A Proposed Extension to the Productive Struggle Framework

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Struggling with mathematics can be beneficial for students (Hiebert & Grouws, 2007). However, we need to ensure that student tasks are developmentally appropriate (Hiebert & Grouws, 2007). Productive struggle (PS) is "the space within which a student's struggle is likely to be productive" (Hiebert & Grouws, 2007, p. 388). PS hinges on the participant reaching a productive resolution, maintaining the intended level of cognitive demand, and completion or moving forward with the task (Warshauer, 2015a). PS also involves the risks of vulnerability and self-reflectivity, for both student and teacher (Murdoch et al., 2020).

The research question related to this poster asked: What pedagogical approaches could be used to support undergraduate developmental mathematics students as they work toward constructing fraction understandings that will be useful in college-level mathematics courses? Specifically, what pedagogical approaches support an environment such that a student productively struggles in a difficult fraction task during a teaching episode? By undergraduate developmental mathematics students, I mean undergraduate students who do not test ready for college-level mathematics.

In this poster, I share insights from a larger dissertation study in which I used a productive struggle (Warshauer, 2015a; 2015b) approach while conducting clinical interviews (Ginsberg, 1997) and teaching experiments (TE; Steffe & Thompson, 2000) to explore how undergraduate developmental mathematics students understood fractions. Vivian (pseudonym) was recruited from a randomly selected undergraduate developmental mathematics class at a large research university in the southern United States. Her TE was during fall 2023 and spring 2024. Data were analyzed through ongoing and retrospective analysis (Steffe & Thompson, 2000). Using subtasks as my unit of analysis, I applied the PS framework (Warshauer 2015a; 2015b) to identify instances of Vivian's struggles. Vivian had to express a struggle in some form, for a subtask to be classified as containing a struggle, consistent with Warshauer (2015a). Using Warshauer's (2015a; 2015b) framework, I identified Vivian's productive struggles, then classified the teaching response(s) and move(s) used during the tasks. Multiple codes were applied when present.

Through the coding process, I found that Vivian experienced PS during 24 of the 31 subtasks in her TE where she struggled. When coding Vivian's PS for teacher responses (Warshauer, 2015a) I found that one subtask received a telling response. Vivian received directed guidance during four subtasks, where she was given probing guidance during 17 subtasks. Vivian received an affordance response, such as acknowledgement or giving time, during subtasks. The results for teacher moves (Warshauer, 2015b) used during Vivian's PS revealed that she was asked questions during 20 subtasks. She received encouragement during six subtasks. Vivian was given time to work through 11 subtasks, and her mathematical thinking and effort were acknowledged during 3 subtasks. Unexpected results included the telling and directed guidance moves, but they were productive when Vivian was reiterating the task prompt or being redirected back to the task goals. Additionally, Vivian had two unproductive struggles that remained unresolved when she chose to shift the focus of her solution strategy for a task, showing a potential extension to the PS framework (Warshauer, 2015a; 2015b) by adding an additional ending to an episode of struggle.

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