A Preliminary Investigation into Prospective Teachers' Productive Struggles for Making Sense of Mathematical Practices

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Intro

- Struggle is perceived as a bad thing
- Productive struggle supports sense making for students (Peterson & Viramontes, 2017)
- Experiencing productive struggle may support teacher learning

Research Question

What struggles that prospective teachers encounter when engaging with the frog problem support them in making sense of mathematical practices (MPs)?

Methods

13 prospective teachers (PTs) engaged with a challenging problem (Frogs) and analyzed their experiences solving it in relation to the MPs.

Struggles were identified using the frameworks to the right (Kelemanik et al., 2016; Smith 2000; Washauer, 2015). Then, we identified whether those productive struggles helped PTs made sense of MPs by looking at their MP analysis documents.

Results

Below is the list of productive struggles that helped the PTs make sense of MPs:

Discussing

- different solutions with peers *(MP3 & MP6)*
- only some potential rules in the first half of the activity *(MP2, MP7 & MP8)*

Asking

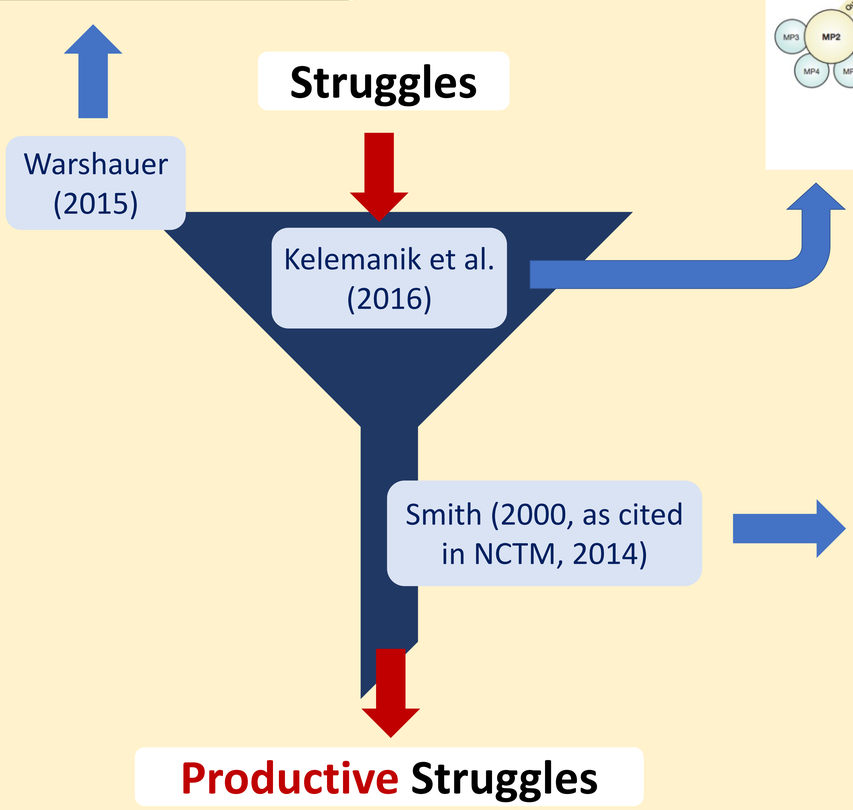
- about variables— What/Why/How *(MP2 & MP6)*
- whether [something] makes sense. *(MP1)*
- how to explain ideas to others *(MP3 & MP6)*
- about tools to help them solve the problem *(MP5)*

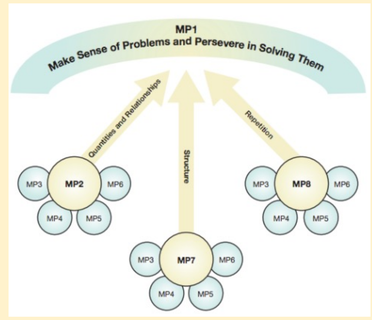
Generating

- equations *(MP4, MP7, & MP8)*
- precise record *(MP6)*

Generating **struggle related to mathematical practices** and providing time for prospective teachers to engage with that struggle **supported** them in **making sense** of those practices.

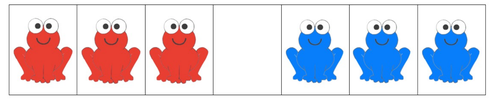
1. Get Started
2. Carry out a process
3. Uncertainty in explaining and sense-making
4. Express misconception and errors





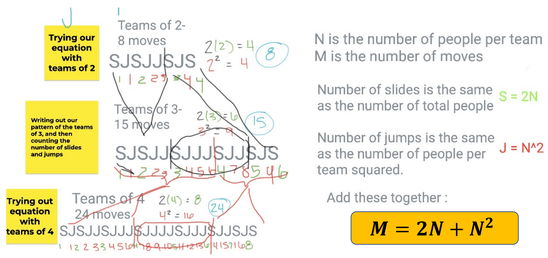
Expectations for students
Most tasks that promote reasoning and problem solving take time to solve, and frustration may occur, but perseverance in the face of initial difficulty is important.
Correct solutions are important, but so is being able to explain and discuss how one thought about and solved particular tasks.
Everyone has a responsibility and an obligation to make sense of mathematics by asking questions of peers and the teacher when he or she does not understand.
Diagrams, sketches, and hands-on materials are important tools to use in making sense of tasks.
Communicating about one's thinking during a task makes it possible for others to help that person make progress on the task.

Frog Problem



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.)*

Examples of Students' Solutions



Examples of Students' Struggles

Discussing different solutions with peers
S1: Alright, well. What did you guys think?
S2: For the least number of moves, or like...
S1: I guess so.
S2: Umm... I thought 15 was the least amount of moves
S3: We got 16
S1: I thought we had 14
S2: I don't remember.
S3: I thought it was 16, but umm I wrote it out. I drew it out. I used circles for one team and squares for the other. And then I used slide and jump and that's what I've done without going back.

Asking whether [something] makes sense
S1: Is this making sense S2?
S2: You're starting to lose me again
S1: Which part is confusing? It's confusing me. That's why I'm trying to see...
S2: Ok, so from the previous equation that we did. I understand that. For your $2 + n$, what part is that? Is that slide or jump?

Generating equation
S1: So, my question is with an equation? How could we write an equation that starts with a jump? Like usually is like $mx + b$ usually starts with b...
S2: I don't know yet.
S1: b is a usual way to start.
S2: So, maybe let's create rules. Like, we know that you have to start with a slide and then do a jump.
S1: And, anything more than one back track is gonna be a waste of moves.

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