The Effect of an Activity-Based Quantitative Reasoning Course on Students' Perspectives About Mathematics

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Previous studies identify that student-centered approaches to teaching and learning result in academic outcomes that are as good or better than more traditional lecture-based approaches and that the positive effect is more evident for previously low-achieving students (Freeman et al., 2014; Kogan & Laursen et al., 2014). These results have driven change efforts toward course design and content delivery in introductory mathematics courses nationwide (Smith et al., 2021). In light of such results, we redesigned our non-STEM quantitative reasoning course to be activity-based and interactive. Studies also investigate students' attitudes in a variety of active learning courses including calculus and linear algebra (Duran et al., 2022; Murphy et al., 2015). We aim to know whether students in our quantitative reasoning course, who often hold a negative view and prior experience with math, have changed perspectives after completing the course. In particular, has this course impacted students' views about mathematics, learning, and the relevancy of mathematics to their lives?

The redesigned course, *Mathematical Investigations*, is required for all students at our institution seeking a 4-year degree that is not in a Bachelor of Science or Bachelor of Business Administration program. Approximately 200-250 students enroll in the course each semester. The sections are capped at 25 students and are primarily taught in person by full-time, non-tenure-track faculty with some sections offered on a satellite campus and others offered asynchronously online. In Fall 2020, we introduced the course redesign which transformed our traditional, computational, lecture-based course to a course that emphasizes relevant, real-world applications through classroom activities and course projects. We collected anonymous responses to identical pre-course and post-course surveys to informally gauge the effectiveness of the redesigned course. After early indicators of success, we shifted to distributing the surveys through Qualtrics, using personalized 5-digit codes to link the anonymous pre-course survey responses to the individual's anonymous post-course survey responses.

The complete survey includes three open-response questions and seven Likert scale questions. Across four semesters beginning with Spring 2023, we have approximately 795 pre-course and 490 post-course respondents including 392 paired survey sets. The current analysis focuses on the paired responses to a subset of the Likert scale questions. We see favorable results in response to the statement "I feel anxiety about math" (n=392). While 48 students disagreed or strongly disagreed with the statement in both surveys, 166 students who did not initially disagree with the statement indicated improvement, shifting in the direction of "strongly disagree" in the post-course survey when compared to their pre-course response. In response to the statement "Mathematics has no relevance to my life" (n=391), 191 students disagreed or strongly disagreed with the statement in both the pre- and post-course surveys. An additional 111 students indicated improvement, shifting in the direction of "strongly disagree" in the post-course survey.

Our results indicate that students' perspectives were improved after completing the course. Our future work is to conduct a qualitative analysis on the paired responses to the open-ended survey questions which are tied to students' feelings about math and making mistakes in math.

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