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## ONE TEACHER'S UNDERSTANDINGS AND PRACTICES FOR MAKING REAL-WORLD CONNECTIONS IN MATHEMATICS

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*Recent scholarship in mathematics education has increasingly supported the power of connecting mathematics lessons to students' lived experiences. This case study, drawn from a larger multi-year study, traces the reflections and pedagogical practice of a middle school mathematics teacher who regularly connected her lessons to real-world contexts. We highlight how the teacher connected a fractions lesson to the context of making soup for her family to accomplish several goals including: (1) sharing stories to learn more about students, (2) moving beyond numbers to build understanding, (3) building students' mathematical confidence, and (4) making space for students to connect mathematical ideas. These findings provide insight into how making real-world mathematical connections may impact students' understanding.*

Keywords: Instructional Activities and Practices; Teacher Knowledge

Mathematics educators increasingly agree that connecting school mathematics to experiences, situations and contexts outside of school, including students' own experiences and understandings of the world, is a critical element important to student learning (Ladson Billings, 2009; Turner, Aguirre, Bartell, Drake, Foote, Roth McDuffie, 2014; Turner & Strawhun, 2007). This argument is supported by studies that suggest that the knowledge and experiences that students bring from their everyday lives can serve as resources for learning mathematics (Civil 2002, 2007), as well as evidence that student learning is enhanced when concepts and skills are connected to realistic contexts and situations (Boaler, 2008). In this paper, we refer to teaching that includes connections to real-world contexts and situations, including students' own experiences outside of school, as *real world mathematics teaching*. While some prior research has documented examples of how mathematics teachers make real world connections, still needed are in-depth analyses of teachers' reasoning about these connections, and investigations of how these connections play out in teachers' instruction.

In one study of secondary teachers' understandings of real world mathematics teaching, Gainsburg (2008) found that although the teachers had a wide range of practices they classified as real world, the fleeting connections that teachers made did not often require students to actively engage or think deeply about the mathematics. Moreover, some teachers believed that real world mathematics learning should occur after students have mastered mathematical skills and concepts. Gainsburg also found that although some teachers saw great worth in rigorous tasks, others were apprehensive that challenging and poorly executed real world mathematics tasks might overwhelm students. Gainsburg's study illustrates the complexity and challenge that real world mathematics teaching poses for classroom teachers, and raises questions about what it might mean for teachers to connect their mathematics teaching, in meaningful and sustained ways, to students' experiences outside of school.

In this study we analyzed one early career 7th grade teacher's understandings and practices related to real world mathematics teaching, guided by the following research questions:

- What are the teacher's (Evelyn's) understandings about real-world mathematics teaching?
- How does Evelyn plan for, enact and reflect on connections to real-world contexts and situations, including students' own experiences outside of school?

### Methods

Evelyn, an early career middle school mathematics teacher, is a participant in a larger ongoing research project, [TEACH MATH] that follows preservice teachers from their preparation programs and into early career classrooms. Across three years, we observed Evelyn teach 22 mathematics lessons; two observations occurred during student teaching and the remainder during her first two years as a classroom teacher. Evelyn was purposefully selected for this case study because she frequently made connections in her mathematics lessons to real world contexts, and her own and students' experiences in and out of school.

Data included transcripts of recorded pre and post observation interviews, field notes detailing the observed mathematics lessons, classroom handouts, and sample of student work. During the first round of analysis, the three authors reviewed all data for instances of real world connections during mathematics lessons, including Evelyn's planning or reflections on such connections. Then, through iterative analysis, secondary codes were developed that focused on specific instructional moves that Evelyn used to a) elicit and incorporate her students' knowledge and experiences, b) introduce a real world context for a lessons, or c) to share about her own experiences. Codes also attended to key ideas in Evelyn's reflections on connecting mathematics to real world contexts and/or students' home and community funds of knowledge. From this broader analysis, one specific lesson, "Making Tortilla Soup for my Family" was identified as a case of Evelyn building a mathematics lesson around her own experience. This lesson was then analyzed to build the following case study.

### Findings

We first overview the "Tortilla Soup" lesson. We then use this lesson to highlight key features of Evelyn's understandings and practices related to real-world mathematics teaching.

Evelyn began her second year of teaching seventh grade mathematics at a different school and with a different curriculum. Although Evelyn saw merit in the curriculum she was expected to teach, she worried about the lack of real world examples and how/if her students would personally connect to, and see the relevance of the content they would be learning.

Evelyn recognized that her students had a limited understanding of multiplication of fractions. After teaching a "very numbers-based lesson," she realized students lacked conceptual understanding, leaving them apprehensive and unsure about following the procedure they had been taught. Although Evelyn felt pressure to "move" through the curriculum she was reluctant to do so, and opted instead to reteach the lesson. She considered presenting a "hands-on" activity from the textbook to support students' learning, but decided to veer from the text. She planned a lesson around cooking and scaling recipes that she believed might support understanding of multiplication of fractions in a "real way." Evelyn's choice of context was informed by a beginning of the year survey in which students reported using mathematics in family cooking and/or baking activities.

Evelyn began the reteach by presenting a handwritten version of her family's favorite tortilla soup recipe. She shared her experience of cooking soup and adjusting the recipe for groups of different sizes, hoping to link her experiences cooking to those of her students. Evelyn drew students' attention to the different ingredients, as well as how many people the recipe would serve (16). She then posed the task to students: Adjust the recipe for smaller and larger groups of family and friends. For example, how much of each ingredient is needed to serve 8, 32, 40, or 82 people? Evelyn's goal was for students to understand how to scale up or down the quantities in the soup recipe by multiplying each quantity by a fraction or mixed number.

As students worked on the task, Evelyn probed their thinking, asking questions such as, "What did you do to get this number?" or "What happened when you were feeding more people?" Students used multiple strategies to adjust the recipe, envisioning themselves cooking the soup, and questioning if their adjusted ingredients made sense. Some students made connections between multiplying ingredient quantities by a fraction and their prior understanding of operations with

decimals and percents (i.e., multiplying by  $\frac{1}{2}$  is like taking 50% of a quantity). In summary, the lesson helped students connect the real world experience of adjusting a recipe to the mathematical concept of multiplying by a fraction.

### **Shared experiences leads to learning about students**

A key feature of Evelyn's real world mathematics teaching was that she created spaces for students to share their experiences during her lessons. One way that Evelyn invited students to share about themselves was by telling stories from her own experience. She reported:

I get [students] an hour each day, and it's been a lot more harder to make those connections. I say, "Hi" in the hall all the time and stuff like that to try and get them to feel comfortable with me. When I have something like [the recipe] that's sharing a part of me, they're willing to share a part of themselves. I just feel like everybody's a little bit more open to sharing and taking risks.

When Evelyn introduced her family's tortilla soup recipe, several other students shared food they made with their families and/or enjoyed eating (i.e. the making of enchiladas, the enjoyment of corn tortillas). Evelyn used this practice of sharing her out of school experiences as a means to discover more about her students' own experiences.

### **Moving from numbers to meaning**

A key motivation underlying Evelyn's use of real world contexts in her mathematics lessons was that the connections would help students make sense of the mathematical tasks. Evelyn used gesturing to illustrate the concept of doubling the recipe of all the ingredients into two separate pots. When one student expressed confusion about how to adjust the recipe, and wondered whether he should add the quantities of all the ingredients together, Evelyn drew the student's attention to the activity of cooking soup to support his sense making. She noted:

Yeah, but if we're cooking – I was like, “Sure we put it in the pot [the ingredient] but if you add them, what does that number mean?” He goes, “Oh! Okay!” Then it was like he thought about it in a real way.

This aspect of Evelyn's practice suggests she recognized that providing students with a familiar real world context (the making of soup) might help students move beyond seeing only numbers in mathematical tasks towards sense making and understanding.

### **Stepping up to do the mathematics**

Additionally, Evelyn thought that real world connections in mathematics lessons would enhance students' engagement, particularly for students who tended to be less confident and more reluctant to share their thinking. In reflecting on the soup lesson, she explained:

There was just this level of confidence from the start because they could connect to what we were doing. It wasn't just the digits and operations and think about it as math. It was, "This is an experience, and you guys know how to do it, so how do you do it?" Then it was more of them using the math to help them, but they had this huge experience that they could draw from to help them work with the numbers.

Evelyn reported that because students could relate to the context of cooking “A few people that are normally really quiet all of a sudden felt like they were experts, and they ‘stepped up.’” Students' confidence appeared to flourish, as they used the experience of cooking (something they were familiar with) to make sense of the task of adjusting the recipe. Evelyn reflected that making these kinds of connections in her lessons seemed to support more equitable participation.

### **Making space to connect mathematical ideas**

Finally, Evelyn saw the use of real world contexts in mathematics lessons as a means for students to create connections among mathematical ideas. For example, Evelyn found that when she invited students to share experiences and to make connections to lesson tasks, this opened a space for students to connect a range of mathematical ideas and understandings. In the soup lesson, as students were reasoning about multiplying fractions, they made connections to other mathematical operations. She explained:

Then, one thing that I was impressed with [is that multiplying fractions] wasn't so much of a struggle. So many of them used a reference to money, or a reference to just decimals in general. One student changed, I think, all of his numbers to decimals, and then it was so easy for him to figure out what half of that was, and he just did it.

Evelyn felt that part of the value of real world mathematics teaching was that it encouraged students to make connections and to utilize multiple mathematics strategies to solve the tasks.

### **Discussion**

This study provided a glimpse into one middle school teacher's understandings and practices related to real world mathematics teaching. More specifically, Evelyn's case highlights the importance of teachers sharing their own experiences with students as one entry point to connecting with students and eliciting students' experiences. Additionally, our findings suggest that teaching through familiar real-world experiences is important not only for student engagement and understanding, but also a way to address issues of confidence and status that may surround mathematics learning. Finally, our findings contribute understandings about the ways that teachers might plan, enact, and reflect on real-world connections in their teaching, which may inform mathematics teacher educators in their efforts to support other teachers in this complex and challenging practice.

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