## Students' Responses to Differing Prompts for Reasoning and Proof Tasks

Jihye Hwang	Shiv Smith Karunakaran
Michigan State University	Michigan State University

Students are engaged in various reasoning and proving tasks corresponding to the increased emphasis on reasoning and proving in mathematics education. Students routinely encounter differing language present in prompts for these reasoning and proving tasks. The semantic meaning of the language used in these prompts is not usually explicitly discussed and thus may cause inconsistencies in students' responses to these tasks and in the assessment of their work. The preliminary results imply Calculus I students have various conceptions for prompts such as "prove", "explain", "show", and "convince". This poster will focus on students' various conceptions on the two prompts "prove" and "show."

## Keywords: Proving, Reasoning, Prompts

The mathematics and mathematics education community have emphasized the importance of reasoning and proving across the K–16 levels. As a result, curricula and research have asked how students understand reasoning and proving (Harel & Sowder, 1998; Knuth, Choppin, & Bieda, 2009; Weber & Alcock, 2004). Students face differing language within these prompts—such as "prove", "explain", "show", "convince", etc.—both in textbooks and research tasks (Knuth et al., 2009; Otten, Gilbertson, Males, & Clark, 2014). As the semantic meaning of these prompts is not explicitly discussed, researchers have raised questions about the perceived differences between these prompts. For example, a teacher might expect either rigorous proof, or a causal argument when they asks students to "explain" their reasoning (Dreyfus, 1999; Hersh, 1993). Dreyfus (1999) also questioned whether the prompt "show", asks students to generate an actual mathematical proof, or examine some examples. In keeping with such research, we hypothesized that there may be differences in students' responses to each type of prompt. These differences, then, might cause inconsistencies in students' learning, and in the assessment of students' work.

This poster presents preliminary findings based on a study with the following research question: *How differently do Calculus I students perceive and respond to different prompts, such as "prove", "explain", "show", and "convince", for reasoning and proving tasks?* The survey data was collected from 131 students enrolled in a Calculus I course at a large public university in the Midwest United States. The survey consisted of three parts: the students' academic background, questions to choose hypothetical prompts based on given arguments, and Likert–type questions regarding the perceived meanings of these differing prompts.

The preliminary findings indicate the existence of differences in meanings for students for different prompts. Among results, we want to focus on the prompts "prove" and "show" for this poster. Although some students (26.7%) considered "prove" and "show" as synonyms, aligning with mathematicians' understanding of the two prompts as synonyms (Alcock, 2013), the majority of students (55.7%) regarded the prompts "prove" and "show" as different. Some students considered these two prompts to be distinct, and a second group of students thought the meanings of these prompts to have an intersection, but also that each have independent characteristics. Across the data, the students' responses imply that presenting some examples is enough for the prompt "show". This inconsistency in students' responses challenges the notion that students may perceive "prove" and "show" as synonyms and justifies further research on students' perception of the language used for prompts of reasoning and proving tasks.

## References

- Alcock, L. (2013). *How to study as a mathematics major*. Oxford, England: Oxford University Press.
- Dreyfus, T. (1999). Why Johnny can't prove (with apologies to Morris Kline). *Educational Studies in Mathematics*, *38*, 85–109. https://doi.org/10.1023/A:1003660018579
- Harel, G., & Sowder, L. (1998). Students' proof schemes: Results from exploratory studies. *CBMS Research in Collegiate Mathematics Education. III*.
- Hersh, R. (1993). Proving is convincing and explaining. *Educational Studies in Mathematics*, 24(4), 389–399. https://doi.org/10.1007/BF01273372
- Knuth, E. J., Choppin, J. M., & Bieda, K. (2009). Middle school students' production of mathematical justifications. In D. A. Stylianou, M. L. Blanton, & E. J. Knuth (Eds.), *Teaching and learning proof across the grades: A K–16 perspective* (pp. 153–170). New York, NY: Routledge.
- Otten, S., Gilbertson, N. J., Males, L. M., & Clark, D. L. (2014). The mathematical nature of reasoning-and-proving opportunities in geometry textbooks. *Mathematical Thinking and Learning*, *16*(1), 51–79. https://doi.org/10.1080/10986065.2014.857802
- Weber, K., & Alcock, L. (2004). Semantic and syntactic proof productions. *Educational Studies in Mathematics*, 563(2), 209–234. Retrieved from http://www.jstor.org/stable/4150282