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Interaction between a First-Year Elementary School Teacher and Students in Mathematics Class[1]

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Teaching and learning mathematics in a classroom setting is based on the interactions between the teacher and her students. Using classroom observations and interviews of students and the teacher, this research examines a first-year teacher and her students' interactions in the mathematics classroom. In this mathematics classroom, teacher and students interaction had inconsistency between mathematical topics and non-mathematical topics. For non-mathematical topics, their interactions were very active but for mathematical topics their interactions were very limited. This paper ends with raising questions for future research and calling for the opportunities for first-year teachers to reflect on their interactions with their students, in particular about mathematical topics.

Keywords: elementary mathematics education, interaction, teaching practice, student participation
MESC Classification: D42
MSC2010 Classification: 97D40

1. INTRODUCTION

Teaching mathematics is improvisational performance in classroom (Borko & Livingston, 1989). Teachers start the class with general guidelines for lessons and fill out the gap between the planned guideline and implementing lesson while they are teaching and interacting with their students. Such improvisational characteristics of teaching make teachers, in particular first-year teachers, struggle and narrow their instruction in the mathematics classroom. While improvising, for example, first-year teachers sometimes miss opportunities to foster students' mathematical understanding, or chances to give prompt feedback to students.

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First-year teachers are confronted with the real-world of teaching in mathematics classroom (Steele, 2001). Teaching and learning mathematics in a classroom setting is based on the interactions between the teacher and her[2] students. The teacher interprets students' answers or solutions, their questions, and/or participation in a mathematical activity to help her students understand mathematics better. As such, the teacher reacts to her interpretation of students' actions. The teacher's reaction can be through the adjustment of questions, details of explanation, or perhaps the provision of more concrete or complex examples. Students also interpret the teacher's explanation, questions, and examples to understand mathematics better and they react through their interpretation of the teacher's action. Students' reactions can occur by changing their answers, by asking questions, and by expressing their ideas.

As noted above, considering the importance of teacher and students' interaction in teaching and learning mathematics and the struggles of first-year teachers in mathematics classroom, in-depth examinations of first-year teachers' interaction with their students during mathematics instruction would be necessary. We can investigate the interaction between a first-year teacher and students through classroom observations. Observations play an important role in understanding teacher and students interaction in mathematics class (Pianta, LaParo & Hamre, 2008) and observed classroom interactions are a "valid source of information for understanding relational quality in the classroom" (Sabol & Pianta, 2012, p. 215).

The central research question posed in this study is: "How does first-year teacher and her students interact with each other in the mathematics classroom to create mathematical meaning?" through mathematics classroom observations. To be specific, I look at how the first-year teacher reacts to students' answers, how the first-year teacher reacts to students' difficulties in solving problems, how the first-year teacher reacts to students' errors, how students react to their teacher's explanations, and how students react to their teacher's questioning?

2. THEORETICAL BACKGROUND

I begin by reviewing what researchers know about novice teachers for mathematics teaching and learning. I also review literature focused on teaching practice in mathematics classroom.

2.1. Research on novice teachers

[2] The teacher observed and interviewed for this study was female.

Research on first-year teachers has focused on their Pedagogical Content Knowledge (PCK). Researchers analysed first-year teachers' PCK in various way. Kim & Pang (2012) compared three first-year teachers' PCK through mathematics classroom observations. In the results, they found substantial differences in three first-year teachers' PCK and emphasized the critical role of classroom observations to examine teachers' knowledge. Additionally, Kim (2007) analyzed two novice teachers' PCK using interview. She found inconsistency between their PCK interviewed and teaching practices regarding teachers' feedback to students' answer and instructional material. Novice teachers did not give students appropriate feedback and did not use enough instructional materials.

Raymond (1997) studied the relationship between beginning teachers' beliefs and their teaching practice. From six beginning teachers, Raymond noted that teachers' beliefs and their practice were inconsistent. The inconsistency came mainly from social teaching norms (school philosophy, administrators, standardized tests, curriculum, textbook, other teachers and resources) and immediate classroom situation (students—ability, attitudes and behavior—, time, constraints, and the mathematics topic at hand).

In addition, Choe & Hwang (2009) compared PCK between novice and expert teachers focusing on teachers' understanding students. They found that

(1) Novice teachers directly started the main topic of the day without motivating students;
(2) Novice teachers did not consider students' previous knowledge and assumed that students would understand what they teach in any way; and
(3) Novice teacher's monitoring of students' misbehavior is absent or ineffective, and attempts to redirect misbehavior are ineffective too.

In particular, Leinhardt & Smith (1985) compared knowledge of novice and expert teachers for fraction instruction. They found

(1) Differences in teachers' presentation (with considerable difference in the amount and level of conceptual information);
(2) That expert teachers emphasized the role and value of algorithmic information differently.

Overall, novice teachers had weaker knowledge than expert teachers.

Much of the work studying on novice teachers has analyzed the relationship between the content of teacher education programs and actual teaching practice of their first year. First-year teachers have conflict between theory based-knowledge from mathematics method course and practical skills of teaching in their mathematics classroom (Ensor, 2001; Liston, Whitcomb & Borko, 2006; Rust, 1994; Steele, 2001). They confront unexpected problems in classroom due to local context, teachers' workload, or administrators.

Ensor (2001) investigated how the beginning teachers recontextualized what they learned in mathematics method course in their mathematics classroom. She found that first-year teachers had inconsistency between what they learned in their method course and what they did in their mathematics class, and discrepancy between what they said in the interview and what they did in their mathematics classroom. They limitedly adopted discrete tasks from their mathematics course and used special vocabulary from their mathematics course to explain their teaching in the interview.

Steele (2001) conducted a four-year longitudinal study to contrast cognitively based concepts about mathematics teaching of four elementary beginning teachers. She studied how teachers' cognitively based concept has changed from method course to their first year of teaching. As results, only two of them sustained and implemented such concepts from mathematics method course. Steele found several factors to influence teachers' concept about mathematics teaching: personal commitment, professional strength, curriculum, planning, assessment, beliefs, knowledge, and support from school administration.

To improve teacher preparation program, Liston et al. (2006) addressed three issues that first-year teachers will encounter:

(1) University-based teacher preparation program pay too much attention to theory and not enough to the practical skills of teaching;
(2) First-year teachers struggle with emotional exhaustion and stress of the beginning years; and
(3) School context and setting do not support first-year teachers' learning and development.

To overcome first-year teachers' struggles in their classroom, teacher preparation program in university should consider those issues and try to address them.

2.2. Research on teaching practice

The teaching practice tells us what actually happens in mathematics classrooms where teaching and learning mathematics take place. The topics researchers investigate varied when they consider teaching practice. Cobb, Wood, Yackel & McNeal (1992) contrasted social interaction between traditional mathematics classroom and inquiry mathematics classroom. The meaning of success differs in the classroom that focuses on procedural knowledge and in the classroom that examine mathematics through inquiry. When students followed procedural instructions successfully, it was meaningful in traditional mathematics classroom but when students created and manipulated mathematical objects with their explanation and justification, it was meaningful in the inquiry mathematics.

Stigler & Hiebert (1999) compared teaching practice internationally. They analyzed the typical 8th grade mathematics lessons from Germany, Japan, and the United States

and found general patterns of teaching in each country, which varied across countries. Stein, Smith, Henningsen & Silver (2000) analyzed how the cognitive demand of mathematics tasks changed during instruction. Although teachers set up tasks with high cognitive demand, several factors lowered the high cognitive demand of the tasks. These factors included teachers' emphasizing correctness of the answer, not enough time, classroom management, inappropriateness of the task, and teachers' not accounting for high-level process. However, several other factors maintained high cognitive demand of the task including scaffolding, students' monitoring their own progress, modeling of high-level performance, press for high level process, tasks based on students' prior knowledge, teachers' conceptual connections, and sufficient time.

Other researchers examined mathematical discourse during instruction (Lampert, 1990; Lampert, 2001; Williams & Baxter, 1996). Lampert (2001) described a variety of teaching practice such as establishing a classroom culture, preparing a class, and teaching while individuals work and whole class. William & Baxter (1996) documented the patterns of discourses in mathematics classroom where the teacher supported producing mathematical knowledge through discourse among students. In addition, Cobb and his colleagues analyzed sociomathematical norms in the classroom (McClain & Cobb, 2001; Yackel & Cobb, 1996).

In sum, researchers analyzed teaching practice for various purposes. However, little research has studied teacher and students interaction in mathematics instruction. Although Battey (2012) analyzed student-teacher interaction in mathematics classroom, his main interest was mathematics teaching for students of color. In this study, I investigate the interaction between first-year teacher and her students in mathematics classroom.

3. METHODS

3.1. Participants

The participants in this study were a Hispanic origin female teacher, Ms. Morales[3], and 19 third grade students. There were nine boys and ten girls and all students were Hispanic. The classroom is situated within an urban K–8 elementary school of approximately 845 students who are mostly Hispanic in origin (96%, 2% African-American, 2% Caucasian) in the southwest USA. Ninety three percent of the students received free lunch and an additional seven percent received reduced lunch. At this particular school, grade level classes were organized according to students' English proficiency levels. The English level of this class is a little below than average and students sat as a group in the class-

[3] All names in this study are pseudonyms

room.

Ms. Morales was a first-year elementary school teacher. Ms. Morales said that she likes mathematics so someday she would like to be a mathematics teacher in a high school. To focus deeply on the students' interactions with Ms. Morales, I decided to observe closely one group of four students instead of the whole class as a group. I asked Ms. Morales to select this one group. Ms. Morales suggested a group composed of Jose, Antonio, Jeremy, and Kim. These students actively participated in the classroom work and were composed of students displaying high, middle and low ability in mathematics. Ms. Morales told me that Jose was good at mathematic; Kim was a middle level student; and Antonio and Jeremy were poor at mathematics. In general, I sat next to Kim to observe; sometimes I sat next to the Jeremy to observe mathematics class.

I have worked in this school to support a mathematics professional development for elementary school teacher. The classroom, third grade, for this study is one of the classes in which I worked on the professional development project. My role was to participate with the classroom teacher (when asked for input) during the follow up component of the professional development project. For the purposes of this qualitative research project, however, I participated in the classroom as an observer. I had worked with this classroom teacher and her students for a semester before conducting this particular set of visits. I chose this classroom from the five classrooms in which I had worked with because the teacher and students discussed more in this class as opposed to many of the other classes I have seen where teachers delivered what they felt the textbook said.

3.2. Data Collection

This is a qualitative study using Erickson's approach (1986). Data were collected over a two-month period with participant observation of mathematics classes, a semi-structured interview with the teacher and with students and analysis of classroom artifacts in form of documents.

Observations: I observed the mathematics class for eleven hours over two months focusing on the interactions between the teacher, Ms. Morales and four students, Jose, Antonio, Jeremy, and Kim, when they occurred. The goal of the observations was to discover the first-year teacher's use of students' answers, misunderstandings and errors in teaching; the teacher's reaction to students; and the students' reactions to the teacher. I wrote a field note during the class and I filled out the field note right after the class.

Teacher Interviews: I interviewed Ms. Morales using a semi-structured format after observing her mathematics classes. The interview took approximately thirty minutes. I started the interview with the following question, "what is

hard about teaching in the elementary school?" The main follow up questions were: Do you have any special reason to focus on what students talk to you, if yes, what is that? Do you make a lesson plan, if yes, how do you make it? When you prepare your lesson plan or material, do you think about students' level of knowledge? If students do not understand what you explained, what do you usually do? What do you do with students' wrong answers? The interview was audio recorded and transcribed.

Students Interviews: Four students, Jose, Antonio, Jeremy, and Kim were interviewed individually again in a semi-structured format. The interview took ten minutes on average. The main questions were: When you do not answer the teacher's question in mathematics class, why don't you? When you do not know the answer to the teacher's question, what do you do? When you get the wrong answer, what do you do? The interviews were audio recorded and transcribed.

Document Collection: In order to understand the mathematics class better, I collected the chapters of mathematics textbook from which Ms. Morales taught. The textbook widened my understanding of the classroom activity.

3.3. Analysis

I analyzed data using the Erickson's approach (1986). Erickson says (1986, p. 146):

> One basic task of data analysis is to generate these (empirical) assertions, largely through induction. This is done by searching the data corpus-reviewing the full set of field notes, interview notes or audiotapes, site documents, and audiovisual recordings. Another basic task is to establish an evidentiary warrant for the assertions one wishes to make. This is done by reviewing the data corpus repeatedly to test the validity of the assertions that were generated, seeking disconfirming evidence as well as confirming evidence.

I followed Erickson's analysis. I read the data, including the mathematics classroom observation field notes, the teacher and students' interview transcripts as a whole to have general understanding of data. I generated two empirical assertions through writing a memo. These are presented in the section below. Next, I read through the data again to find warrant for the assertions. I went through one assertion at a time. I searched confirming data and disconfirming data. For the first assertion, it was hard to find disconfirming data but for the second assertion, I could find one outlier from the observational field notes. However, this outlier was weak enough to survive the second assertion and the other confirming data were strong enough to survive the second assertion. I report the outlier in the results section. For each surviving assertion I presented one vignette. Excerpt from the interviews and field notes were presented in support of the assertions.

4. RESULTS

4.1. Interaction about non-mathematical topics

Ms. Morales listened what students said carefully. In mathematics class, students asked Ms. Morales non-mathematical questions and Ms. Morales allowed students to talk and ask questions that were unrelated with the class topic. Ms. Morales answered and gave feedback to students about their questions that were not on mathematics. The following vignette shows Ms. Morales and her students interact about a non-mathematical topic during a mathematics class.

> *Mathematics class starts. Ms. Morales turns on the projector to show the problem, which she typed on the computer, to her students. On the screen, the problem says, "The state flag of indiana has 19 gold stars and a flaming torch. There are 13 stars in an outer circle representing the 13 original states. How many stars are in the inner circle?" Morales asks "I forgot something, what is it?" Hannah says you misspelled it. Morales replies, "No, I did not misspell". Michael says indiana should be the capital letter I, Indiana. Morales says "right" correcting the letter on the computer. Morales shows the Indiana state flag asking how many stars the Indiana flag has and what else the flag has. Victoria asks, "Why do we focus on Indiana?" Morales encourages Victoria saying "good question! This problem asks us about Indiana." Marilyn asks, "Why do we talk about Indiana?" Morales again answers that the question is about Indiana. Finally, Matthew asks, "Do we do math?" Morales replies, "Yes, we are doing mathematics."*
>
> *Showing students the Indiana state flag on the screen, Morales and the students talk about the problem. "Ring, ring, ring." The interphone rings. Morales answers the phone. While she is talking on the phone, there is a small blue letter, "office" blinking on the left topside of the screen. Morales comes back and explains about the problem. As soon as Morales starts to talk, Carolina raises her hand and asks, "What was that?" pointing left topside of the screen. Carolina explains that there was the blue blinking letters on the screen. Because the computer screen is projected on the board screen, students see what Ms. Morales's computer has on its screen. At first, Morales does not understand what Carolina is talking about but soon Morales catches the question and says, "Oh, when I get the interphone, it lets me know who is calling me." Morales goes back to the problem and explains it.*
>
> *Ms. Morales gives the students another problem, which one is larger 370 and 369 using the sign > or <. Morales explains the sign > and < with a shark's mouth for students to remember the sign easily. Morales says shark eats bigger number then who does the shark eat? As soon as Morales talks about a shark, Jeremy raises his hand and says, "I saw a Garfield. A shark was chasing the Garfield and the Garfield was eaten by the shark." Morales says "wow!" Jose raises his hand and says, "I went to the zoo. The animals had numbers on the back."*

Ms. Morales reminded students that the first character of a state starts with the capital letter and showed students the flag of Indiana and the U.S. map. At first students did not know that this was about mathematics. I was surprised that a student asked why this ques-

tion focused on the state Indiana, which was not related with the mathematical idea at all. Ms. Morales did not ignore the question but explained that the question was about Indiana and encouraged her students to keep having interest in this problem.

When Ms. Morales got the interphone, Carolina asked Morales about the blinking letters. It was obvious that what Carolina question was not related to the topic they were talking about. However, Carolina asked Morales directly about her question and Morales answered the question. In this classroom, Ms. Morales allowed students to ask questions that were not related to mathematics, although it was about the teacher's business; and was not related to her students' work. Morales did not ignore her students' questions and she explained why the blue letters came and blinked to students.

For the problem to compare the size of the number, Ms. Morales used a shark for students to remember the sign easily. Jeremy related a shark to the Garfield story that did not have any relationship with the comparison of numbers by size or the mathematical signs, < and >. Ms. Morales reacted to Jeremy saying "wow" without ignoring his story. She could have said, "That is not related with mathematics" or "let's focus on this problem" to make students pay attention to the mathematical topic. Morales's reaction that encouraged student's talk about non-mathematical topic might have students feel that they were allowed to say aloud an experience although it was not about mathematics. This might be why Jose talked about the zoo and animals with numbers on their back. Ms. Morales listened to the students carefully in the mathematics class although it is not related to mathematics. Students asked questions that were not about mathematical ideas or the mathematical content being presented; rather it was from students' curiosity unrelated with mathematics.

In the interview, I could also see that Ms. Morales tries to be a good listener to students. Ms. Morales said this:

> *I am very sensitive. When they [students] are crying, I am crying. That's hard too. Specially, this grade they [students] said something (happened) at home and they [students] share with me and to be honest, I cry when they [students] cry. That's hard for me not to cry when they [students] cry…. everybody wants to tell me. I am like okay raise your hand; everybody is excited to tell me. I am like how was your weekend? They [students] tell me some of them are good, some of them are bad. I try to listen to everybody. That way everybody feels like an equal that I don't have a favorite one. I don't have one I really like best. I like everybody… When I was third grader, I wished to go to the spot. I wanted to say something to my teacher. I felt like she didn't listen to me. That's one thing, you will take forever. When you remember the teacher never listens to you. I just want to make sure that they [students] know that they [students] need something when they want to share something that happened at home, they can come up to me I will try to help them. Because I am a teacher but I am a counselor, I am a nurse, I am a mom, I am a dad sometimes.*

Ms. Morales thinks it is important to listen carefully when students talk to her. She is

sensitive enough to cry when students cry. This tells me that her sympathy is one of the reasons why she listens to students carefully and why she does not block students' questions which are not related with mathematical ideas or the content being covered that can distract from the mathematics class. Also because she wants to treat her students equally, she listens to students' stories carefully. She thinks that if she listens to one student's story, she also should take another student's story to treat her students equally. This issue is related to her elementary school experience. Because she still remembers her third grader teacher as one who never listened to her, she does not treat her students unequally. In addition, Morales considers herself to be not only a teacher but also a counselor, a nurse, and parents whose charge is taking care of patients or kids. This also makes her to listen to her students' stories even when they are unrelated with or to the mathematics in her mathematics class.

4.2. Interaction about mathematical ideas

Ms. Morales listened to what her students said in mathematics class carefully but she did not pay attention to students' mathematical ideas, errors or misunderstandings with the same care and attention. When students asked mathematical questions to Ms. Morales, she simply answered "yes" or "no" without further explanations or comments. When students had wrong answers, Ms. Morales did not ask students "why do you think so?" or she did not discuss students' errors or misunderstandings with them or the class; rather she said "no" or she provided the correct answer immediately. The next vignette describes Ms. Morales's typical mathematics class.

> *Morales introduces the idea of a fraction as part of a whole and draws a circle divided by four equal pieces. She colors one piece out of four pieces saying, "This is one fourth or one out of four." Morales colors each piece one by one, asking her students to call fraction part that represents the number of colored pieces out of the total number of pieces. She colors three pieces (Figure 1) and then asks, "How much do I color?" Kim answers "three" then Jeremy says "three out of". Kim and Jeremy answer together the last part of their teacher's question: "one". Morales asks to students "is this really one?" but no one answers. Morales says "three out of four" which is the correct answer. She keeps moving on the next problem.*
>
> *While Morales explains the example from the textbook page 516 (Franke et al., 2000), Jeremy reads the bottom of the textbook, saying "I don't know why this is two out of five (Figure 2). Jeremy does not listen to Ms. Morales's answer; he keeps watching the bottom of page 516, mumbling "why….." Ten minutes pass; all of sudden Jeremy says, "I get it!" He makes a big smile and raises his hand. Morales comes to Jeremy. Jeremy says, "Now I get it. I thought this picture is two out of three" Morales says "no, total" and she goes back to the blackboard. Morales does not explain what Jeremy said to her to the other students. She keeps talking about the fraction, four out of ten, which is next picture in the textbook.*

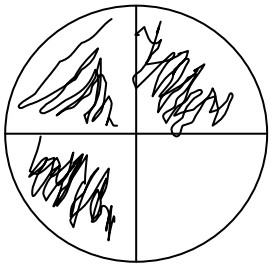

Figure 1. Three out of four

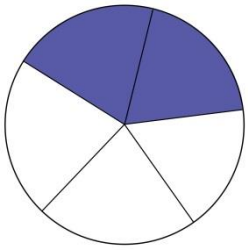

Figure 2. Two out of five

Dante asks Morales whether $\frac{3}{5}$ *can be written* $\frac{5}{3}$ *. Kim says "yes" and Jeremy says "no". In a moment Morales says "if you switch the number, it is not the same." Morales moves on to the next problem. Next problem is expressing fractions on number line. Ms. Morales draws a number line; she divides it into six equal parts; and writes the numbers from 0 to 6 under the number line (Figure 3). She asks "what is equal to 1?" No one answers the question. Morales says "one out of six" writing* $\frac{1}{6}$ *under 1. Morales asks for the fraction equivalent for 2 out of 6, 3 out of, 4 out of, and 5 out of, but no one answers it. She writes* $\frac{2}{6}$, $\frac{3}{6}$, $\frac{4}{6}$, *and* $\frac{5}{6}$ *saying "two out of six", "three out of six", "four out of six" and "five out of six". At last, Morales asks "what is equal to 6?" Still, no one answers her. Morales answers herself one, writing 1 under 6.*

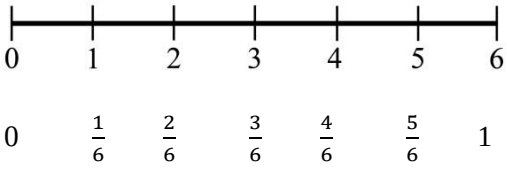

Figure 3. Fraction on number line

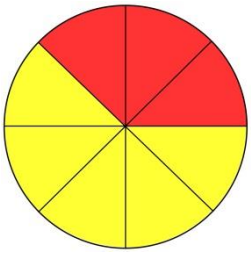

Figure 4. Three out of eight

At the end of the class, students work as a pair; one makes a fraction with fraction circle and the other answers what the fraction is. Jeremy and Kim is a pair. Jeremy goes first. He makes a fraction with three red parts and five yellow ones in a circle (Figure 4). Kim answers "eight out of three". Jeremy says to Kim "you switch it. Three out of eight." Jeremy says with small voice "this is awesome, this is my best day ever!" During this group work, Ms. Morales looks around the classroom watching her students work. When students struggle, she goes there and talks to the student individually.

In the vignette, Jeremy and Kim say three out of one for the colored part (Figure 1). I can interpret Jeremy and Kim's answer in two ways: first, Jeremy and Kim considered the circle as one because it is one circle; second, Jeremy and Kim thought the fraction as the colored part and the un-colored part. Both of them are very critical issues in fraction teaching and learning (Lamon, 2007). In any case, Jeremy and Kim did not understand

the form of the fraction representation that is the part out of the total number of pieces. However, Ms. Morales did not ask Kim and Jeremy why they thought it as one and she did not discuss these central issues with her students. Rather she just said the correct answer. In addition, Jeremy and Kim did not ask why it is four not one. Although their answer was wrong and the teacher did not explain why, Jeremy and Kim did not react to Morales's answer.

Jeremy struggled with the form of the fraction. He thought fraction as the number of shaded pieces out of the number of un-shaded pieces, not the number of shaded pieces out of the total number of pieces, which is a common misunderstanding of fraction (Lamon, 2007). Jeremy saw the circle that had two pieces colored and three pieces un-colored so it was two out of three not two out of five (Figure 2). I focused on Jeremy here because although he could not understand the fraction expression, he did not ask Ms. Morales to explain further; rather he thought about it by himself. Jeremy did not ask what he did not know to Ms. Morales. It took him a while but he got the correct answer by himself, fortunately. After he solved his confusion, he explained what he misunderstood to Mr. Morales, which was also interesting to me. Jeremy did not ask questions of Ms. Morales but he explained what he got to her. But Mr. Morales's reaction to Jeremy was simply saying "no, total" without any conceptual or mathematical feedback. Morales did not give any mathematical support to Jeremy or the other students in her class for this very common and important mathematical misconception.

Dante generated another very common and well document student misunderstanding for the conceptual understanding of a fraction (Lamon, 2007). Because Dante did not understand about the numerator that is the part and denominator that is the total, he did not think where the numerator goes and where the denominator goes in the fraction. However, Ms. Morales did not focus on this issue and just said "no". Kim said "yes" but Morales did not ask or talk more about it and Kim did not ask any more, either.

When Morales taught fraction using a number line (Figure 4), I did not hear students' answer. No one answered Morales's question. I thought it was natural for students not to answer Morales's question because that was the first time for students to think about fraction on number line. I was not sure that students knew why 1 is $\frac{1}{6}$ on the number line but no one asked any question. Students did not say the answers, either. However, Morales just kept saying the fractions. She did not ask to students "do you follow me?" or "do you understand this?" Moreover, 6 was set equal to 1 at the end, which was not easy for students to understand. Without any further explanation, Morales finished the topic of fractions on number line. When students did not answer or ask questions, Ms. Morales answered herself providing answers to her own questions that she kept asking. Here, her question did not seem to be a real question to her students; rather the question was for the answer that Morales wanted to say to her students. Therefore, although students did not

answer her questions, she kept asking and answering by herself. Morales did not expect or wait for students' answer to monitor students' understanding.

In the pair work, Kim said $\frac{8}{3}$ but the correct answer was $\frac{3}{8}$ (Figure 4). This was the same issue that Dante made a moment earlier in the class. Morales said $\frac{3}{5}$ and $\frac{5}{3}$ were not the same but Kim did not know what the difference between $\frac{3}{5}$ and $\frac{5}{3}$ was, or what was correct. Hence she made the same error again here. However, Jeremy understood fraction representation by himself and he fixed Kim's wrong answer correctly. At the end of the class, Jeremy was very satisfied with this class because he felt that he understood a form of fractions. During group work, Ms. Morales helped students who struggled with the problems but she did not make important mathematical issues public. Rather, she talked about the issue with individual student. In the class, Ms. Morales did not use students' error or questions in her teaching. Ms. Morales did not change her explanations, questions or examples after her students posed questions or wrong answers.

I was able to find one outlier when Ms. Morales reacted to her students' ideas related to mathematics (it is not real mathematics issue though but it is related with mathematics). Ms. Morales asked students to solve $\frac{1}{2}+\frac{1}{2}$ and she looked around classroom to check students' answers. Ms. Morales saw Jose's solution. She went to the board and said to students. "Look at this. Someone circled '+' writing '$\frac{1}{2}\oplus\frac{1}{2}$' on the board. I think it is good idea. Sometimes, you do addition for the subtraction problem or do subtraction for addition problem. When you make a circle on the operation, you will not forget it." This time, Ms. Morales shared Jose's idea with the whole class. Ms. Morales was influenced by Jose and she made the local issue public. However, this example was very rare. It was hard for me to find this kind of influence in this mathematics classroom.

The following excerpt is more typical in this classroom and also shows that the limited interaction about mathematics ideas between Ms. Morales and her students.

Ms. Morales: 3/6 + 2/6, which one do you add? Numerator or denominator?
Kim: Denominator.
Ms. Morales: I will get heart attack.
Carolina: Numerator.
Ms. Morales: What should I do? *(Students raise their hands and Ms. Morales points Lopez.)*
Lopez: (comes to the board and write 1/6)
Ms. Morales: Not subtraction.
Lopez: (erase the answer and then about to write the answer)
Kim: No, two chances!
Jose: (comes to the board and writes 5/6)

When Kim said that add "denominator" for fraction addition, Ms. Morales did not give Kim any mathematically (or conceptually) meaningful feedback; rather Morales's

comment, “I will get heart attack” meant that it was the wrong answer. Lopez also had a wrong answer. Ms. Morales’s comment, “not subtraction” also meant it was wrong answer. Although Lopez found what his error was, he could not fix his answer because they were not supposed to have second chance to fix the answer. Ms. Morales said in the interview “I just give them [students] one chance to give me the correct answer. I want them to take their time, think about the answer then write it down or say it to me. They [students] say oh, I am sorry it’s 36 not 35, I am like, you need to think about it and then give me the answer. Some of them just rush. That’s why I tell them one chance.” This rule that students can have only one chance to say their answer shows that Morales thinks that it is more important for students to think deeply at first than for students to have opportunities to reflect and revise their answer with comment from the teacher and students, which may be one of the reasons why the interaction about mathematics between Morales and students are limited in this mathematics classroom.

4.3. Teacher and students explanation about their limited reaction

In the interview with Ms. Morales, it was hard for me to find that Ms. Morales used students’ errors or questions in support of her explanations, her choice of questions or the examples she provided for the mathematics topic. The following interview contains what Ms. Morales said about what she does when students do not understand her explanations; what she does with students’ wrong answers:

> *I don’t know they will know to be honest, I thought they will know because this is something like you tie your shoes, like okay how to do this, do that. And I thought they will know what to do during the math problems but some of them are still lost what to do first. So tomorrow we will do more practice, they will get it for sure…Usually I don’t go over the same thing because otherwise it will be like, they are going to be like, okay I don’t get it. They look like I don’t get it here in the head.*

According to the interview with Ms. Morales, she thinks that students can understand what they do not know about the problems through practice. She does not focus on what students’ errors or misunderstandings that show about student knowledge. When students struggle with problems she gives these students more practice. She even says that she does not know whether students know it or not, which means that Morales’s explanation is not influenced much by her students’ understandings; rather she keeps following her plan with little consideration of her students’ reactions. Moreover, she says that she does not go over the same problem when students do not understand it. She changes the problem in order to explain all over again, which means that she does not try to focus on students’ difficulties but she explains it again with other problem. Ms. Morales focuses more on her explanations than on students’ understandings to help her struggling students, which implies that Ms. Morales does not consider students’ reactions important.

In this class, students did not express their mathematical ideas or questions about mathematics topics actively. I found this issue in the student interviews too. Here are some statements made by these students:

Jose: Sometimes I don't answer her questions because I didn't get the question. I don't know what it means. I don't get it because I don't know what she is asking us to do.

Antonio: When I know the answer, I answer it. When I don't know the answer, I don't answer it.

Kim: Sometimes, I forget the question then I cannot answer…. When I don't know how to solve a problem, I am just quiet.

Jeremy: Sometimes I don't know what the answer is because I am doing something else when she asked me…. Sometimes I don't understand what she is asking to me, Sometimes, I do. When I don't understand I stop what I am doing and then listen.

Neither Jose nor Jeremy answer Morales's question when they did not understand what Morales asked them to do, which is partly because Morales did not present questions carefully to her students. As I have noted earlier, Ms. Morales does not draw on a model of student learning to inform her instruction. But what I want to focus more on here is that when students did not understand what Morales asked to them do, they chose or decide not to answer it; rather they asked Ms. Morales "what do you mean?' or "I don't understand." They did not ask Ms. Morales to explain one more time. Jeremy thought he did not understand what the question was because he did not pay attention to the problems. He changed his attitude and attended more, instead of asking what the problem was to Ms. Morales. Kim said when she did not know how to solve it she was quiet. When Kim could not solve the problem, she chose to be quiet rather than asking the question to Morales. The four students chose to be quiet rather than to ask the question again, or to get help from Morales, when they did not understand the question, or they did not know the answer.

5. DISCUSSION

Ms. Morales and her students displayed active interaction about non-mathematics topics across the lessons. Ms. Morales listened to students' story and questions carefully and encouraged them to talk to her in mathematics class although it is not related to mathematics. Students asked their questions and expressed their reactions to non-mathematics topic without any restrictions. On the other hand, their interaction about mathematics topic was very limited. Ms. Morales ignored students' misunderstandings and errors, with-

held further explanations, comment or feedback, and emphasized practice more than conceptual understanding. Put differently, Ms. Morales did not adjust her instruction according to her interpretation of students' reactions. Or Ms. Morales's interpretation of her students' reaction was inappropriate. In addition, students did not ask their questions when they did not understand what Ms. Morales explained or questioned; and students did not ask further explanations when they had wrong answers. Students' reaction to Ms. Morales was giving up their questions. The interactions raise a number of questions for future research: how do both first-year teachers and students shape these interactions? What makes first-year teachers ignore students' reactions? What makes first-year teachers do not adjust their instruction according to students' reactions? What makes students passively and limitedly react to their interpretations of teachers' instruction?

While the current study does not answer these questions, it does speak to the fact that first-year teacher and students interactions in mathematics classroom is very different between mathematics topics and non-mathematics topics. It is possible that the same is true for expert teachers and their students but this study did not focus on those teachers and their student populations. Additionally, the previous literature discussed points to the impact of PCK, sociomathematical norms, cognitive demand of mathematics tasks, and discourse in mathematics classroom. While investigating all the possible cases that discuss first-year teacher instruction is beyond the scope of this paper, this research does give credence to teacher and students interaction being an important mechanism to consider. What is particularly interesting in this case is the gap of teacher and students interactions between mathematical topics and non-mathematical topics.

The interaction between Ms. Morales and her students about mathematics topics and non-mathematics topics in this mathematics classroom was quite consistent across many mathematics topics including: fractions, geometry and arithmetic. Ms. Morales' limited reactions about mathematics topics come possibly from her lack of mathematical knowledge and understanding students. As noted in the previous literature, Ms. Morales's lack of knowledge could limit and narrow her instruction (Leinhardt & Smith, 1985) and she could not predict if students understand the content or not, and assumed that students understand what she teaches in any way (Choe & Hwang, 2009). As previous researchers found those issues relate to the novice teachers' lack of PCK, as could be the case with Ms. Morales.

To reduce the gap of interactions between mathematics topic and non-mathematics topic in this class, Ms. Morales should have the chance to reflect on her instructional quality. Teachers' emotional support that is strong in Morales's class is usually improved during the school year in mathematics classroom but their instructional quality that directly relate to meaningful mathematics learning is not (Kim, 2012). The quality of mathematical interaction can be improved by teachers' intentional effort. To support first-year

teachers interaction like Ms. Morales, they should have opportunities to examine their interactions with students about mathematical topics deeply and separately from their emotional support for non-mathematical topics.

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