

Exploring Student Experiences in Calculus I: The Impact of Inquiry-Based Versus Lecture-Based Instruction on Math Anxiety

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Math anxiety affects student learning and academic performance, causing physical, mental, and emotional symptoms (Ashcraft, 2002; Mattarella-Micke et al., 2011; Ruffins, 2007). Math-anxious individuals may dislike math and take fewer math courses, ultimately avoiding math and math-related courses (Hembree, 1990). Due to this significant impact, it is essential to diagnose the causes of math anxiety and determine potential interventions to reduce math anxiety. As such, this study investigated the effects of inquiry-based learning (IBL) vs. lecture-based instruction on Calculus I students' math anxiety through the following research questions.

1. What have been students' experiences and perceptions of taking Calculus I in an online setting via IBL or lecture-based instruction?
2. How and to what extent do these experiences and perceptions influence math anxiety?

Methodology

Sequential Explanatory Mixed Methods Design was employed to investigate quantitative and qualitative research questions. Since the data were predominantly collected through one-on-one online interviews, this study fits more into a qualitative research study.

Participants, Data Collection, and Data Analysis

The sample of this study comprised of students who were enrolled in the Calculus I course and were taught using either IBL or lecture-based instruction during Spring 2021 at a university located in the Midwestern United States. Students who received IBL instruction were in the IBL group, and those who received lectures were in a lecture-based group.

A short version of the Mathematics Anxiety Rating Scale (MARS-S) developed by Suinn and Winston (2003) was used to collect the quantitative data from 15 IBL and 20 lecture-based students. Based on the change in their anxiety scores from pre- to post-MARS-S survey, 9 students from the IBL group and 3 from the lecture-based group were selected and interviewed via Zoom. Quantitative data were analyzed using the SPSS, and qualitative data were analyzed using the NVivo software.

Findings and Implications

Results show that the activities, such as collaborative work, optional and ungraded homework, and the instructor's anytime readiness to meet with his students, decreased IBL students' anxiety, whereas the instructor's readiness to reexplain the material in class and recitation classes by the teaching assistant decreased lecture-based students' anxiety. However, the tests and exams, anticipating the instructor's call for a response, and responding to instructor's questions in front of their peers increased anxiety among both groups of students. Moreover, students with IBL experience felt more confident and empowered compared to the lecture-based learning experience.

Reflecting on students' increased anxiety taking tests, it might be worth considering more group-based assignments and fewer in-class tests. Also, since IBL developed confidence and critical thinking among students, implementing an IBL in math teaching might be worth it.

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