based mathematics skills that makes connections with prior learning experiences (e.g., asking ELLs what they already know, linking ELLs' personal experiences with mathematics content, and allowing ELLs to clarify understanding in their own words); (b) comprehension strategy instruction that provides questioning support that assists students in answering questions about word problems, feedback to students regarding their problem solving process, and opportunities for students to ask and answer questions about challenges they encounter during problem solving; and (c) incorporating instructional tools with instruction.

Implications for Policy, Practice, Research, and Limitations

Policy. Although, past and present educational policy provides reasons for schools to improve mathematicsematical programming in assisting to prevent ELLs with MLD underachievement, to date, it fails to provide specifics on how schools can address these learner needs' in mathematics. First, schools need policy guidance on how to develop professional development models that not only address national reform efforts but also provide training that takes into account the specific learning needs of ELLs with MLD with evidence-based practices. Furthermore, schools need help with how to provide special education teachers with a professional development base with evidence-based practices that allows them to draw on and build upon several other interconnecting teaching components (e.g., extending students' knowledge of academic language, activating their background knowledge, engagement, and scaffolding meaning). Finally, schools would also need help with how to undertake policy reform efforts within old instructional practices and routines (e.g., rote memorization) that have been difficult to change in special education teachers. Findings from this study provide evidence that word problem solving instruction with ELLs with MLD can be meaningful if professional development wraps around evidence-based practices, interactive culturally responsive special education teaching approaches, and students' cultural and linguistic experiences.

Practice. The education literature continues to indicate that many teachers feel inadequately prepared with ELL pedagogy and content to instruct ELLs (Ballantyne, Sanderman, & Levy, 2008). Elementary special education teachers are still too comfortable providing direct skills-based mathematics instruction void of any mathematics comprehension strategies matched to ELLs' background knowledge. Professional development could provide a beneficial segue to showing teachers how to match skills-based instruction with strategies and ELLs' background experiences. Evidence from this study indicates that teacher's instruction can be relevant with ELLs with MLD if given professional development and training built on a culturally responsive foundation of direct and explicit teaching integrating interactive teaching dialogue and using cooperative learning strategies found effective with students with MLD. This instruction should emphasize and incorporate the following instructional characteristics: (a) model for special education teachers how to build upon ELLs' with MLD experiences and integrate this knowledge with evidence- based skills instruction; (b) provide special education teachers with differentiated instructional methods to address ELLs' with MLD various learning needs; and (c) make sure special education teachers understand the second language acquisition process and how it impacts word problem solving in English.

Research. Finally, the findings that arise from this study contribute to the special education literature, but also, leave many questions unanswered that need to be explored through future research. The first and perhaps most critical inquiry that research must continue to investigate and often posed by special education teachers of ELLs with MLD, "How should word problems be taught to my ELL students?" Case study research can be a valuable instrument because it allows researchers to describe in depth the instructional behaviors that are occurring within a classroom, and help us understand what practices are working or not. Observation studies like the one that was just described can tell us a lot about the attributes of effective teachers and characteristics of effective word problem solving instruction. In addition, because of this research, it can provide an in-depth understanding of what instructional practices work or not and what components are affecting implementation. In summary, case study research can be an effective method for professional development, because it can connect mathematics training back to special education teacher drawn inferences about patterns of change in instructional practice over time, and understanding the instructional characteristics that differentiate more and less successful special education teachers in training and comparison conditions.

Limitations. As with most studies, this research has inherent limitations that can be addressed with future research (Harry et al. 2005). First, this was a qualitative study conducted in a public classroom with time imposed limitations associated with access to the participant, individual skills of the researcher; it was therefore influenced by the participant's personal biases and idiosyncrasies. Next, although the descriptive and interpretive work gave this study strength and the research team independently examined the data in order to mitigate bias, all observations and analyses are filtered through one's worldview, values, and perspectives (Denzin & Lincoln, 2005), and so it is not possible to eliminate all possible bias in data analysis. Further research is therefore recommended.

Conclusion

In conclusion, special education teachers who are provided professional development in evidence-based practices that are matched with ELLs with MLD cultural knowledge and language needs can positively promote ELLs' with MLD problem solving skills. In addition, special education teachers who receive professional development gain access to a wide range of instructional approaches and strategies that can be meshed with evidence- and skills-based practices. The academic success of ELLs with MLD with word problem solving challenges may be dependent on how well teachers are provided training with mathematics instruction that has been found effective with ELLs with MLD.

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