MATHEMATICS PRESERVICE TEACHERS LEARNING ABOUT ENGLISH LANGUAGE LEARNERS THROUGH TASK-BASED INTERVIEWS

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This paper explores what two cohorts of middle school mathematics pre-service teachers (PSTs) report they learned after interviewing two middle school English Language Learners (ELLs) using four measurement tasks. The written responses of the PSTs to the question about what they learned from the experience were coded and classified into three overarching themes—accommodations, conceptions about ELLs, and the role of language in mathematics. Implications of these themes in future teacher preparation are also discussed.

Introduction

The school population of English Language Learners (ELLs) has seen rapid growth in the US. Between 1979 and 2008, the number of 5–17 year olds who speak a language other than English at home increased from 9% to 21% in the US (NCES, 2010). ELLs require teachers who are familiar with the unique challenges that these students face as they try to learn new content in a language they are still learning. With the increasing number of ELLs in the US, there is a great need for better trained teachers as more mainstream teachers work with ELLs in their classrooms. Of the 41% of teachers working with ELLs in their classroom, only 13% are adequately prepared (National Center for Education Statistics [NCES], 2002). The underperformance of ELLs in the National Assessment for Educational Progress (NAEP) (Martiniello, 2008), known as the "nations report card", is indicative of the critical need for all teachers to be trained to work with ELLs.

In this article I report on initial results from an exploratory project that I conducted, for two semesters, in mathematics content courses for middle school pre-service teachers (PSTs). The goal of the project was to foster an understanding, among the PSTs, of the challenges faced by ELLs as they learn mathematics in English. The PSTs engaged in a semester long project in which they interviewed two ELL students on four measurement problems and wrote a structured report on each occasion. In this paper, I will focus on one of the guiding research questions from this project: What do PSTs report about learning from mathematics task-based interviews with ELLs?

Most of the PSTs in my classes were monolingual English speakers and reported having minimal to no interaction with ELLs. I conjectured that engaging these PSTs in

task-based interviews would provide the needed platform for them to rethink some of the preconceptions that they may have about ELLs.

Literature review

The educational needs of ELL students are complex as they are learning content in a language in which they are still developing proficiency (Lucas, Villegas, & Freedson-Gonzalez, 2008). Cummins (2000) differentiated between the informal conversational language used in everyday interactions and the more formal academic language that is usually used in content areas like mathematics. Conversational language is acquired through interactions with others in different settings, requires limited vocabulary and meaning making is assisted through the use of contextual cues. Academic language, on the other hand, refers to the special language of a content area that is usually acquired in school, employs special vocabulary and discourse features and is devoid of context. Conversational language fluency is acquired in one to two years whereas five to seven years are needed for development of academic language.

Part of learning the academic language requires that students become proficient in the "mathematics register" (Halliday, 1978) which refers to the special vocabulary and linguistic structures that are used to express and discuss mathematics. Spanos, Rhodes, Dale, and Crandall (1988) further elaborated the syntactic, semantic, and pragmatic features of the mathematics register that could pose a challenge to all students, but especially ELLs. Syntactic features included comparisons of size (X is greater than Y) or conditional relationships (if X, then Y). Other syntactic features of the mathematics register include the use of passive voice (e.g. When 15 is added to a number, the result is 21. What is the number?), which is known to be challenging for ELL students (Abedi & Lord, 2001). ELLs need to master the semantic features of the mathematics register which include the use of special words like *coefficient* and *denominator* or the use of everyday terms like *square* and *rational*, which have a special meaning in a mathematical context. The last category of pragmatics referred to the use of language in particular contexts where students would need to know culturally specific meanings to understand and solve a problem (e.g. Campbell, Adams, & Davis (2007) discuss a problem where the student would need to understand the word Laundromat).

Future teachers have to understand the challenges that ELLs face learning the academic language if they are to assist these students in learning mathematics (Lucas et al., 2008). However, in most cases, PSTs are usually white and monolingual, and they may not have experienced the same linguistic challenges that ELLs face in English only classrooms; hence it is hard for them to empathize with these students. In the absence of formal experiences with ELLs, the PSTs' views about ELL students are most likely shaped by media or the public leading to the creation of stereotypes (Walker, Shafer, & Liams, 2004). For example, PSTs may assume that an ELL student possesses a disability if they are proficient in conversation but struggle with the mathematics content. Currently, there is an over representation of Latinos, who constitute 85% of ELLs, in special education (Gandara & Contreras, 2009). Providing PSTs with the proper experiences during their preparation is important so that they have opportunities to re-examine prior conceptions and acquire views that are more aligned with research (Sleeter, 1995).

In multicultural education, experiences with diverse populations like living in communities that are culturally different to one's own or tutoring such students have shown promise in challenging PSTs existing beliefs about such diverse students (Sleeter, 2001). In particular, Griego-Jones (2002) found that PSTs who had tutored or worked with ELLs had beliefs that aligned most closely to those in the research literature about second language acquisition. Youngs and Youngs (2001) also found that increased exposure of PSTs to ELLs promoted positive attitudes towards these students. Mathematical field-experiences, like tutoring students, have also shown promise in changing PSTs initial beliefs about mathematics teaching (Ambrose, 2004; Vacc & Bright, 1999). A note of caution about field-experiences is that they can reinforce preconceived notions that PSTs have about diverse students (Grant, 1991; Grant, Hiebert, & Wearne, 1998). So it is imperative that the experiences are followed up with guided reflection from the instructor for them to impact the PSTs (Cabello & Burstein, 1995; Mewborn, 1999). Teacher reflection is also tied to what they notice and attend to in the experience (Mason, 2002). In interviews with ELLs it is possible that the PSTs attend to mathematical aspects of the student's thinking and not pay attention to the influence that language may have on the mathematical thinking. Mason (2002) outlines techniques that can be used to foster noticing, the key being recording incidents of interest and probing them. Mason refers to the descriptions of the incidents as providing "Accounts-of" which "describe as objectively as possible by minimising emotive terms, evaluation, judgements and explanations" (p. 40). By holding off judgement, there is potential to get a fresh look at the incident of interest. On the other hand, "Accounts-for" "introduces explanation, theorising and perhaps judgement and evaluation" (p. 40). By providing "Accounts-of" and "Accounts-for", there is potential for a person to notice things that they might not otherwise pay attention to. Overall, field-experiences, like task-based interviews, in conjunction with structured reflection, guided by noticing, has the potential to foster an awareness of the unique challenges ELLs face as they learn mathematics content in English.

Methods

The study was conducted in my data analysis and probability course in spring 2010 and in a geometry course that I taught in fall 2010. As part of the courses, I engaged the 17 PSTs (spring 2010) and 32 PSTs (fall 2010) in two task-based interviews with fifth- and sixth-grade ELL students at a local school. The PSTs worked in pairs, with one interviewing the student and the other taking notes. They switched roles for the second interview. The interviews in fall 2010 were also videotaped. Four measurement tasks from the NAEP were selected by me based on my own experience interviewing ELL students with them.

In the second week of class the tasks were presented to the PSTs who solved them on their own. Two video clips from a prior study were used to illustrate the questioning process and highlight aspects of the language that could challenge ELL students. After watching the clips, the PSTs brainstormed in their groups and developed an interview script for each of the four problems. The PSTs were instructed to first allow the ELL student time to solve the problem independently and then engage them in a discussion about their solution. If they could not start the problem or sought help, the PSTs were

asked to intervene appropriately. The PSTs were advised to allow the ELL student to do most of the thinking for the task without explicit hints.

After the interviews were conducted, the PSTs were required to write a detailed report about the process. In spring 2010, the pair of PSTs that interviewed the ELL student submitted a joint report (there was one group of three PSTs). However, in fall 2010, each PST submitted an individual report. Guiding questions, based on Mason's (2002) notions of "Accounts-of" and "Accounts-for", were provided to assist the PSTs notice features that went beyond the superficial. The questions encouraged the PSTs to describe the interview in detail and then analyse specific aspects like the student's challenges, resources they used to solve the problem, their oral communication, writing, and their mathematical thinking.

The PSTs turned in the reports which were graded and in most instances I provided feedback and asked them to produce a revised version. Later in the semester, the above process was repeated with another ELL student. The data for this article consist of the PSTs' responses to the question that asked them to list at least three things they learned from the task-based interview experience.

For data analysis, all the PSTs' responses to the question about what they had learned were compiled into four documents (two from each semester) using NVivo 9, a qualitative analysis software. I printed and read all the documents multiple times and did *content analysis* to first outline broad themes that captured what the PSTs were saying about their learning (Patton, 2002). I kept refining these themes to arrive at a final list of codes. I used this list to code the four documents in NVivo which allowed me to observe the number of instances a certain code occurred and I dropped the less frequent ones (less than five) from my analysis. I looked at the final set of codes and determined subsets of them that could be related under an overarching theme.

Results

Based on the above analysis, the PSTs' reports about what they learned from the task-based interviews could be captured in three overarching themes—accommodations, conceptions about ELLs, and the role of language in mathematics. I discuss each of these below.

Accommodations

After interacting with the ELLs, most of the PSTs observed that they would have to make an extra effort to ensure that the ELLs understood the content. Some of the accommodations discussed included: spending one-on-one time with the students, relating the concepts to the ELL students' experiences, breaking down the question, slower speech, assistance with the mathematical vocabulary, and accepting different ways of demonstrating understanding that went beyond the traditional written format. For example, one PST mentioned that ELLs will need extra support and slower paced instruction as they try to negotiate the language and the content.

> In order for an ELL student to excel in math, they need additional support and explanation. Also, a teacher may need to slow instruction for students who are English language learners. These students need more time to process information than those whose native language is English. (Keith, Interview 2, Fall)

Another PST reported the need to incorporate aspects of language like reading and writing in the mathematics class to support the development of ELL students in the class.

> I also learned that it is very important to make sure that reading, writing and math are all covered in class. It is important for a student to be able to solve the math, write out the answers and explain themselves and be able to read and interpret what is being asked. All three of these things should be focused on when teaching lessons on different topics. Also, many opportunities should be given to each student with all three of these elements so they can improve or master each. (Sandra, Interview 1, Fall)

Most of the PSTs see these accommodations as necessary if the ELLs are to develop an understanding of the content and keep pace with the other students in the class. One group of PSTs observed that it was easy for the ELL students to remain quiet or for their conversational fluency to mask understanding of the content. They recommended a proactive role for the teacher when working with ELLs.

> For our classrooms, we now see that we will need to take extra steps such as one on one time to make sure that all students clearly understand, particularly ELL students. We learned that they can easily coast through the class just by being quiet or proficient in the English language. It would be the greatest failure as a teacher to have a student come through the classroom and go through the entire school year being years behind in mathematics. (Clair, Janet, and Karen, Interview 1, Spring)

A majority of PSTs espoused the benefits of using visuals and concrete materials to assist ELLs with understanding and also as a means for students to explain their solutions. These recommendations could be traced back to the materials that were part of the Area Comparison problem and the String problem. The Area Comparison problem provided cut-outs and involved comparison of the areas of a right-triangle and square where the side of the square was equal to the height of the right-triangle and the base was twice the height. Two cut-outs each of the square and the right-triangle were provided for the students. The String problem asked the students to describe how they would instruct another student to divide a length of string into four equal pieces. For this problem, the PSTs provided a piece of string to the student after they worked on the problem independently. Based on their experience with the String problem, a PST reports,

> I also learned that manipulatives can be helpful to an ELL student when learning math. He was able to solve the third question easily after he had the string [String problem] in his hand… the manipulative helped him understand the problem. I think that manipulatives are good for any student, but it may be even more helpful for a student who does not quite understand what all the words in the question mean. (Betty, Interview 2, Fall)

The PST observes that manipulatives could play an important role for all students, but especially ELLs. Another PST reports on the usefulness of the cut-outs [Area Comparison problem] and string to assist the student with their explanation.

> I can't stress enough how helpful the string and the cutouts were…. Not only did they help her solve it, but they were a big factor in her communicating how she did it. The same would be said with the string problem. Where her writing was a little confusing, she was able to demonstrate using the string very clearly…. I think the availability of concrete materials to aid in understanding and communicating are vital for these students and should be used extensively in the classroom. (Tess, Interview 2, Fall)

Other accommodations that the PSTs reported included making the directions of the problem clear. The PSTs related the confusion that the ELL students were having solving a problem to the wording of the question. One PST pointed to the lack of clarity—"It is very important when teaching not only ELL students, but all students in mathematics, that the questions are worded very clearly and simply to ensure they are not confused by what is being asked of them" (Mills, Interview 2, Fall). Another PST went further to recommend that teachers should pay attention to the language of the questions they plan to ask and think of ways the question could be misunderstood by ELLs, and modify them accordingly.

Conceptions about ELLs

The interactions with the ELLs helped the PSTs rethink some of the conceptions that they may have had about ELLs. One conception involved associating ELLs with having a disability in mathematics.

> We also learned that just because a student is classified as ELL does not mean that they will have problems in school. A lot of people tend to see ELL as a "disability" while in many cases it can be a sign of a high intellectual ability. Not many people are bilingual and these students can read, write, speak, and comprehend in two languages. (Karen and Janet, Interview 2, Spring)

Another PST reports,

> If anything we learned that you cannot be stereotypical about a student and think that they are instantly going to have a problem with mathematics because they are learning English as a second language. (Elisa, Interview 1, Fall)

A majority of the PSTs understood that the language ability of the ELLs could interfere with their mathematical performance. One PST reports,

> First I learned that ELL students sometimes just need a little guidance to get to the solution. Often, they understand how to solve the problem once they comprehend what the problem is asking. This may be a huge indicator that these students are struggling with the language and wording rather than the math. (Clair, Interview 1, Fall)

In some cases, the PSTs observed that the ELLs tended to interpret the problem differently and this could lead them on a different solution path. For example, the String problem stated "Brett needs to cut a piece of string …" which some ELL students thought referred to a part of the string rather than the whole string. The PSTs observed that the ELLs could understand the requisite mathematics but struggled with deciphering the question due to their still evolving language skills.

Another conception that some PSTs seemed to have was that ELLs would have difficulty speaking in English.

> Overall, I learned a lot more about ELL students after this interview. I learned that not all students are the same, including ELL students. Teachers should not assume that if the student is ELL that they will not be able to understand English. This student was classified as an ELL student, but was able to read and understand all the questions. (Betty, Interview 2, Fall)

Given the limited exposure that these PSTs had to ELLs it is understandable that they might assume that ELLs were a homogenous group who did not speak English. In other cases, there were some PSTs who assumed that conversational fluency displayed automatically implied academic fluency and considered the ELLs to be no different than non-ELLs.

> First of all, I don't know if you could really call these kids ELL students because it seems like they already know the language fluently. So to me, these kids seem just like all other American school children. So for ELL kids that are so American and not even that ELL, so to speak, I can't say I have learned anything about teaching children who are learning English. (Richard, Interview 2, Fall)

Role of language in mathematics

The experiences with the ELL students helped the PSTs see the possible role that language played in the mathematical performance of these students. One PST notes,

> I learned that ELL students' difficulty with language does affect their math…. The student I worked with had difficulty understanding the language of the question which made it almost impossible for her to answer the question correctly. But, once the student understood the question she was able to mathematically think correctly and figure out the answer to the question. (Betty, Interview 1, Fall)

The PSTs also understood that their role as future teachers of ELL students should extend to assisting the students with the language in addition to the mathematics content.

> I also learned that language is an issue when working with ELL students and as teachers we need to be able to bridge language and math so that the student is able to learn and comprehend. We as teachers also need to make sure the language we use is effective and understood by the student. (Linda, Interview 2, Fall)

In contrast, there were some PSTs who believed that mathematics was a universal language and their knowledge of English should not pose a major barrier to learning mathematical concepts in English.

> …regardless of how you say the words, Math is a very structured subject. By this I mean that two plus two is four no matter what language or dialect you speak, how long you've been in the US or where you come from. Two pesos plus two pesos is still four pesos just like two quarters plus two quarters is four quarters. You don't have to worry so much about the subjectivity of the translation. (Mark, Interview 2, Fall)

This PST assumes that language plays a minimal role in the mathematics education of ELLs. Here the PST discounts the language used by the teacher and the students in the classroom interactions and how that impacts student learning.

Discussion

The PSTs responses to the question about their learning from the experience can be classified into three overarching themes—accommodations, conceptions about ELLs and role of language in mathematics. The PSTs in this study observe the importance of incorporating language goals like vocabulary, reading and writing into mathematics lessons. They also understand that as future teachers they will have to take the extra step to teach ELLs. Their notions of accommodations agree with the literature on the best practices of teaching ELLs, which calls for instruction to be scaffolded for such students with an emphasis on both the language and the content (Gibbons, 2002).The PSTs see the role of concrete materials as making the abstract math ideas more accessible to the ELLs, which is also an idea elaborated by Cummins (2000). The role of the cut-outs as part of the Area Comparison problem helped in this respect. The PSTs emphasis on clarity in language is also discussed by Abedi and Lord (2001) who found that modifying the language in test questions allowed ELL students to improve their

performance. Interactions with the ELLs helped the PSTs rethink some of the past conceptions they had about these students, such as associating ELLs with a disability or not being able to speak English. Gandara and Contreras (2009) pointed out that such conceptions about Latino students (85% of the ELL population) have led to lower expectations for these students and as a result they are over represented in special education classes. Finally, most of the PSTs saw that language played a role in the mathematics learning of ELLs, but there were some who still viewed mathematics as universal. The latter group was more likely to associate ELL's mathematical difficulties to the ability of the student.

Overall, task-based interviews are beneficial for PSTs learning about ELLs. However, they are not enough, and PSTs need exposure to the research about ELLs to complement this experience. Further, getting the PSTs to reflect on the interview is crucial to the learning process. In this regard, Mason's (2002) techniques of "Accounts-of" and "Accounts-for" are key in building a capacity for PSTs to notice aspects of language and how this impacts the mathematical performance of ELLs.

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