

RELATIONSHIP BETWEEN NOT KNOWING AND SUCCESSFUL PROBLEM SOLVING AMONG PRE-SERVICE SECONDARY MATHEMATICS TEACHERS

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Conceptual Perspective and Research Questions

Mason and Spence (1999) state that “awareness of knowing and of not knowing is crucial to successful mathematical thinking” (p. 147). Synthesizing few studies on the topic of not knowing, one may conclude that not knowing is a step to understanding, carrying an important value in learning because from it knowing can follow. In our previous study, we found that students have difficulty externalizing not knowing while solving reasoning tasks (Author, 2019). Taking it further, in this study we are examining the following *research questions*: does the complexity of task relate to students’ externalization of not knowing? to what extent students’ not knowing is associated with successful problem solving?

Methodology

This study employed quantitative methodology. Pre-service secondary mathematics teachers (N=116) enrolled in a math methods course were selected for the study. The problem solving protocol was used to collect student written work while solving connected algebraic reasoning tasks. The protocol consisted of two instructions: a) solve the given task, and b) describe what you are not-knowing while solving the task. The tasks were designed based on the same concept of weighted average in numerical (task 1), semi-abstract (task 2), and abstract (task 3) contexts. Students’ demographics data was also collected including grade point averages in discipline-specific coursework (M-GPA) as well as in pedagogy-related coursework (P-GPA). Each task was graded using the following levels: 1) no solution provided, 2) incorrect solution, 3) partially correct solution, and 4) correct solution. Along with this, students’ externalization of not knowing while solving each task was rated using the following levels: 1) ignorance, 2) deflection, 3) non-relational not knowing, and 4) relational not knowing. The data was analyzed using descriptive statistics.

Results

In response to the research question 1, we found that complexity of the task relates to the level of students’ externalization of not knowing. More specifically, if the task is too easy (task 1), the correlation between correctness of task and externalization of not knowing is negative $r=-.01$ ($p>.05$). As complexity of the task rises from numerical to semi-abstract level (task 2), the correlation becomes practically significant ($r=.16$, $p<.10$). However, as the task becomes more complex (task 3) the correlation coefficient decreases in value and significance ($r=.03$, $p>.05$). Another observation revealed significant correlation between students’ externalization of not knowing for tasks 2 and 3 ($r=.53$, $p<.01$). In response to the research question 2, the study findings showed significant correlation between students’ overall successful problem solving on all three tasks and not knowing expressed while solving the tasks ($r=.37$, $p<.01$). Moreover, students’ discipline specific M-GPA was significantly related to their overall problem solving performance ($r=.35$, $p<.01$) whereas the pedagogy-related P-GPA was significantly associated with students’ externalization of not knowing ($r=.28$, $p<.01$).

The study results might serve as a stepping-stone to further research not knowing, as it may directly link to more effective and efficient student learning.

Relationship between not knowing and successful problem solving among pre-service secondary mathematics teachers

References

- Bjork, R. A., & Kroll, J. F. (2015). Desirable difficulties in vocabulary learning. *The American Journal of Psychology*, 128(2), 241-252.
- Mason, J. & Spence, M. (1999). Beyond mere knowledge of mathematics: The importance of knowing-to act in the moment. *Educational Studies in Mathematics*, 38, 135-161.