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RESEARCH ARTICLE

A First Grade Teacher's Challenge in Promoting Students' Understanding of Unit Iteration

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Abstract

Measurement has been an important part of mathematics content students must learn through their schooling. Many studies suggest students' weak measurement learning, particularly related to length measurement, on the part of lower grade students. This difficulty has been attributed to mathematics curriculum as well as instruction. Building on a view of teaching as an interactive activity, this paper explores how a first grade teacher interacted with her students in small groups in a length measurement lesson to promote conceptual understanding as well as procedural fluency. I found that even though the teacher supported students to explain and justify what they understood, the ways the teacher interacted with students were not effective to promote students' understanding. Even though this finding is based on an analysis of a single mathematics lesson, it provides an example of challenges in promoting students' understanding through interaction with students in the context of teaching length measurement.

Keywords: length measurement, lower grade teachers, mathematics instruction.

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I. INTRODUCTION

Measurement has been an important part of mathematics content students must learn through their schooling in most countries (Buys & De Moor, 2008), including the U.S. (Common Core State Standards Initiative [CCSSI] 2010; National Council of Teachers of Mathematics [NCTM], 1989, 2000). It is a challenging domain, however, that "involves many concepts," including partitioning, unit iteration, transitivity, accumulation of distance, relation to number (Clements & Samara, 2009, p. 164). Studies have shown students' weak measurement learning (e.g., Kamii & Clark, 1997; Kloosterman, Rutledge, & Kenney, 2009; Solomon, Vasilyeva, Huttenlocher, & Levine, 2015; Thompson & Preston, 2004). Literature attributed students' difficulty in developing measurement concepts to a predominant focus on procedure (how to measure) rather than understanding or meaning (what it means to measure) in curriculum materials (Dietiker, Gonulates, & Smith III, 2011) as well as instruction (Kamii & Clark, 1997; Stephan & Clements, 2003).

Given the importance of developing both procedural skills and conceptual understanding in learning and teaching mathematics (Fuson, Kalchman, & Bransford, 2005; NCTM, 2014), mathematics instruction needs to support students to develop procedural fluency in ways to follow and build on conceptual understanding, in this paper, of measurement. In particular, NCTM (2000) suggests that "a conceptual foundation for measuring many different attributes should be developed during the early years" with a main emphasis on "linear measurements" (p. 103). The Common Core State Standards for Math (CCSSM) recommend that instruction focus both on mathematical understanding and procedural skill (CCSSI, 2010). CCSSM includes length measurement as one of the important mathematical contents lower grade students, which refers to students between kindergarten and second grade (McDonough & Sullivan, 2011), should understand and develop. As such, this paper concerns length measurement on the part of lower grade students.

Literature on measurement has shown challenges underlying difficulties in relation to length measurement on the part of lower grade students (Castle & Needham, 2007; Kamii & Clark, 1997; Kouba et al., 1988; McDonough & Sullivan, 2011; Solomon et al., 2015). Given that teachers are responsible for supporting students to develop important concepts of length measurement, as such, the purpose of this paper is to examine how lower grade teachers support students to develop conceptual understanding and procedural fluency regarding length measurement.

Literature on teaching measurement has provided many instances of how to teach students about length measurement with conceptual understanding. Furthermore, Stephen and Clements (2003) urge teachers to teach concepts of measurement focusing "conversations and thoughts on the meaning that students' measuring activity has for them" (p. 8). Teachers' interaction that supports students' meaning-making is supported by literature on a social perspective on teaching and learning, which views "teaching as an interactive activity" (Wood & Turner-Vorbeck, 2001, p. 186). However, literature on teaching length measurement has not explicitly paid attention to this social aspect of teaching, especially in terms of teachers' talk moves. Given Stephen and Clements' (2003)

argument for teaching length measurement through interactions for understanding on the part of students, it is worth exploring lower grade teachers' instruction by understanding talk moves. Therefore, this paper is exploratory in nature. It investigates how lower grade teachers use talk moves to support students to develop conceptual understanding and procedural fluency of length measurement on the part of students. I pose a research question that drives this paper: How would lower grader teachers interact with students to support students in promoting procedural fluency as well as conceptual understanding in terms of length measurement?

II. RELATED LITERATURE

Lower Grade Students' Challenges to Understanding Length Measurement and Unit Iteration

There are important concepts lower grade students should develop, which include conservation of length, transitivity, equal partitioning, unit iteration, accumulation of distance and additivity, and relation between number and measurement (See Clements and Sarama (2009) for more details of each concept). Research on length measurement shows that it might be challenging for lower grade students to develop these concepts. To understand the challenges underlying a difficulty in kindergarten and second grade, Solomon et al. (2015) compared students' performance on a linear measurement task. They found that out of multiple challenges of the younger students to understanding measurement, conceptualizing the ruler as a set of countable spatial interval units was a main challenge. This finding means that younger students might have a difficulty in seeing the hash marks on the ruler as an accumulation of distance. In McDonough and Sullivan's (2011) study, students from kindergarten to second grade participated in an interview in their class twice a year, at the beginning and end of the school year. The interview items consisted of assessment tasks regarding nine domains including length, time and mass. For example, students were asked to measure a straw with paper clips. Interview ended at the point where students encountered difficulty. The study came to a conclusion that "the key targets for the learning of length in the first three years of school [from kindergarten to second grade] are, respectively, learning to compare, learning to use a unit iteratively, and measuring using formal units" (McDonough & Sullivan, 2011, p. 27). Castle and Needham (2007) examined how first grade students might understand concepts of measurement. In this study, these researchers analyzed data including field notes, interviews, and student work samples over a year. They found that "at the end of the first grade year, in spite of the curricular attention to measurement activities, less than half the class demonstrated the ability to iterate units" (Castle & Needham, 2007, p. 220). Castle and Needham's (2007) finding explains why unit iteration should be a key target particularly for first grade students to begin to learn in relation to length measurement. These particular studies point to some challenges lower grade students may have for concepts of length measurement, particularly unit iteration. Based on these studies, this paper focuses on unit iteration, which teachers need to support students in learning.

A Social Aspect on Teaching Length Measurement with Conceptual Understanding

Researchers agree on the importance of teaching through interaction that focuses on students' conceptual understanding relating to measurement. In a comprehensive literature review, Stephan and Clements (2003) suggested that teachers of students from pre-kindergarten to second grade should support students to build concepts of measurement. They emphasized that teachers interact with students in ways to elicit "the meaning that students' measuring has for them, not merely students' explanations of their procedures" (Stephan & Clements, 2003, p. 14). This emphasis on meaning-making through interaction resonates with a view on teaching as an interaction activity (Wood & Turner-Vorbeck, 2001; Wood, Williams, & McNeal, 2006). According to this view, teachers need to go beyond asking students to report their ways to solve problems, which focuses on procedures (Wood & Turner-Vorbeck, 2001). Rather, teachers need to use certain talk moves that invite students to repeat, reason, and justify, which supports students to focus more on meaning they make out of mathematical tasks (Chapin, O'Connor, & Anderson, 2009; Kazemi & Hintz, 2014). This kind of interaction can "help young children clarify their thinking and sharpen their understanding as they try to make sense of their worlds through communication" (Cooke & Buchholz, 2005, p. 365).

Teaching of length measurement cannot be an exception to this view of teaching as an interactive activity. Then an important goal of teachers' interaction with students should go beyond show-and-tell in which teachers only look for students' procedural skills. The goal should support them to discuss what it means for them to measure an object as well. By using such talk moves mentioned above, teachers need to support students to interact with each other in ways to explain, reason, and justify what they make out of measuring activities (Chapin, O'connor, & Anderson, 2009; Kazemi & Hintz, 2014).

Current literature on teaching measurement in general and length measurement in particular has recommended instruction with an emphasis on meaning-making over learning procedures or skills with respect to length measurement (e.g., Erbilgin, 2016; Lee & Francis, 2016; Smith III, Heuvel-Panhuizen, Teppo, 2011). However, such literature has paid little attention to an interactive aspect of teaching in which teachers interact with students to support them in developing conceptual understanding in relation to length measurement. The reason for lacking attention might be explained by a great emphasis on finding instructional activities to promote students' conceptual understanding of length measurement (Stephan & Clements, 2003) rather than on the nature of teaching practices in themselves. Therefore, it is unsurprising to read that "few studies have focused on the nature of teachers' teaching practices for developing students' understanding of length, area, and volume measurement" (Edith, 2015, p. 150). Furthermore, it has been two decades since Stephan and Clements (2003) called for attention to teachers' interactional support of promoting students' conceptual understanding in terms of length measurement. It is worth exploring teaching practices of teachers, particularly lower grade teachers in this paper, in terms of interaction with students to understand how they support students to develop conceptual understanding and procedural fluency regarding length measurement, particularly unit iteration. As an effort to respond to the call, this paper examines talk moves

in the context of teaching unit iteration to understand whether or how teachers' talk moves support conceptual understanding and procedural fluency on the part of lower grade teachers.

Building on what we know in the field about a social aspect of teaching, I pose a research question that drives this paper: How would lower grader teachers interact with students to support students in promoting procedural fluency as well as conceptual understanding in terms of length measurement in general and unit iteration in particular?

III. METHODS

In this section, first, I describe a research project and data collection on which this paper is based. Second, I explain a teacher, Marva (pseudonym), from whom I analyzed a length management lesson in this paper. Third, I provide a description of the length measurement lesson. Finally, I will mention the data sources and analysis.

Research Context and Participant

This paper is based on the data from a research project. For the project, I received approval from the Institutional Review Board (IRB) at a mid-western university in the U.S. The purpose of the research project was to explore how early career teachers (teachers whose teaching career is between the first and third year) facilitate small groups after intervening in small groups. The project recruited two beginning teachers as participants. The data collected included videos of the two teachers' mathematics lessons and interview transcripts that included their elaboration on mathematics lessons.

Since this paper concerns length measurement in general and unit iteration in particular and Marva's second lesson was related to unit iteration, it focuses solely on the lesson. Marva as a participant was in the second year of her teaching career in 2018-2019. She taught at a public charter school for K-12 students, which was located in an urban city area in a mid-western state in the U.S. This area was highly diverse in race/ethnicity, culture, and language, which was reflected in the school as well. She taught 23 first-grade students in her classroom. Seventy-three percent of the students were English Language Learners. Their parents were from Bengal, Yemen, Bosnia, and Poland. Her teaching subjects included Mathematics, Social Studies, English Language Arts, and Science.

Data Collection

Even though this paper focuses on Marva's second lesson, I describe here how I collected the data from the two teachers in the project. I conducted three stimulated recall interviews with each teacher. First, before conducting a stimulated recall interview (Dempsey, 2010; Nguyen, McFadden, Tangen, & Beutel, 2013; Stough, 2001), I video-recorded the entire length of three different mathematics lessons per each teacher. As a result, I obtained video recordings of six different mathematics lessons from the teachers. Second, watching each video recording, I identified four specific interventions with potentially productive intervention approaches (Chiu, 2004; Dekker & Elshout-Mohr, 2004;

Featherstone et al., 2011; Gillies & Boyle, 2006). These approaches included asking students to evaluate other students' work, asking students to explain their mathematical thinking, encouraging students to work together, and mediating students' thinking. Third, during each stimulated recall interview, I had the teacher watch each intervention I had identified prior to the interview. After watching each intervention, I asked the teachers semi-structured questions to explain, elaborate on, and reason about what they noticed, what they thought went on in the small group, where they learned the intervention, and how they viewed themselves as teachers when intervening in the small group. The interview data were audio-recorded and fully transcribed for analysis.

As a result, I obtained four intervention episodes from a single interview transcript. In toal, the data obtained from the six stimulated recall interviews were 24 intervention excerpts. Each intervention episode consisted of two parts- 1) a transcription of the teachers' verbal interaction with students in a small group and 2) a transcription of their explanation, elaboration, and reasoning about their intervention. I analyzed the data for other research purposes (Pak, 2020, 2021). These two prior studies differ from this paper in that they focus on teachers' monitoring routines (Pak, 2020) and their teaching practices to promote epistemic practices on the part of students (Pak, 2021).

The Length Measurement Lesson

The goal of the lesson was, according to Marva, to figure out how to use measuring tools to measure objects and explore the ideas behind "measuring accurately." The lesson was from Everyday Math and was the second day for students to experience length measurement in terms of unit iteration using (non)standardized measuring tools, such as paper clips and regular rulers. Marva said that teachers in the school were expected to stick to the curriculum. The curriculum asked the teacher to distribute four measurement tools (connecting blocks, paper clips, rulers and tape measures) and students measured four objects (their desk, a marker, their workbook, and a fish in the workbook) working together with peers in small groups. In the lesson, there were specific requirements of how to measure those objects. Students were asked to measure their desk and a marker using two measuring tools they wanted to use. They were also expected to measure their book and a fish in the workbook using either paper clips and the connecting blocks. As mentioned above, she used small groups as an instructional organization in this lesson. The formation of small groups in this lesson was based on mixed ability grouping. According to Marva, she mixed students based on different academic achievements (low/high ability) hoping that when her "lower ability students" worked together with "the higher ability" students, explanations by the high ability students could help the low ability students get a better sense of measuring objects.

The Current Paper's Data Sources and Analysis

The data sources I analyzed for this paper were from Marva. They were 1) a teaching video of the length measurement lesson described above and 2) four intervention episodes in the lesson. In the mathematics lesson, Marva intervened in several small groups in which students worked together on measurement tasks. The number of small groups was

eight groups of two or three students in Marva's lessons. She intervened nine times in the lesson. Since four of the nine interventions were elaborated by Marva in the stimulated recall interview, I only have detailed information on the four interventions.

I took three steps to analyze these two data sources. First, I watched the length measurement lesson to identify ways Marva interacted with students in different small groups in terms of whether to elicit students' procedure or understanding. Building on the view of teaching as an interactional activity (Wood & Turner-Vorbeck, 2001; Wood et al., 2006), I looked for certain talk moves that indicate Marva asked students to talk about procedure (e.g., show how you did) or meaning (e.g., what does it mean to be exact when you measure? or why did you put paper clips at the edge of the table?) As a result of the first step, I excluded three intervention episodes from analysis for this paper because the teacher intervened in small groups to deal with behavioral issues. I asked a mathematics education researcher to examine the nine intervention episodes to confirm my decisions of exclusion. Second, I analyzed the interview transcript of the measurement lesson to understand the teacher's intentions when she asked questions regarding procedure or understanding. In the interview transcript, Marva offered why she interacted with students in the way she did. Third, I looked through patterns among ways they interacted with students in small groups to elicit students' procedure or understanding.

IV. FINDINGS

As a result of analyzing the intervention episodes, two patterns emerged. The first pattern was that Marva focused conversations and thoughts on both students' procedures as well as conceptual understanding. The first pattern was related to two intervention episodes. The second pattern was that in relation to interaction with students for conceptual understanding, Marva struggled finding ways to engage students in the concepts of unit iteration. The first pattern was related to four intervention episodes.

Focus on Students' Procedures and Understanding

The first pattern was that Marva's interaction with students in small groups suggested her efforts to support students in explaining how they measured as well as what it meant to measure objects accurately. I present Excerpt 1 as an example in which Marva "just wanted to see what was happening" because the four students in the small group were "very quiet" so she could not "even hear them." The following interaction occurred about 40 minutes after the lesson began. It was initiated by Marva who wanted to check in to see what they were doing.

[Excerpt 1]

1. Marva: What did you get for the desk? What did you use to measure the table? [without saying, a student pointed blocks] The Blocks? Okay, can show me how you measured it?
2. Students: [Showing roughly how they use to measure the table]

3. Marva: Why do you start over here? [pointing out at the edge of the table]
4. Student A: Ready [inaudible] just wanted to [inaudible]
5. Marva: You guys are so smart.
6. Student A: [Measuring their table with 20 connecting blocks] Okay. [inaudible] twenty… forty… fifty [Using half of the connecting block, which are 10 blocks long].
7. Marva: Wait. Right. So why do you go from forty to fifty? So twenty--
8. Student B: [Trying to help Marva see what they did] You have to do it again.
9. Marva: Wait, wait. Okay, [Refraining herself from interfering with Student B's measurement]. go ahead. [Watching Student B complete measuring.]
10. Marva: Good. All right. Is there another way that you can get a little more accurate? Do you think there's a way you can be more accurate?
11. Marva: [To another student in the same small group] Do you know what "accurate" means?
12. Marva: [To all students in the group] It means exact. So do you think in [inaudible] going and eyeballing where we stopped, [pointing out paper clips] we could mark where we stopped, so-- and could you put your finger there? And then put it right there, like that. Do you think that's more exact? [Students nod] Do you think that makes it more exact? Oh, here's one. Just try that again one more time.

This excerpt shows how Marva tried to support students to explain how they measured and what it means to measure accurately using different measuring tools. Line 1 shows that Marva asked students in the small group to show how they measured their desk using connecting blocks. In Line 3, Marva started to make sense of the students' understanding of unit iteration. Marva noticed they started at the end of the desk to measure the desk and made sure they understood the starting point at a zero point by asking them to explain why they started at the end of the desk. In Lines 7 through 9, Marva seemed to have a little hard time in understanding students' procedures of how they measured their desk with connecting blocks because their measurement (Lines 7 through 9) was not the same as their initial measurement (Lines 2 through 6). In Line 10, Marva understood how they used the connecting blocks. In Lines 11 to 12, Marva tried to make sure students understood the concept of unit iteration, which should have no gaps between measuring tools by explaining the meaning of "accurate" and asking students probing questions. According to an elaboration on Lines 1 to 12 in the intervention episode I obtained in the stimulated recall interview, she knew that students in the small group seemed to understand the meaning of being accurate. She pressed students to explain how they did by using the idea of being accurate, which means that, to be accurate, they needed to start over at the end of the desk putting paper clips without gaps.

A Challenge in Engaging Students in Understanding

Even though Marva focused students' thoughts on the meaning of being accurate in the lesson through interacting with students, there was a challenge in supporting students

to engage in the concept of being accurate in relation to unit iteration. I present Excerpt 2 as an example to illustrate this second pattern. Marva intervened in another small group in which a pair of students worked together to measure their workbook using paper clips. In an elaboration on this particular interaction, she said why she intervened in the small group.

> I wanted to see exactly how it was being measured. Because they were using paper clips it was really hard to see, so I just wanted to see because it almost looked like they had them all mixed up next to each other.

Marva's interaction with students in the small group had a clear purpose to understand how they measured their work book with paper clips because she thought they were not using paper clips in ways to get a precise length of the book. Marva approached the pair and looked at them working a few seconds before intervening.

[Excerpt 2]

1. Marva: Do you think you just measure one of them instead of just both of you guys doing it all? Did you want to help him measure it?
2. Students: [Nodding and then taking some paper clips out of a vinyl bag to measure their workbook]
3. Marva: [Noticing the two students measure their own book] Wait, wait. You can measure just one of them. Here, let's move yours. [Moving one book away leaving only one book on the table to measure, which caused Akeem's paper clips to be scattered] Uh-oh, I'm sorry Akeem. That was my fault. So let's push it up. So let's-- lay them back out. So why did you start all the way at the edge like that?
4. Students: [inaudible]
5. Marva: Well, we can do it whichever way you want. How do you want to do it? Okay, you show-- you line them up.
6. Akeem: [Closing the book that was open]
7. Marva: Oh, so you want to measure it like that. Oh. Closed.
8. Akeem: [Putting paper clips along the edge of the book]
9. Marva: [To Akeem] Well, what made you start at the edge? [Looking at Akilah, a female student] Would you have started at the edge? Why? [Akilah said something inaudibly.]
10. Akeem: [Counting the numbers of paper clips] one, two, three, four, five, six, seven.
11. Marva: Seven? Okay. [To Akilah] I want-- how about-- can you come over and look at his measurement? [Akilah moves to the other side of the table to see Akeem's measurement] Do you like his measurements? What do you li-- do you like his measurements? [Akilah nods] What do you like about it?
12. Akilah: it is in a line.
13. Marva: It's in a line?

14. Akilah: Yeah
15. Marva: Okay. Is there anything else you like about it? [Akilah hesitates to say] What?
16. Mohamed: She wants to know what you like.
17. Marva: Want to know what I like? Do you want to know what I like about it? [laughter] I like that there's no gaps in between each one. They line up nicely. So it's very accurate. It's the exact measurement. So I'm going to give you both five-five. Alright, so how many paperclips are-- how many paperclips wide is his book?
18. Akilah: [counting again] seven.
19. Marva: So, is that what you're going to write?

Similar to the section regarding the first finding, this excerpt also shows how Marva tried to press the two students, Akeem and Akilah, to make sense of what it means to measure accurately as well as to show how they measured the workbook. When she came close to the pair of students, Akeem and Akilah measured their own work book using paper clips, which she thought caused them to lose a chance to learn from each other. In Lines 1, 2, 5, 7, 10, and 11, Marva asked them to show and explain how they used paper clips to measure their workbook, which was how she supported them to focus on procedures. Trying to help them understand the concept of unit iteration, in Lines 9, 11, 15, and 17, Marva also continued on asking them to explain what they understood and justify their measurement. For example, Marva asked Akilah to explain what she saw in Akeem's measurement (Line 11). By doing that, Marva wanted Akilah to see paper clips that "line up nicely" (Line 17) "in a line" (Lin 12) along the edge of the closed workbook. Even though Marva focused her conversations on students' understanding of the concept of being "accurate," or the concept of unit interaction, however, the teacher did most of the talking and thinking for the two students. It seemed that this way for her to support was shaped by her awareness of the two students as English Language Learners with a low level of language proficiency. Consequently, the two students did not get a chance to explain and justify how they made sense of being accurate in relation to unit iteration. The teacher's talking and thinking might cause her to lose an opportunity to learn about their understanding. For example, when Akilah said, "it is in a line," she restated what Akilah said and asked Akilah another question ("Is there anything else you like about it?") Marva lost a chance to know about the meaning Akilah might make out of observation of Akeem's measurement. At the end of their interactions, what was clear to the teacher was only that they understood how to measure the workbook with paper clips.

Interview excerpt below reveals that Marva was not fully certain if Akilah owned the meaning of "being accurate."

> So, I think that she [Akilah] was able to take those things and he [Akeem] showed me that he had already understood it and could count them out. So, I think her being able to see it and recognize the positive things about it helped her too. Even if she couldn't have done it or even though I don't necessarily know if she-- Even

> though she looked-- when she was doing it on her own, she was still lining them out too. So I know she likes stepping in. I was able to see what they knew and what they could do.

The excerpt also shows that Marva seemed uncertain about Akilah's understanding of being accurate when she said, "even if she couldn't have done it or even though I don't necessarily know if she-- Even though she looked-- when she was doing it on her own, she was still lining them out too." Instead, Marva was certain that Akilah knew how to measure the workbook using paper clips. As shown in Excerpt 2, the other six intervention episodes indicate a difficulty Marva had in interacting with students to promote conceptual understanding in connection to procedural fluency. Due to a tendency to do the talking and thinking for her students, she was able to know only about whether they could measure objects using measuring tools and was uncertain about students' meaning-making in relation to length measurement.

V. DISCUSSIONS AND IMPLICATIONS

Even though teachers interact with students to promote conceptual understanding in relation to length measurement, the way they interact may not always be meaningful enough for students to make sense of the concept of length measurement. In this study, I found that the lower grade teacher tried to focus students' conversations and thoughts on meaning out of the measuring activity. However, it does not seem to be well aligned with what NCTM (2000; 2014) recommends to promote students' conceptual understanding. Apparently, Marva interacted with students in that the teacher was able to invite students to explain and justify what they came to make out of the measuring tasks. NCTM (2014) asks teachers to facilitate meaningful mathematical discourse in which students have more opportunities to explain, reason, and justify their understanding. Several studies (e.g., Kamii & Clark, 1997; Stephan & Clements, 2003) argued that mathematics instruction might not be effective enough to promote students' conceptual understanding, which results in students' weak measurement learning (e.g., Kamii & Clark, 1997; Kloosterman, Rutledge, & Kenney, 2009; Solomon, Vasilyeva, Huttenlocher, & Levine, 2015; Thompson & Preston, 2004). Even though mathematics curriculum may have instructional activities or tasks, such as the one in this paper, that are designed in ways to promote students' conceptual understanding of length measurement in general and unit iteration in particular, student learning depends on how teachers implement such tasks in their mathematics instruction. This paper shows how teachers, particularly lower grade teachers, may have difficulties in facilitating students' discussions on meanings they make out of measuring activities. This paper contributes to research on lower grade teachers' instruction on length measurement in general and unit iteration in particular by providing an example of how teachers are implementing mathematics lessons on length measurement to promote conceptual understanding as well as procedural fluency.

Based on there some implications for researchers as well as teacher educators. First,

researchers might examine lower grade teachers' instruction on length measurement in general and unit iteration in particular using the view of teaching as an interactive activity. This study showed a challenge of a lower grade teacher to teaching length measurement to promote conceptual understanding. Based on this finding, researchers with an interest in this topic may use the view to explore successful ways lower grade teachers facilitate a meaningful mathematical interaction in their instruction and further how such an interaction may shape students' conceptual understanding. In a further exploration, researchers may draw on particular talk moves to conceptualize teachers' interactions with students in small groups (e.g., Chapin, O'connor, & Anderson, 2009; Kazemi & Hintz, 2014). Second, teacher educators might design instructional activities in which prospective teachers learn about how to interact with students to promote students' conceptual understanding. This study showed that Marva did the talking and thinking for her students, which caused her to lose opportunities to learn what students understood. Teacher educators might support prospective teachers to think about what it looks like to interact with students for conceptual understanding and what they could do to promote conceptual understanding interacting with students.

This study has three limitations. First, the analysis was based on one single mathematics lesson taught by an early career teacher. Thus, this study cannot tell how the other lower grade teachers would support students to develop conceptual understanding as well as procedural fluency. It also cannot be generalized to experienced teachers. Second, I analyzed the length measurement lesson to understand how lower grade teachers might engage students in understanding of the concepts regarding length measurement. As such, this study cannot inform how these ways would affect students' understanding. Third, this study did not pay attention to the relationships between the teacher's teaching contexts and the way the teacher interacted with students in small groups. Marva taught the first grade students, mostly students of color, in an urban area. Her students were considered by the teacher to be English Language Learners. Therefore, this study cannot predict how these different contexts would shape the teacher's instruction in terms of interaction. Despite these limitations, the findings in this paper initiates an example of how lower grade teachers may interact with students to promote not simply procedural fluency but also conceptual understanding.

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