

Introduction

- NCTM (2014) views students' mathematical struggles as "opportunities for delving more deeply into understanding the mathematical structure of problems and relationships among mathematical ideas, instead of simply seeking correct solutions" (p. 48).
- This study focused on investigating an opportunity for productive struggle (OPS) of prospective teachers (PTs) because they are the ones who will support productive struggle in learning mathematics (NCTM, 2014) in their future K-12 classes.

Literature Review

- How PTs facilitated productive struggle in their classes (e.g., Anthony, 2021; Rahman, 2022)
- PTs' productive struggle when engaging with high cognitive demand tasks (e.g., Ducloux et al., 2018; Zeybek, 2016)
- Research Gap: What we as a field do not know is how various PTs in a class respond to the same OPS.

Research Question

What do prospective mathematics teachers report having experienced when reflecting on their engagement in the same opportunity for productive struggle?

Theoretical Perspective

- Our research is based on a participationist perspective (Vygotsky, 1987) and Goldin's (2000) theoretical framework that described the relationships between affect and heuristics.
- We defined an Opportunity for Productive Struggle (OPS) to be a situation where:
 - the PTs were engaged in a *doing math* task (Stein et al., 1996)
 - the teacher had positioned the class to engage in, and was facilitating a discussion about, collaborative sense making of a peer's high-leverage contribution (Leatham et al., in press).

Acknowledgements

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References



Contact Information



Learners' feelings, such as frustration, did not predict the nature of their sense making in a mathematics method course.

Results & Discussion

PT	Reported feelings	Reported sense making as a result of the opportunity for productive struggle	Type of sense making
1	unsettled	"I know when I said increased by two each time I was talking about there [CNI*] and the problem was like a pattern inside a pattern...[the little pattern], was the little pattern in [the big pattern], was by twos and then the big obvious pattern wasn't by twos..."	mathematics
2**		"...I kept thinking this is an exponential because there needs to be an x in the exponent..."	
3		"I would just say I have learned about the importance of variables in an equation and like the importance of explaining your variables."	
4		"I would say that everything has structure. You just need to like dig a little deeper and find [the answer]. And then I, the problem will be easier."	
5	neutral	"...look carefully into the equations..."	mathematics
6	settled	"Like breaking apart student work and understanding the different parts"	mathematics
7		"...I was able to understand, um, what, like what the numbers meant in the equation, like what they represented"	
8a***		"I think like justification in mathematics, like an explanation. There needs to be a proper justification of like why it [CNI] works..."	
8b	settled	"...So I think thinking really deeply about like, clarifying questions I could ask if this was like a student of mine, or um, like asking questions that might get them to provide me with a proper justification..."	teaching
9	neutral	"...it's more like just good teaching practices than math itself...[for example:] What makes a good problem? What makes a bad problem?"	teaching
10	unsettled	"...[difficulty explaining equations to peers] is testing my patience a lot, which is good because I know that that will be pushed when I'm a teacher [because my students will also struggle to explain equations]"	teaching
11	unsettled	"...So [the discussion] was very nice; hearing other people's thought processes and ideas and trying to make sense of something that confuses me as well. ... when the entire class and the teacher agree[ed] with [me] [it increased my confidence]"	other
12	neutral	"...I would say [the course instructor] put a lot of emphasis on us knowing about exponential functions, and [the instructor] had us do an assignment..."	other

Notes: *CNI means cannot be inferred. **Bold indicates a PT in the secondary education program. ***PT8 reported two explicit pieces of information.

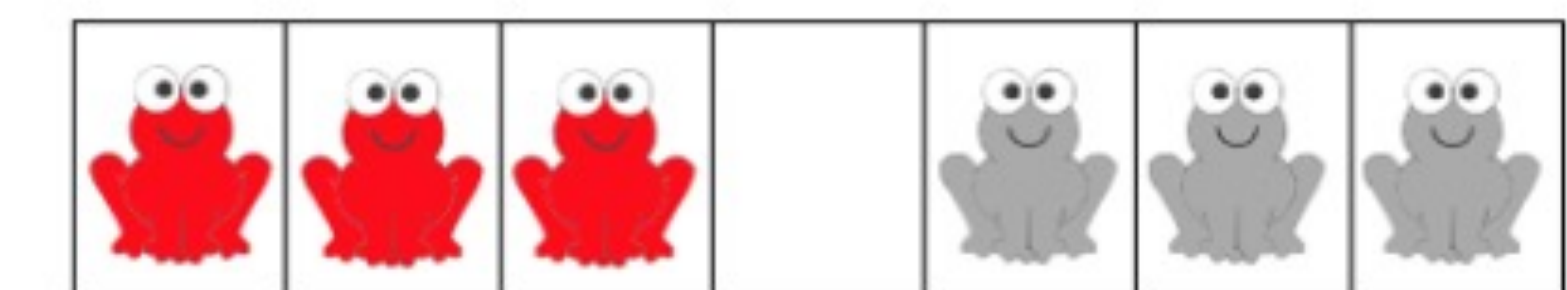
Methods

- This study investigated what 12 PTs in a middle school mathematics method course reported during a video-stimulated recall interview about their experiences when they were engaged in a doing math task (the Frog Problem) that yielded an OPS.

The Frog Problem Prompt

What is the fewest number of moves to switch each group of frogs from one side to the other? (Allowed moves are jumping over one frog to an empty spot or sliding to an adjacent empty spot.)

A Representation of Two Frog Teams of Size Three



- The researcher-identified OPS discussed in this study occurred at the beginning of the third session and was six minutes long. The PTs engaged in a conversation about the incorrect explanation from their peer.

The (Incorrect) Explanation that Initiated the Opportunity for Productive Struggle

The equation $[n^2 + 2n = m]$ works because the number of moves $[m]$ increases exponentially each time the amount of people $[n]$ increases by 2. And the $2n$ works because the difference in the number of moves increases by 2 each time.

- One researcher interviewed each PT around 30 minutes to ask them to describe what they were experiencing in this OPS (e.g., their feelings at that time) and what mathematics they made sense of as a result of that OPS.
- The authors independently coded the data, discussed the coding, developed code names and definitions, and refined them with the help of the faculty mentor (For code names, see the second column in the table to the left for PTs' feelings during the OPS and the fourth column for what PTs made sense of from the OPS).

Conclusion

Our finding that the PTs' feelings did not predict the nature of their sense making suggests that even when PTs feel unsettled, they can make sense of important mathematical and pedagogical concepts. This finding supports the idea that rushing in to relieve their struggle may undermine the benefits of high cognitive demand tasks (Warshauer, 2015).



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