Exploring tensions: Leanne's story of supporting pre-service mathematics teachers with learning disabilities

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This paper presents a case study of a mathematics teacher educator, Leanne, and her story of trying to support the development of two pre-service elementary school teachers with recognized learning disabilities. We analyze data through a lens of mathematical knowledge for teaching, focusing in particular on concerns and tensions about (i) maintaining academic rigor while meeting the emotional, cognitive and pedagogical needs of her students, (ii) seemingly opposing pedagogies between special education and mathematics education practices, and (iii) equitable opportunities for teachers with disabilities and the consequences for their potential pupils. We offer an analysis of Leanne's personal struggle, highlighting implications for teacher education and offering recommendations for future research.

Keywords: Mathematics Teacher Educators, Learning Disabilities, Mathematical Difficulties, Pre-service teachers, Pedagogical Content Knowledge

Preparing future elementary teachers in mathematics is often challenging, with a multiplex of considerations that aim to help prospective teachers transition from (and to) being engaged mathematics learners to being engaging mathematics teachers who can support the diverse needs of their future students. The learning needs within an elementary pre-service mathematics classroom itself can be just as diverse as the classes for which the pre-service teachers are being prepared. One consideration for teacher education that has not received much research attention is the preparation of future elementary teachers with learning disabilities and the pedagogical content knowledge it entails of teacher educators. This paper presents a case study of a mathematics teacher educator, Leanne, and her story of trying to support the pedagogical and mathematical development of two pre-service elementary school teachers with recognized learning disabilities. Leanne's story took place in a math-for-elementary school course, which focused on mathematical problem solving and content knowledge. We use the theoretical framework of mathematical knowledge for teaching (Ball, Thames & Phelps, 2008), specifically knowledge of content and students (KCS), to analyze the data. Analysis of the data revealed three areas of tension Leanne experienced while trying to meet the learning needs of her students, despite her background in special education. We discuss concerns and tensions about (i) maintaining academic rigor while meeting the emotional, cognitive and pedagogical needs of students, (ii) seemingly opposing pedagogies between special education and mathematics education practices, and (iii) equitable opportunities for teachers with disabilities and the consequences for their potential pupils. We offer an analysis of Leanne's personal struggle, highlighting implications for teacher education and offering recommendations for future research.

Mathematics Teacher Educators

Mathematics teacher educators are integral to the learning and growth of each generation of the pre-service and in-service teachers they teach and, by extension, to mathematics education reform as well (Tzur, 2001). Yet, there has been relatively little research into the learning and growth needs of mathematics teacher educators (Goos, 2014). This lack of research may echo the progression of mathematics education research where the original focus was on learners and not on teachers (Even, 2008). Just like teachers of mathematics, mathematics teacher educators require the subject matter and pedagogical knowledge of mathematics in order to teach children. However, mathematics teacher educators also require additional subject matter and pedagogical knowledge of mathematics in order to teach teachers (Jaworski, 2008). For this latter knowledge, teacher educators metamorphose from being "math teachers" to being "math teaching mentors", where mentorship involves preparing individuals for future teaching scenarios that may not be predictable(Lampert & Ball, 1999). Mason (2008) describes this accomplishment:

> "the effective teacher educator aims to direct attention so that participants' attention is drawn out of the actions of doing mathematics and also out of the actions of teaching mathematics, so that awarenesses become explicit. In this way, individuals and their social milieu may serve to educate that awareness, and thus inform actions in the future" (p.50).

Mathematical knowledge for teaching and KCS

Given the dearth of research on teacher educator's pedagogical content knowledge, we look to research conducted with teachers to frame our analyses. Ball and colleagues (2008) argued that the specific knowledge required to teach mathematics may be qualitatively different than the knowledge needed to teach other school subjects. They, thus, posited the theoretical framework, mathematical knowledge for teaching, as an extension to Shulman's (1986) pedagogical content knowledge framework. Ball and colleagues found that the knowledge required for teaching mathematics was complex, with multiple layers of knowledge required. They saw mathematical knowledge for teaching as having two main general categories, with each category further broken down into three subcategories: Subject Matter Knowledge (SMK) consists of content knowledge, specialized content knowledge and knowledge at the mathematical horizon, and Pedagogical Content Knowledge (PCK) consists of knowledge of content and students (KCS), knowledge of content and teaching, and knowledge of curriculum. We focus on KCS.

At the root of KCS is knowledge about student learning of mathematics, and the specific background knowledge that allows a teacher to anticipate, recognize and mediate likely misconceptions and errors in students' learning of mathematics. Using knowledge of the mathematics curriculum and knowledge about potential errors, a teacher can then create lessons that have at their center the goal of (re)mediation of the potential errors (Hill, Ball, & Schilling, 2008). An important distinction between KCS and common content knowledge is that the former requires teachers to *anticipate* and *prepare* for mistakes while the latter entails responsiveness to such mistakes (Ball et al., 2008). For a rich KCS, teachers require more than knowledge of mathematics, but also knowledge of how learners' may interpret, respond to, or represent mathematical ideas (Hill et al., 2008).

Leanne's Story

Leanne teaches a required mathematics content course for elementary pre-service teachers. The purpose of the course, like others of its kind (Goos, 2014), is to develop much needed content knowledge and problem solving skills for pre-service teachers. The course uses the text Thinking Mathematically by Mason, Burton and Stacey (2010) and is structured around mathematical tasks. Leanne's academic background is in mathematics education, and her professional background includes special education teaching in the elementary school. Through a series of informal interviews, Leanne reflected on tensions she felt when trying to support two students with identified learning disabilities in mathematics. She discussed what she felt were successes and failings in her attempts to meet the needs of these students. In what follows we analyze Leanne's reflections with an eye toward what the construct of KCS could mean for teacher educators.

Results

Maintaining academic rigor while meeting the emotional, cognitive and pedagogical needs of her students:

Leanne: I want to practice what I preach, and even in a university class I tried to differentiate, but there is always a stress about academic rigor.

Leanne: I really want my students to succeed, these students were so labor intensive… spending time with me outside of class time… they took class time and all my office hours and then some… The population itself is already riddled with its own problems, and layered on top of that are students with special needs who have had negative experiences with mathematics. It is a circular attempt to help them… I do not have enough information about how to help special needs populations, but we are in the class now so it is a trial and error mode.

Here, Leanne expresses tensions concerning meeting the emotional needs of her students while maintaining academic rigor. Leanne wanted to support her students with special needs in the same way she supported her students when she was an elementary teacher. However, Leanne faced barriers of knowledge and tried to compensate by spending more time inside and outside of class with her students. Leanne expressed she did not feel she was progressing in helping her students; describing her attempts as "circular."

Seemingly opposing pedagogies between special education and mathematics education practices:

Leanne: It is not the same in elementary school. There, you are supporting them for doing well on a test… not for this. You can use all these strategies to help the students because the question is, if the kid passed the test, not if they know the material. Of course I wanted my students with learning disabilities to know, but we need to help them pass and we don't know how to get them to know.

Leanne: In math research, I don't know why, we have the ideal student and it is definitely not the LD kid. In math research, there is so much of a focus on conceptual understanding and abstractness… but not in special education. There the focus is on procedures. Procedures, and they don't care if there is understanding.

Here, Leanne's views of teaching from special and mathematics education perspectives

seem to oppose each other. In Leanne's view mathematics educators and special educators have different purposes. Mathematics education teaches for understanding beyond the classroom, and special education teaches for success in a classroom. Leanne finds herself bending towards the special education perspective as "we need to help them pass." However, this view is in direct disagreement to the purposes of the course she is teaching.

Equitable opportunities for teachers with disabilities and the consequences for their potential pupils:

Leanne: The other student didn't ask for any help. As soon as we started looking at anything resembling mathematics, she disappeared. She would be there at the beginning of class, I think she was trying, hoping each day was different, that maybe we wouldn't do anything resembling math that day... So I spoke to her…I think I was successful for her and the other student because in the end they had a more positive attitude towards mathematics. Some might argue that they should not be teaching because of their low content knowledge but we could lose a great teacher and what does this mean for equity?

Leanne: I know that the best teachers for kids with special needs are often those with special needs themselves. But kids also need teachers who have knowledge of the content.

Leanne deeply believed that all of her students had the right to become teachers and that great teachers may develop with a variety of different backgrounds, abilities, and needs. However, she also had pressing concerns about the subject matter knowledge demonstrated by her students and how to prepare them to meet the mathematical demands of the profession while accommodating their special needs and disabilities.

Discussion

Similar to Mason's (2008) observations, Leanne seemed to take for granted that her experience of being a special education teacher would be a seamless transition to mentoring students with special educational needs in a university setting. However, it was fraught with difficulties and tensions. Leanne tried to use the strategies she had acquired from teaching in special education, however those strategies were meant for scholastic achievement in a school setting and not for supporting the development of *math-for-teaching*. Leanne described a lack of KCS to teach her students with special needs. KCS would have allowed her to anticipate their difficulties and to create a program around those difficulties. Instead, and not dissimilar to what happens in elementary schools with children with special needs, Leanne was frantically trying to support her students to achieve after the fact.

Students with learning disabilities can learn mathematics but learn differently (Lewis, 2014). What Leanne was feeling relates to how little we know of how to help students who learn differently in mathematics and especially in a university setting. Leanne associated her tensions with academic rigor, however, the issues may have stemmed from a mismatch of settings. Just as the knowledge needed to teach mathematics is different from the knowledge needed to teach mathematics teachers (Simon, 2008), so too, here the knowledge needed to help those who learn differently in an elementary setting is different than the knowledge needed to help those in a university setting.

The differences in special education needs in the university and in the elementary classroom may also have their roots in the differences between the fields of special education and mathematics education (Sfard, 2007). The elementary school system is structured so that a child can do well on a final exam or a state test and be ready to progress to the next grade. The question is not if the child "understands the mathematics" or sees the aesthetic beauty of the mathematics, or if she can use the mathematics in the outside world. The child has passed the test and is ready to move on. In university, and in this course in particular, the purposes diverge. One of the many goals of a course like this is to "help students, who do not see the world as examples and non-examples of the operation, to do so" (Simon, 2008, p.21). In other words, the students in the mathematics course that Leanne is teaching will have to go out and aid their own students in making sense of the mathematical world. They will have to use what they learned from the course as a tool to help their own students. Thus, the way remediation is used in elementary schools cannot be duplicated in universities where the purposes differ. However, one might argue that with the new reform efforts towards understanding in elementary mathematics classrooms, they too require new strategies for remediation.

Many universities require their pre-service elementary teachers to take and pass some iteration of a mathematics course in order to graduate. For many students this course may stand in the way of their aspirations of becoming teachers. However, the content, delivery and theoretical underpinnings that frame these math courses, like Leanne's, vary across universities. Thus, mathematics acts as a gatekeeper for teaching, in different ways to different students in different spaces. In this case, as Leanne reflected, there were many facets to the problem of equity: there is the pre-service teacher who is faced with a barrier; the future student who deserves to have access to mathematical content knowledge; and there is also the mathematics teacher educator who requires her own specialized KCS.

Remarks and Questions

Elementary pre-service teachers already arrive at pre-service programs with a variety of needs in regards to (re) learning mathematics. We would argue that an additional need, not given attention in the literature is the knowledge needed to teach students with learning differences. It is notable that Leanne experienced tensions, despite her training in special education. This stresses the importance for special attention to be paid to KCS for helping special needs populations *understand* mathematics at the university level. Mathematics teacher educators need the knowledge of misconceptions, errors and difficulties and how to create lessons that address them for even their most different students. In this way, mathematics teacher educators can create more equitable opportunities for all their students and themselves. We propose the following questions:

- *In what ways might a teacher educator's KCS differ from that of a school teacher's?*
- *How can teacher educators use-to-advantage their KCS such that they can adequately support pre-service teachers' development of math-for-teaching?*
- *In what ways do learning disabilities impact pre-service teachers' development? What are the challenges? What are the advantages? How can teacher educators better support the learning and professional needs of this community?*

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