LANGUAGE GAMES IN ELEMENTARY STUDENTS' MATHEMATICS DISCOURSE:

UNDERSTANDING SOCIALLY CONSTRUCTED LANGUAGE AND TEACHING IMPLICATIONS

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OVERVIEW

This session is based on our recent publication in *For the Learning of Mathematics,* published in November of 2021. The full citation is in our reference list. In this session, we examine ways in which members of a mathematics classroom engaged in working towards understanding a mathematical situation. We use an episode between a fourth-grade student, a teacher, and a researcher. Our aim is to highlight the importance of interpreting language usage from the perspective of those involved in constructing everyday understanding. Using Wittgenstein's concept of language games (1953/2009), we highlight how each person comes to use the same words but reaches very different understandings of the situation. Conclusions for research are shared at the end.

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LANGUAGE GAMES

We build from Wittgenstein's (1953/2009) concept of language games. His concept refers to language in use and the actions associated with how language is woven into interactions and how language creates the opportunity for interactions to occur. Wittgenstein theorized that words, phrases, and sentences have meaning only due to the *rules of the game* that are being played out in interactions; thus, language is contextually oriented. To derive meaning when using with specific words or utterances, one must understand the rules to respond or make sense of the exchange.

A distinction must *be drawn* to understand the concept of language games–in playing a game, according to Wittgenstein, correct moves are determined while the game is being enacted or played out; thus, the meaning of words are found in their contextual usage (Kitchen, 2017). Take for example, our use of *be drawn* in the previous sentence; if the phrase were used in another context, one might assume that we are asking you to draw a picture. However, we used it to outline a clear distinction of Wittgenstein's ideas. Thus, to play a language game is to use the rules associated with using particular words and actions.

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THE EPISODE UNDER INVESTIGATION

This work is based upon a singular episode that took place in a fourth-grade classroom in the United States. It took place in a single mathematics lesson and lasted around three minutes. It was a part of a larger ethnography. At the time of the episode, students were in the middle of a review for their end-of-year assessments. The exchange took place around a multiplication problem that was a part of a larger conversation on using the box method, a common method associated with drawing a box and multiplying by place values of the multiplier and multiplicand and then adding the products of each. In the following slides, we share the dialogue between a student, teacher, and researcher.

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VIGNETTE PART 1

Researcher Notes: As I sat down next to James, I noted that he was working on three by two-digit multiplication, 684 × 12. I asked him to explain his process "James, can you walk me through what you are working on today?"

1. *James:* I am multiplying the bigger number *[pointing to 684]* by the smaller number *[pointing to 12].*

2. *Researcher:* Ok, can you show me what you do?

3. *James: [James drew a rectangle and then divided the rectangle into six squares.]* The first you got to do, every time for the box method, you draw a box. And then you got to put the big number on the top and the smaller number on the side.

4. *Researcher:* Ok, I think I follow you, but can you put the big number on the side and the small number on the top?

5. *James:* No, big number always goes on top because it is the bigger number *[He gestured to 684]*

6. *Researcher:* Ok, so now that we have this box and you told me where 684 goes, where does 12 go?

7. *James:* That's the small one so it goes here *[He gestured to the left side of the drawn rectangle.]*

8. *Researcher:* Ok, and we are sure?

9. *James:* Oh yeah, yup, that's the way we do it to get the correct answer.

10. *Researcher:* And the correct answer is important?

11. *James:* Well uh yeah, that's why we do this. Got to get them correct for the test.

12. *Researcher:* Ok, I see. So, what now? Is it all set up the way you want?

13. *James:* Yeah, we are ready to multiply the numbers and put it in the small boxes. *[He gestured to the boxes he had drawn in the rectangle.]*

14. *Researcher:* Ok, walk me through that part then.

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VIGNETTE PART 2

15. *James: [James gestured throughout the multiplication using the box method and carefully placed his solutions into the boxes.]* See, 600 times 10 is 6,000. *[Pointing proudly to the box that held his solution.]*

16. *Researcher:* Wow, that's a pretty large number. How did you do that?

17. *James:* Yeah, my brain is pretty good at those. I can just do them real quick. *[This was his first mention of 'his brain'.]*

18. *Researcher:* Can you tell me more about how you do that?

19. *James:* Well, it's pretty easy. The 600 has two zeros in it and the 10 has one. So, I just count the zeros really fast and that's three of them. And 6 times 1 well that's easy it's 6. Then I add the four zeros to the number and that's 6,000.

20. *Researcher:* Interesting way of thinking about that. *[James then completed the rest of his boxes.]* Ok, now the box is complete. Now what?

21. *James:* You got to add up this row *[Running his finger across the top row]* and this row *[Running his fin-ger across the bottom row. He added the rows.].*

22. *Researcher:* Ok, so now that you've added the rows, now what?

23. *James:* Now I just add these two numbers and we get the answer.

24. *Researcher:* Wow, so do you always do this method for multiplication?

25. *James:* Yup, I only use the box method. It's the best one for me.

26. *Researcher:* What do you mean by 'best one for you?'

27. *James:* My brain just works better with that strategy.

Researcher Notes: At this time Ms. Baker, the classroom teacher, walked by and James asked if she could look over his work.

28. *Ms. Baker:* Did you use the box method? You didn't do that last time. *[Two second pause.]* It doesn't mean you are wrong by doing it another way we just need to do it how it works best for us and how we can see it with our math brains.

29. *James* I know I know, 'do it how you see it in your brain.'

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LANGUAGE GAMES ACROSS POSITIONS

For the purposes of our session, we use the last five exchanges between the researcher, James, and Ms. Baker (turns 25—29 and provided below). We focus on the language game being played across the three positions that are made visible through the word 'brain' which is first used in turn 17 by James. The researcher's questions were aimed at understanding what the word meant in the context in which James had used it.

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LANGUAGE GAMES BETWEEN THE RESEARCHER AND JAMES - PART 1

In this episode, James begins a specific language game. The intent of the researcher was to understand James's rationale for using a specific method for multiplication. James responds to the researcher's prompts with "it is the best one for me" (turn 25). The researcher did not understand this usage of "best one for me." In viewing this exchange through the concept of language games, we can indicate that James used a phrase that was known to him in the context but was foreign to the researcher. From the perspective of the researcher, this is because he does know the rules of the game relating to this phrase. The researcher attempts to understand the rules by responding with "what do you mean?". James continues the game and offers a reference to "his brain" as a means to communicate his meaning of the phrase "best one for me." In turn 27, this language game is concluded due because Ms. Baker joins the exchange.

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LANGUAGE GAMES BETWEEN THE RESEARCHER AND JAMES - 2

Within this game, James is using certain words and phrases in interesting ways. When prompted to elaborate upon his usage of the phrase, he offers “his brain” as a response, but in such a way that is outside of his own body, almost as if he and his brain are two separate entities. He does this in a similar manner in turn 17. The researcher attempts to understand the rules for the use of his “brain” within the context of the episode, which is amplified by the larger context of the episode because the researcher was prompting James to provide details of the solution processes. However, even though the researcher did not understand the usage at the time, James was responding based upon how he understood such games are played.

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LANGUAGE GAMES BETWEEN JAMES AND MS. BAKER

Ms. Baker enters the exchange, and a new language game is played. James prompts Ms. Baker to examine his work. Ms. Baker outlines the rules for the new game by first asking a question. In the teacher's usage of an immediate proposition after the question, the language game becomes intertwined with a previous exchange. In terms of language games, Ms. Baker is using a previous game to outline the rules. Although she asked a question, it did not allow for a response; thus, the rules of using it in this particular game mean it as rhetorical in nature. This lack of opportunity is further characterized by the pause in the conversation. Although no words are spoken, it becomes part of the language game being played between the student and the teacher. Ms. Baker ends this pause by responding to an assumption James might have made about his novel use of the box method. This is evidenced by "it doesn't mean you are wrong by doing it another way." Ms. Baker has not yet looked at James' work, meaning this language game being played is not around his mathematical thinking but instead on his use of a particular method.

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CONCLUDING THOUGHTS

Language use plays an instrumental role in the ways and extent to which students come to understand mathematics. While language is at the core of learning mathematics (Sfard, 2015), some researchers note that learning mathematics means to also learn the language of mathematics (Pimm, 1987). Thus, language cannot be overlooked in mathematics education research. Here, we have attempted to provide insights into the importance of understanding the language in use from an insider perspective and to offer an opportunity to reflect on mathematics education research. This session highlights how language games can come to be understood in the context of mathematics classroom-based research. While we illuminate some of the rules from an insider perspective, this is just a snapshot. We cannot simply understand the mathematical language needed to learn mathematics, we must begin to understand how students, teachers, and even researchers socially construct the language games around learning mathematics.

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How often do we make assumptions of what a student might understand about mathematics based on our own interpretations of the situation or based on the language games we as educators might bring into the classroom?

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