Chapter 15
Facilitating Mathematical Discourse in Online Learning Environments

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ABSTRACT
Facilitating meaningful mathematical discourse in an online setting can be a challenge for instructors. The purpose of this chapter is to analyze an instructor’s discourse interventions to encourage mathematical discourse in online asynchronous discussions in an analysis course for secondary mathematics teachers (SMTs). The SMTs were required to participate in the discussions and encouraged to ask/answer questions, share/compare their ideas, and explain their thinking/answers. Instructor responses were analyzed using both Mazzolini and Maddison’s four categories of response the respect to instructor intervention—(1) question, (2) answer, (3) mix of answer and question, and (4) other—and Simonsen and Banfield’s five recurring categories—(1) resolve, (2) validate, (3) redirect, (4) expand, and (5) withhold. With respect to instructor intervention, the author suggests mainly withholding from responding and to use expand, redirect, question, or mix if necessary to encourage mathematical discourse.

INTRODUCTION
Facilitating meaningful mathematical discourse is an important goal in mathematics education. With the increase in the number of online education courses offered in mathematics, engaging online students in meaningful discourse is just as important as discourse in face-to-face classes. Online delivery in these courses have included both synchronous and asynchronous communication via Internet technologies. In an asynchronous online course, the asynchronous discussion forum would replace the classroom interactions and the instructor would facilitate the discourse.

The focus of this study is to analyze an instructor’s discourse interventions to encourage mathematical discourse in online asynchronous discussions in an analysis course for secondary mathematics teachers (SMTs). The course used a completely asynchronous model of distance delivery and the SMTs were

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encouraged to ask/answer questions, share/compare their ideas, and explain their thinking/answers. Instructor responses were analyzed using both Mazzolini and Maddison’s (2005) four categories and Simonsen and Banfield (2006) five categories of response with respect to instructor intervention.

BACKGROUND

“Mathematical discourse includes the purposeful exchange of ideas through classroom discussion, as well as through other forms of verbal, visual, and written communication (NCTM 1991, 2000).” The discourse in the mathematics classroom allows students to share ideas and clarify understandings, construct convincing arguments, develop a language for expressing mathematical ideas, and learn to see things from other perspectives. Facilitating this type of mathematical discourse to online settings can be just as challenging as it is to create in traditional classrooms. In traditional classrooms, the teacher’s role in facilitating discourse is to engage students in sharing mathematical ideas, orchestrate student approaches and solution strategies, and ensure progress towards mathematical ideas (NCTM). Students who take mathematics courses that use asynchronous communication are essentially forced to engage in some level of mathematical discourse as a requirement of the course (Simonsen & Banfield, 2006). The role of the online instructor, however, impacts the facilitation of the discourse.

At one time, the role that instructors should play was thought to be “ambiguous and largely untested” (Easton, 2003, p. 87). Other researchers, however, propose that an instructor should take the “Socratic approach” (MacKnight, 2000) or play a more active role earlier in the course’ (Gold, 2001) or play the ‘’sage on the stage’ (Mazzolini & Maddison, 2003), or take a constructivist approach (Chinnappan, 2006; Gold, 2001; Shackelford & Maxwell, 2012). Literature on the role of online instructors in fostering discourse also encourages creating and facilitating learning environments that are collaborative, inquiry-based and student centered (Carey, Kleiman, Russell, Venable, & Louie, 2008; Chinnappan, 2006; Zhou & Stahl, 2007).

Various methods to classify how instructors participate and intervene in the online discussions have also been addressed in the literature (See e.g., An, Shin, & Lim, 2009; Mazzolini & Maddison, 2005; Simonsen & Banfield, 2006). The two instructor intervention classifications that are used in this study are highlighted in this section. In their study on instructor participation rates, Mazzolini and Maddison (2005) found that the frequency, timing (during or at the end of a forum), and nature of online instructors’ postings can influence students’ participation and perception in unexpected ways. An increase in the number of postings by the instructor led to a decrease in the number of postings by the students and to shorter discussion threads. The timing of the instructors’ posts did not have an impact on student participation but instructors who posted frequently and towards the end of a forum received higher scores for enthusiasm. Mazzolini and Maddison classified each instructor’s posting as either a question, answer, combination of both, or other. They found that while 68% of the postings were answers to students’ questions, the nature of the posting did not impact students’ participation but one-third of the students appreciated when instructors asked questions in the forums.

A constant comparative analysis of instructor discourse interventions in online asynchronous discussions in a statistics course by Simonsen and Banfield (2006) revealed five recurring categories of instructor intervention: (1) resolve (28%), (2) validate (28%), (3) redirect (11%), (4) expand (33%), and (5) withhold. Out of the 1,151 messages posted, the instructors responded 134 times accounting for 27% of the total response opportunities, meaning they withheld 73% of the time. They suggest that