Characterizing Self-explanations for Undergraduate Proof Comprehension

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A study was conducted with 11 undergraduate students in a real analysis course to further investigate important results reported by Hodds, Alcock, and Inglis (2014) on self-explanation and undergraduate proof comprehension, and by Ainsworth, S., & Burcham, S. (2007) on self-explanation and textual coherence. The main product of the current study is a framework of self-explanations in proof comprehension that takes into account students' questions as they self-explain both high and low coherence proofs.

Self-explanations are explanations of textual material generated *by* the student *for* the student that attempt to aid comprehension. Students can be taught to self-explain and can realize the same benefits as those that do so spontaneously (Chi et al. 1994) especially in domains like mathematics (Rittle-Johnson, B., & Loehr, A. M. 2016). Hodds, Alcock, and Inglis (2014) replicated the self-explanation effect for proof comprehension in undergraduate mathematics. Based on previous research, Hodds et al. described three categories of self explanations (Principle-Based, Goal-Driven, and Noticing Coherence) and four categories of non-explanations (Paraphrasing, False Explanation, Positive Monitoring, and Negative Monitoring).

While these categories reveal important distinctions between undergraduate self-explanations, we argue that they are too broad. Although participants who were trained to self-explain saw greater scores on a proof comprehension test, they still produced the same amount of Paraphrasing and False Explanations as those who were not. Additionally, the proofs provided to participants did not vary in textual coherence (a text can be made more or less coherent depending on the degree to which it makes inferences between ideas and connections to textual goals explicit). While Ainsworth and Burcham (2007) showed that minimally coherent texts elicited different self explanations compared to maximally coherent texts, Hodds, Alcock, and Inglis (2014) used only minimally coherent proofs in their study. However, undergraduate students encounter proofs that are not minimally coherent, particularly in lectures and textbooks.

We explore the following questions: What are some of the different types of questions/self explanations that students generate when reading low- and high-coherence proofs, after going through a self-explanation training? How do these types relate to previous self explanation frameworks? In this study, 11 undergraduate students in a real analysis course received self-explanation training and were audio recorded as they modeled the self-explanation strategy out loud, with both low and high coherence proofs. Their self-explanations and questioning behaviors were used to create a framework based off of Hodds et al. (2014) that allows for a more nuanced consideration of self explanation types. For example, a statement in a proof such as *Since object O has properties A, B, and C,* was often followed by: "I see why we need properties A and B, but why was C necessary?" This kind of self-explanation has attributes of a Goal-Driven self-explanation, but it's not really related to the structure of the proof as a whole (as defined by Hodds et al., 2014). Furthermore, since more coherent proofs would be more likely to include this information, the level of coherence of the proof seemed to influence the extent to which this type of self-explanation was produced.

References

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