Argumentative Knowledge Construction in an Online Graduate Mathematics Course: A Case Study

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ABSTRACT

The authors report on three students’ argumentative knowledge construction in an asynchronous online graduate level geometry course designed for in-service secondary mathematics (ISM) teachers. Using Weinberger and Fischer’s framework, they analyzed the ISM teachers’ a) geometry autobiography and b) discussion board posts (both comments and attached work including solutions to assigned problems and Geometric Sketchpad explorations) throughout an 8-week summer course. The goal was to better understand the key similarities and differences in the nature of their interaction with each other and the course content that may have contributed to the differences in their knowledge construction. Findings led researchers to re-conceptualize a rubric to (1) assist instructors in facilitating productive interaction among students, (2) prepare students to better utilize the discussion board with a critical eye, and (3) provide specific guidelines for a more productive engagement among students, using the framework as a guide.

KEYWORDS

Argumentative Knowledge Construction, Asynchronous, Discussion Board, Mathematics Teaching, Online Instruction

INTRODUCTION

The landscape in higher education has been increasingly moving toward online education (Lin, Dyer, & Guo, 2012; Sloan Consortium Survey, 2008). Because of the convenience fully online courses (synchronous and asynchronous) are progressively becoming more popular (Sullivan, 2001), particularly among professionals interested in advancing their education. In-service teachers are no exception (Hull & Saxon, 2009). In asynchronous courses, one of the most commonly used ways in which students interact with each other is via discussion board posts.

Studies have shown that both online instructors and students “continue to face some unique demands including the “whys” and “hows” of online teaching” (Lin et al. 2012, p. 1). Several studies have-addressed the challenges that online instructors face (e.g., Godwin-Jones, 2012; Ko & Rossen, 2010; Koehler & Mishra, 2009; Moore, 1989; Moore & Kearslev, 2012; Osika, Johnson, & Buteau, 2009) but a limited number of studies focus on students’ perspectives. The researchers Marttunen and Laurinen (2001) and Stegmann, Weinberger, and Fischer (2007) are among few who investigated how online instruction may affect the students’ experiences. Marttunen and Laurinen (2001) argued that because learners have more time and flexibility to formulate their arguments, asynchronous

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experiences such as discussion board posts might better facilitate knowledge construction. On the other hand, Stegmann et al. (2007) argued that, although “online discussions provide opportunities for learners to engage in argumentative debate, learners rarely formulate well-grounded arguments or benefit individually from participating in online discussions” (p. 421). In their research where they tried using computer-supported scripts to support discourse activities, they concluded that “scripts facilitate the acquisition of knowledge on argumentation without affecting the acquisition of domain-specific knowledge” (p. 421). The characteristics of scripts, particularly external scripts, which facilitate the acquisition of domain-specific knowledge remain to be seen (Fischer, Kollar, Stegmann, & Wecker, 2013).

We, a mathematician and two mathematics teacher educators, became curious and wanted to examine the dynamics of students’ interaction among each other and with the course material in a graduate-level geometry course that was delivered fully online. Our motivation was the belief that if we could better understand the dynamics of how students’ interactions led to learning in an online environment, we could improve our facilitation and guidance for optimal online learning. This geometry course is a part of a fully online Master of Education (M.Ed.) program for secondary mathematics teachers in the southeastern part of the United States of America. The course utilizes a textbook (Reynolds & Fenton, 2011) that was developed based on APOS theory (Arnon et al., 2014; Asiala et al., 1996), a particular learning theory intended to foster students’ understanding of geometrical concepts via a set of guided investigative activities completed with Geometer’s Sketchpad. For the purpose of this study, we asked the following research questions to better understand the knowledge construction process and identify repeated practices among the students in an asynchronous online mathematics course:

- What is the nature of student interactions with each other and with the course content on a discussion board?
- How do these interactions contribute to individual knowledge acquisition?

We identified with and employed Weinberger and Fischer’s (2006) argumentative knowledge construction (AKC) framework to analyze the construction and reconstruction of knowledge during students’ interactions on the discussion board within our computer-supported collaborative learning environment. AKC is proved to be a “useful framework for analyzing collaborative online activity as it emphasizes the role of social activity in negotiating meanings relevant to the learning task” (Teo & Johri, 2013, p. 470). Moreover, mathematics being the context of this study made AKC even a better fit for it as the core of learning mathematics relies on construction of arguments and counterarguments, balancing arguments and supporting them with evidences and logical reasoning.

THEORETICAL FRAMEWORK

In this study, we looked at the data with guidance from Weinberger and Fischer’s (2006) framework to analyze argumentative knowledge construction in our computer-supported collaborative learning environment. According to this framework, there are four dimensions that may “…extend and refine our understanding of what kind of student discourse contributes to individual knowledge acquisition…” (p. 73). participation, epistemic, argument, and social modes of argumentative knowledge construction. We also used this multidimensional approach to analyze the interaction of students on the discussion board and identify the argumentative knowledge construction process. Below we present the categories and provide brief descriptions of the four dimensions.
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