

Student Engagement in Online Calculus 1: Cognitive and Social Dimensions

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At the university level and in STEM fields students' drop out in part due to not being able to pass mathematics courses, particularly Calculus I. According to the Mathematical Association of America (MAA), Calculus I occupies a unique position as a gateway course to STEM degrees. Almost all STEM majors need to take at least the first course in Calculus. Hence, there is the need to understand how to create successful Calculus courses, particularly in online settings. This study examines the ways students engage with the mathematical content, each other and the course while learning about the concept of derivative in an asynchronous online Calculus I course. The purpose of this research is to investigate the nature of students' cognitive and social engagement in an asynchronous online Calculus I course.

Methods

In this qualitative study, we investigate the question, What is the nature of students' (a) cognitive, and (b) social engagement as they learn about limits and derivatives in an interactive asynchronous online calculus 1 course?

We analyzed weekly discussion posts from 23 participants for evidence of argumentation (Toulmin, 1958) and social presence (Swan & Shih, 2005) to learn about students' cognitive investment with mathematical content and ways of interacting with each other, respectively. We also drew on features of the learning management system used to facilitate the course to understand students' behaviors. Additionally, transcripts from interviews with six students were analyzed to further understand student engagement during the course.

Results & Conclusion

In general, students' initial posts to discussion boards almost always contained evidence of cognitive engagement in the form of components of mathematical arguments; however, dramatic differences in whether replies to initial posts contained components of mathematical arguments occurred. We found that the cognitive demand (Smith & Stein, 1998) of the prompt influenced whether reply posts contained evidence of cognitive engagement. Specifically, high-demand tasks tended to yield replies with components of mathematical argumentation more often than low-demand tasks. Regarding social engagement, students tended to participate in more back-and-forth interactions when they were assigned to small discussion groups. We also noted that the composition of initial posts could influence whether other students replied. Specifically, when initial posts involved a level of uncertainty from the original author, classmates tended to reply more often. Results from this study demonstrate the importance of conceptualizing student engagement as a multidimensional construct, and indicate that pedagogical practices such as using high-cognitive demand tasks, promoting rough draft thinking (Jansen, 2020), and grouping students for online discussions will promote student engagement and learning in asynchronous online courses.

References

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