The Distribution of the Mathematical Work during One-on-one Tutor Problem Solving

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Undergraduate math tutoring is an important context for student learning, yet little empirical work has been done to understand tutor-student interactions. Using frameworks for problem-solving and socially mediated metacognition (Carlson and Bloom, 2005; Goos, et. al, 2002), this poster examines who guides the development of mathematical ideas throughout the problem solving process within a drop-in one-on-one tutoring context. We found that the majority of the tutoring interactions closely followed the Orienting-Planning-Executing-Checking phases of problem solving. The "Executing" phase had the highest degree of student contribution, while the "Checking" phase was least represented.

Keywords: Undergraduate Tutoring, Problem Solving, Socially Mediated Metacognition

Peer undergraduate mathematics tutoring is widespread (Sonnert & Sadler, 2015) and has been shown to lead to significant learning gains for both tutors and students (Graesser, 2011; Lepper & Woolverton, 2002). However, empirical investigation of tutor-student interactions has been minimal (Roscoe & Chi, 2008), particularly at the undergraduate level. Given the lack of theoretical development in this area, our understanding of tutoring interactions can be framed by modifying lenses developed for other contexts. For example, we draw heavily on best practices for teaching, which strongly emphasize the importance of active learning (Larsen et. al, 2015; Freeman et. al, 2014; Topping 1996). In addition, the majority of math tutor interactions, particularly in a drop-in context, are based on solving homework problems. Thus, frameworks for problem solving, such as Carlson and Bloom's (2005) are useful for understanding the progression of the tutor-student interaction. We are interested in understanding the problem-solving process in a tutor-student interaction. In particular, this poster focuses on who guides the mathematics in the interaction, and how that shifts during the problem-solving process.

Data for this study was drawn from 18 undergraduate math tutors at two different universities in a drop-in tutoring environment. Tutoring sessions were recorded using video or scribe-cast. Data for this analysis was based on 6 episodes. The episodes were selected based on their clarity and focus on a problem-solving context. We coded transcripts according to two frameworks. First, we identified the problem solving phase: (1) Orienting, (2) Planning, (3) Executing, or (4) Checking (Carlson and Bloom, 2005). Next, within each phase we identified how the mathematics was being presented or developed. We modified Goos, Galbraith, and Renshaw's (2002) coding scheme for socially mediated metacognition to include kinds of interaction (Explain, Answer, Question, Correct, or Reflect) and types of mathematics for those interactions (Information, Strategy, Concept, or Computation).

We found that many of the tutor-student interactions closely followed the problem-solving cycle proposed by Carlson and Bloom (2005). The "Checking" phase was least represented in our episodes: commonly a single line or completely absent. Across the episodes, the "Planning" phase had the most variation in the level of student participation; either entirely planned by the tutor or planned cooperatively between the dyad. The "Executing" phase had the most consistent student mathematical contributions. This study indicates a need for tutor training that elicits student mathematical contributions at every stage of the problem solving process.

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