PRESERVICE TEACHERS' STRATEGIES TO SUPPORT ENGLISH LEARNERS

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Although English language learners (ELLs) are one of the fastest growing groups of students in the United States, many teacher preparation programs have yet to require preservice teachers (PSTs) to receive training in effective practices for teaching ELLs. We examined a four-week field experience pairing an elementary PST with an ELL. We examined the strategies PSTs used to support ELLs as they implemented cognitively demanding mathematics tasks. Through interviews, observations, and written reflections, we found that the PSTs tried to support students, with varying degrees of success, by allowing for multiple modes of communication, including visual supports, pressing for explaining, and checking for understanding. Implications for teacher preparation are discussed.

Keywords: Equity and Diversity; Elementary School Education; Teacher Education-Preservice

Recent curricular reforms have emphasized the importance of engaging all students in rich mathematical activity (e.g., National Council of Teachers of Mathematics, 2000; National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO), 2010). Rather than passively participating in mathematics classrooms, children are expected to actively engage in the mathematical practices. The shift toward engagement in the mathematical practices has come with an increase in the linguistic demands of the mathematics classroom. For example, students are expected to justify their solutions and to critique the reasoning of others. To engage in these practices requires extensive communication skills in not only everyday English, but also the academic language of mathematics.

In conjunction with curricular reforms, the demographics of U.S. public schools are undergoing significant changes. English language learners (ELLs) are one of the most rapidly increasing groups of students (Wolf, Herman, & Dietel, 2010). In states such as Texas, California, and Florida where ELLs have made up a sizeable portion of the school population for a number of years, teacher education programs are required to prepare preservice teachers (PSTs) to teach ELLs. Many states with historically low numbers of ELLs are now experiencing dramatic increases in their ELL population. This has driven the need for these states to consider ways to prepare teachers to work with the realities of today's classrooms.

Despite estimates that nearly every teacher in the U.S. now has at least one ELL student, teachers are still underprepared to teach ELLs. In 2008, Ballantyne and colleagues found that only about a third of teachers had received training in strategies to support ELLs. The need for greater attention to strategies for teaching ELLs is further evidenced by the persistent achievement gap among ELLs and their native English-speaking peers (Fry, 2008). There is widespread agreement that teacher education programs must prepare PSTs to work with ELLs. Increasingly, researchers in mathematics education have examined PSTs' work with diverse groups of students (e.g., Aguirre et al., 2012; Foote et al., 2013; Turner et al., 2012; Wager, 2012), though these studies did not focus on ELLs in particular, but on the broader group of students characterized as culturally and linguistically diverse. Because ELLs are simultaneously learning language and mathematics, meeting the needs of ELLs in the mathematics classroom may require teachers to learn skills and knowledge specific to supporting

ELLs. In this study we examined a four-week field experience for PSTs to engage in mathematics with ELLs. The following question guided our work, *What instructional supports do PSTs enact when implementing cognitively demanding mathematics tasks with ELLs*? The answer to this question was important in helping to provide a foundation from which to build further work in determining effective means of preparing PSTs to teach ELLs.

The present study will provide greater insight into PSTs' work with ELLs in particular; a topic few researchers have examined. Downey and Cobbs (2007) and Pappamihiel (2007) conducted empirical studies that offered fieldwork opportunities for PSTs to teach mathematics to ELLs. Downey and Cobbs' study was situated in a university-based teacher preparation program that required elementary PSTs to complete one-on-one tutoring fieldwork with a culturally diverse student. As a result, the PSTs deepened understanding of the relationship between cultural diversity and mathematical learning. In the Pappamihiel study, content-area PSTs who spent 10 hours with an ELL changed their views and recognized that more acceptance and adaptation are essential of multicultural perspectives. Fernandes (2012) observed how middle school mathematics PSTs noticed ELLs' understanding in mathematics through task-based interviews. He found that the PSTs started adopting ELL strategies from an intervention course and became aware of ELLs' needs and challenges. McLeman and colleagus (2012) found that field experiences with ELLs in conjunction with reading ELL literature were valuable in helping PSTs learn instructional strategies for ELLs and helping them understand linguistic complexity such as academic language. These studies suggest that field experiences with ELLs have promise, therefore we wanted to understand how one such experience might help PSTs develop strategies for supporting ELLs in enacting cognitively demanding tasks.

Perspectives

We frame this study in a situated-sociocultural perspective (Moschkovich, 2002) of learning. Because we are interested in the supports the PSTs provided, we focus this study on the learning and experiences of the PSTs. We view learning as discursive activity and that PSTs participate in a community of practice as they draw on a variety of resources in developing sociomathematical norms with their students (Moschkovich, 2002; Yackel & Cobb, 1996). That is to say, we focus on what the PSTs are capable of and the ways they draw on these capabilities to extend their own learning that will, in turn, support ELLs.

In considering the strategies the PSTs might employ, we draw on the work of Chval & Chavez (2011). Chval and Chavez described seven, research-based strategies they characterized as key to supporting ELLs' mathematical proficiency. These strategies included: (1) connecting mathematics with students' prior knowledge, (2) fostering a classroom environment that is rife with language and mathematics, (3) allowing for the use of multiple modes of communication, (4) including visual supports, (5) connecting mathematical representations to language, (6) recording key ideas and representations, and (7) discussing students' writing (Chval & Chavez, 2011). These strategies support students' use and development of academic language (Cummins, 1980) in conjunction with their development of mathematics and served as a framework to guide our examination of the PSTs' work with the ELLs.

Methods

The purpose of this study was to examine the supports elementary PSTs employed when enacting cognitively demanding tasks with ELLs. Four PSTs—Kimberly, Hannah, Morgan, and Fiona—participated in the study, all of whom were juniors in a four-year undergraduate elementary education program at a large research university. Each PST was white and spoke English as her native language. One PST, Kimberly, stated that while not fluent in Spanish she was able to communicate in that language. All four PSTs had limited prior experiences working and learning about ELLs and were eager to put their limited knowledge into practice.

The four ELLs were native Korean speakers. Kyong-Tae, Jin, and Ho-Min had each been in the United States for about six months, Hwa-Young had been in the United States for a little over a year and was also a fluent Japanese speaker. We purposefully (Patton, 2002) selected students enrolled in classes specifically for ELLs but were at or above grade level in mathematics. This allowed the PSTs to gain experience with students who were not yet fully fluent in English without having to also support students who struggled greatly in mathematics.

The field experience centered on the PSTs' weekly, one-on-one meetings with their assigned ELL. The field experience spanned four weeks and each meeting lasted approximately 30 minutes. Prior to each meeting, the PSTs were given a cognitively demanding task that they were to enact with the student. The PSTs were asked to complete a lesson plan detailing their plan for the meeting and given free reign to modify the task and make use of any resources they wished. During the meeting, the PSTs enacted their plan with their ELL.

Data Sources & Analysis

We used qualitative methods in order to gain rich descriptions of the PSTs' interactions with their ELLs (Patton, 2002). Each PST completed a survey before and after the field experience. These surveys contained both open-ended and Likert scale items and provided insights into the PSTs' teaching experiences, prior experiences with ELLs and thoughts about issues of equity and diversity in the classroom and their teacher preparation program. We collected the PSTs' written lesson plans that detailed the learning objectives, their procedures, planned modifications, and assessments. After each meeting, the PSTs crafted a written reflection.

For each weekly meeting, the PSTs would arrive half an hour before their ELL student to participate in a pre-meeting interview. In these video recorded interviews we asked the PSTs to discuss their lesson plans and planned supports in depth. We also observed and video recorded the meetings with the ELLs during which the observer took field notes on moments on which to follow up with the PST. Immediately following each meeting, we conducted a video recorded post interview with the PSTs. The post interview investigated the PSTs' immediate reactions to the meeting, things she would do differently if she could do the meeting again, and thoughts for the subsequent meeting. All video data was fully transcribed.

Using themes previously described from Chval and Chavez (2011) and additional themes that emerged from initial rounds of analysis, we generated a list of codes to use in our subsequent analysis of the interview and meeting data. To establish inter-rater reliability (Patton, 2002), two coders worked to code each data source. From this initial analysis, we further refined our codes and recoded the data. Then, we collapsed the codes into larger categories. For the present study, we examined the most commonly occurring categories that were present in all four of the PSTs' data sets to better understand what strategies the PSTs used and how they supported the ELLs in enacting the tasks.

Findings

Each of the PSTs employed a number of strategies to support their ELLs during the weekly meetings. These supports were both intentional and unintentional. The following sections describe those supports that were most frequently employed across all four PSTs. These supports included using multiple modes of communication, using visual supports, pressing for explanations and meanings, and checking for understanding.

Allowing Multiple Modes of Communication

All four PSTs encouraged their ELL to make use of multiple modes of communication during the weekly meetings. We defined multiple modes of communication as teacher actions that encouraged/allowed students to communicate meaning and thinking through the use of speaking, writing, gesturing, drawing, manipulating, and/or using a first language as they grow in language and mathematical proficiency (Chval & Chavez, 2007).

Across the data set, when PSTs referred to speaking as a mode of communication, they did so in one of two ways: as an alternative to writing (when unable to) or as a means to explain or communicate one's process (i.e. reaching a solution), thinking, or ideas. When Morgan employed this strategy during week two, she asked her student "And this, this time can you try, maybe, telling me what you're doing? Talking about it?" With this question, Morgan was asking her student to verbally explain his process and thinking while problem solving.

During the pre-interview sessions, all four PSTs described drawing as another way to explaining one's thinking in lieu of writing or speaking. The PSTs readily identified that their ELLs may have difficulty communicating in English and discussed the need for other methods of communication to relay their mathematical thinking. There was one occurrence when Hannah verbalized this to her student during a session. During week 2, she said, "Can you draw some over here? Let me help you out (began to draw 24 circles on the paper by 6 x 4)." In this instance, Hannah offered an alternative method of communication to her student; however, she also took over this communication by drawing the representation, removing some challenging aspects of the problem and reducing the cognitive demand.

When PSTs used this strategy with regards to writing, they did so in several ways. During pre-interviews, the PSTs identified that writing would be used to communicate explanations, equations, processes, and thinking and to improve language development. While working with students, three of the four PSTs made use of this strategy to provide an additional method of communicating, specifically for explanation. In all instances, with two exceptions, requesting students to write their explanations did not impact the cognitive demand of the task. In the two instances where the cognitive demand was impacted, the PSTs stated a pathway for solving the problem after stating. For Fiona, in week 2, she stated, "So, how can you write a sentence to explain how each stadium is compared to each other? So are they all the same number? Is one stadium bigger than the other stadium?" For Morgan, in week 2, she stated, "If you need, you can write it out. And you can start subtracting numbers." In both statements, in addition to suggesting the student write their thinking they also suggested a pathway for reaching a solution, which thereby reduced the overall cognitive demand of the task.

Providing Visual Supports

Throughout the four weeks, each of the PSTs included visual supports in her lesson planning and implementation. We defined visual supports as concrete objects, videos, illustrations, or added emphases (bolding, color-coding, etc.) on written tasks. These supports were used in various ways by the PSTs but generally involved the use of manipulatives or images.

Hannah, Fiona, and Kimberly used manipulatives in the meetings with their ELLs. These manipulatives included alien cutouts, connecting cubes, and small vehicles intended for the students to use in their exploration. In some cases the PSTs used the manipulatives to demonstrate a certain solution strategy as in the following excerpt from Fiona's second meeting.

Fiona: It's impossible? Let's work through this, ok, because it's possible. It's kind of confusing, I know. So, if I have [moves one of each 2, 3, and 4 eyed cutouts of creatures into center of table]—how many eyes do I have?

Jin: 9 eyes
Fiona: How many more do I need to get to 24 eyes?
Jin: 15
Fiona: 15. So is there a way I can use the rest of these [cutouts] to make 15 eyes?

Throughout the lesson, it was Fiona, and not her student, that used these manipulatives, leading to an imposed solution strategy. This lowered the cognitive demand on the student by removing the challenging aspect of developing a solution. In the majority of instances involving manipulatives, the PSTs elected to implement them in a similar manner to Fiona.

Finally, all four PSTs used imagery in their lessons. For example, Kimberly drew a picture of a group of coconuts to help define "pile." Although many images were used as linguistic supports, some were utilized as scaffolds for mathematical learning. In the fourth task, in response to Morgan's student's ineffective attempts to find the perimeter of a complicated shape, she drew a simpler example for him to examine. This figure was intended for him to explore his own strategy in an easier setting before returning to the larger figure, applying his exploration, and correcting his mistake. However, as the following excerpt shows, this did not occur.

Morgan: Ok. Alright, so you just added- so can you tell me what you did? What did you add together? All of the what? What did you add all of? You added all- all the sides?
Ho-Min: Yes,
Morgan: Sides, together?
Ho-Min: Yes.
Morgan: Yeah, all sides. Ok. So on [the first problem], when you did this for perimeter, you added all the sides, but you made- you made new sides. With these lines. See, you added these also. But with this shape, see here-

Morgan stopped requiring the student's reflection and instead used her drawing to show him his mistake and how to solve the problem. When the PSTs used such scaffolds, they often relied on them as a crutch themselves, prompting the use of strategies that lowered the cognitive demand.

Most visual supports were implemented to allow students to organize their mathematical thinking. However, there was often conflict between the planned intention and their actual use. When the PSTs relied on the visual supports too heavily, they tended to think for the students and provide a solution method or an idea instead of encouraging the student to use the supports in his or her own way. Thus, the visual supports more often led to lowered cognitive demand, even though the PSTs may not have been intended to do so.

Pressing for Explanation and Meaning.

PST actions that pressed a student to explain his/her solution or meaning of task statement were one of the prevalent strategies that all of the PSTs frequently used throughout the four weeks. The most popular format they used to press students to explain about their solution was questioning and they usually asked students to explain more details and rationale about their work. However, they sometimes took on command forms such as "Explain what you mean by that" or "Tell me about how you figured that one out."

The PSTs most frequently prompted students to justify their solution and/or provide more details about their solution strategies. Hence, the PSTs' press for student explanation usually came after students finished or stopped their solving process. They used various types of questions ranging from general inquiries such as "Why do you think so?" or "How did you find out?" to more specific ones such as "Why did you decide to add these and not something else?" or "Where does the 12 come from?" Other ways the PSTs employed this strategy included asking students about the meaning of the task statement, asking clarifying questions, asking for students' current thinking, asking for students' plans to solve the task, and pressing students to think further.

Each PST favored one particular approach in pressing for meaning. For example, Kimberly's use of this strategy involved asking her student for justification and more details. Hannah used instances of her student's work to ask questions such as "I saw you looked over your piece of paper over here. What were you just thinking?" This type of question evidenced her careful observation of her student's activity and was particularly effective in eliciting her student's explanation of her mathematical thinking.

When the PSTs used this strategy, in general it seemed to provide students an opportunity to speak with longer expressions and to think more deeply about their solutions. However, this was not always the case. Consider the following excerpt.

Kimberly: Ok. (he writes) Ok, how did you find that?
Kyong-Tae: Mm, (long pause) I don't know. I just found.
Kimberly: Yeah, well I saw you do it and I was thinking about how I would have done that in my head, so I saw what you did, first was you found the two- eyed creatures right? And you found five of those and that gives you how many eyes?

In the first line, Kimberly asked her student to explain about his solution pathway. However, the student could not come up with an explanation after a long pause. Kimberly did not provide him with support to find appropriate words or use guiding questions; instead, she provided her interpretation on his work. In this case Kimberly took on much of the thinking for the task.

Most of the instances in which the PSTs pressed for explanation sought to maintain the cognitive demands of the given task. By asking students to explain their thinking after arriving at a solution, the PSTs maintained the initial intent of the tasks. There were several instances, as in Kimberly's excerpt above, in which the PSTs pressed for explanation but did not support students or hold students accountable for responding to the questions. This led to the PSTs suggesting specific solutions, or moving to another task without further discussion.

Checking for Understanding

Each of the PSTs frequently checked for their ELL's understanding during task implementation. Checking for understanding usually occurred after the PSTs presented the student with the task and allowed them time to read it. For example, in week two Kimberly gave Kyong-Tae a task about space-creatures and said, "Ok, well this is the first one that I put together for you. And I want you to read it before anything else. [Very Short Pause] Okay, are there any words on there that you don't know?" Asking if there were any words the ELLs were unfamiliar with was a common strategy to check for understanding among the PSTs.

Once the student identified unfamiliar words, the PSTs similarly responded by defining the words for the child by attempting to connect to the child's prior knowledge. For example, Hwa-Young did not know what *creature* meant and Hannah tried to explain by connecting to other words Hwa-Young might know.

Hwa-Young: Creature.
Hannah: You know what that is.
Hwa-Young: Nope
Hannah: Okay. So, a creature is a broad term that covers multiple animals, so it could be, do you know what a monster is,
Hwa-Young: Yes.

Hannah: Do you know what an alien is
Hwa-Young: Alien?
Hannah: Like, UFO, like Ti-Yoong Ti-Yoong (make a sound of UFO).
Hwa-Young: Oh, oh, I know.
Hannah: Okay, so monsters, aliens, bugs, animals, they are all considered creatures,
Hwa-Young: Oh.
Hannah: So, today, it's going to be the space creatures, so it's going to be aliens. That would say.
Hwa-Young: Okay. Aliens.

In this excerpt, Hannah attempted to define the term *creature* for Hwa-Young by comparing it to other terms such as alien or monster. She also pantomimed a UFO in an attempt to support Hwa-Young in understanding the concept.

This support for language was common among the PSTs when finding the student was unfamiliar with a term after checking for understanding. Checking for understanding was most often used to check for *linguistic* understanding, not mathematical understanding. As such, there were several missed opportunities to support their students' mathematics misconceptions because they assumed the students' misunderstandings stemmed from language, not mathematics.

Discussion & Conclusion

During the four-week field experience, we found that the PSTs employed a number of strategies in attempting to support their ELLs. These strategies were not prompted by the research team, but rather by their own experiences working with the students. Each of the PSTs reported no prior experiences specifically focused on the mathematics education of ELLs in their teacher preparation program. As such, this study provides some insight into the strategies teachers might draw on without further formal preparation.

The PSTs drew on a limited number of strategies in supporting their ELLs. Over time the number of strategies did not increase but the ways in which they used the strategies changed, as did the frequency in which they employed the strategies. For example, Morgan, whose student was hesitant to speak, drew more on multiple modes of communication for her student throughout the weeks. In addition, she broadened her range of acceptable communication from spoken and written to include drawing and gestures throughout the experience. However, Morgan was unable to employ strategies that allowed her to elicit detailed descriptions of Ho-Min's mathematical thinking. His thinking was often shown by a calculation on a page or gesture to a solution, leaving Morgan to assume the process behind these artifacts. Morgan and her peers' experiences suggest that while the PSTs did learn from prior experiences with their ELLs, this experience was not sufficient to fully meet their students' needs.

We also found that the PSTs had difficulty determining whether students' struggles stemmed from linguistic or mathematical misunderstandings. As such, the PSTs typically supported the linguistic aspects of the task without considering possible mathematical misunderstandings. Further, they typically attempted to take on the mathematical thinking in an effort to support the students. This implies that PSTs should be provided with guided experiences that help them begin to support both the mathematics and linguistic needs of their ELLs while also maintaining the cognitive demand of mathematics tasks.

In analyzing the PSTs' final reflections and surveys, we found that completing the field experience left the PSTs with the view that ELLs are capable of any task. This is in contrast to earlier thinking present in their pre-surveys that particular tasks are more appropriate for ELLs. Further, the PSTs were also more aware of their lack of preparation to teach ELLs following the experience. This implies that the field experience allowed the PSTs to better understand the need for further learning in this area. Though further research is needed to understand how teacher preparation programs might better prepare PSTs for the increasing number of ELLs, this study suggests that PSTs' natural inclinations to support ELLs is not sufficient to support both the linguistic and mathematical needs of ELLs. Teacher educators should build on PSTs' natural inclinations and provide further support to help them learn to better accommodate ELLs. PSTs need explicit instruction and experiences enacting both mathematical and linguistic supports with ELLs to help build on ELLs' cultural, mathematical, and linguistic resources as they help them develop linguistic and mathematical proficiency.

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