ABSTRACT

Inquiry-based mathematics instruction with collaborative reasoning and problem-solving necessitates opportunities for rich discourse as students make and test conjectures, explain their reasoning, and critique the reasoning of others. This discourse occurs in an environment where participants feel safe to try out ideas and learn from mistakes. Research in mathematics education includes many frameworks and strategies for encouraging discourse in face-to-face settings. Orchestrating such discourse presents a unique challenge in online settings where discourse usually takes the form of discussions about shared readings or experiences rather than collaborative problem-solving of a mathematical task. Examples of strategies and tools for orchestrating discourse during mathematics problem-solving in a graduate program for K-5 teachers that meets in both synchronous and asynchronous environments are shared. This is followed by a discussion of the affordances and constraints of supporting discourse in online settings. Finally, recommendations for instruction and directions for future research are suggested.
Strategies and Tools for Promoting Discourse During Mathematics Problem-Solving in Online Settings

INTRODUCTION

Inquiry based mathematics instruction with collaborative reasoning and problem-solving necessitates opportunities for rich discourse as students make and test conjectures, explain their reasoning, and critique the reasoning of others. Discussions occur in an environment where participants feel safe to try out ideas and learn from mistakes. Orchestrating such discourse presents a unique challenge in online settings where communication usually takes the form of discussions about shared readings or experiences rather than collaborative problem-solving of a mathematical task. This chapter presents strategies and tools for orchestrating discourse during mathematics problem-solving in both synchronous and asynchronous environments.

All of the tasks and tools discussed in this chapter are from courses in the North Carolina Elementary Add-on Licensure Program (EMAoL). A planning team of faculty from seven universities, representatives from the NC Department of Public Instruction, and LEA representatives worked collaboratively to establish and pilot the program from 2009-2011. In addition, an eighth university joined the consortium of universities offering the program. Currently, statewide implementation is occurring with universities working both individually and in collaborative teams to offer the courses in the program of study.

Each of six graduate-level courses (See Table 1) for practicing K-5 teachers was designed around a high-leverage teaching practice, a primary mathematics content area focus (approximately 80%), and a secondary mathematics focus (approximately 20%). The primary mathematics focus serves as a context for exploring the high-leverage practice and the secondary mathematics focus serves to exemplify how the high-leverage practice can be applied across content domains (Rachlin, 2013).

A second cohort of students completed the program in 2012-2013 and courses were redesigned and transitioned to a blended synchronous/asynchronous online format (Schwartz, Morge, Rachlin, & Hargrove, 2017). The courses are a mix of asynchronous courses and blended online (Sharma & Barrett, 2007) courses with bi-weekly synchronous online sessions and asynchronous modules completed in between sessions. In both synchronous and asynchronous settings, the faculty have been committed to promoting a high-level of participant interaction through discourse. Both synchronous and asynchronous courses use programs such as Blackboard and Canvas to deliver course content. Synchronous courses also use a web conferencing application such as SabaMeeting, WebEx or Zoom to engage students in real-time discussions.

Table 1. Foci of six courses in the EMAoL program

<table>
<thead>
<tr>
<th>High-Leverage Teaching Practice</th>
<th>Mathematics Content</th>
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| Selecting, Designing, and Using Mathematical Tasks | Primary: Number Systems and Operations  
Secondary: Number Theory and Rational Numbers  |
| Understanding and Applying Knowledge of Learning Trajectories | Primary: Rational Number and Operations  
Secondary: Measurement  |
| Orchestrating Classroom Interactions | Primary: Data Analysis  
Secondary: Measurement  |
| Fostering Reasoning through Discourse and Questioning | Primary: Algebraic Thinking  
Secondary: Number Systems and Operations  |
| Assessing Student Knowledge | Primary: Geometry and Spatial Visualization  
Secondary: Early Number Concepts  |
| Helping Teachers Develop as School-based Leaders | Primary: Mathematical Modeling  
Secondary: Connecting Number to Algebra  |
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