Bridging Concepts and Practice:
The Effectiveness of Recitations in Calculus Education

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Introduction

Historically, lecturing has dominated the mathematics classroom, with students passively receiving information. However, this traditional model often limits opportunities for active engagement and deeper conceptual understanding. In response, many institutions have introduced recitation sessions—smaller, discussion-based classes that accompany lectures—as a way to bridge the gap between theory and practice. These sessions emphasize problem-solving, peer collaboration, and real-time feedback, creating space for students to solidify their understanding of calculus concepts.

Background

Challenges in Calculus

- Calculus is a foundational course for many STEM majors, yet it remains a significant hurdle for a large portion of students. Nationally, high drop and failure rates in introductory calculus courses have prompted efforts to rethink instructional strategies. Recitations, commonly used in science and engineering education, are being explored in mathematics to provide more opportunities for active learning.

Role of Recitation

- Prior studies suggest that collaborative environments and guided practice can lead to improved comprehension and retention in math-heavy courses. This project builds on existing research by specifically evaluating the impact of recitation sessions in a university-level calculus setting.

Methods

We searched for articles through Google Scholar, and the online databases available at Saint Louis University, which lead us to other online libraries.

Research Question

To what extent do recitation sessions in a first year calculus course enhance students' understanding, performance, and engagement compared to traditional lecture based instruction alone?

Results

Article: [1] Explores a course redesign at the University of South Alabama aimed at improving learning outcomes in Calculus I. The redesign increased weekly contact hours from 4 to 5 and introduced twice-weekly recitation sessions led by Graduate Teaching Assistants (GTAs) to reinforce lecture material. The study found that students in the redesigned course performed significantly better on exams and received better overall course grades compared to those in traditional sections.

Article: [2] Investigates the role and effectiveness of recitation sessions in supporting student learning in a university-level Calculus II course. The research focuses on gathering insights from both students and GTAs to understand their experiences, expectations, and perceptions of these supplementary sessions.

Acharya aims to determine how recitations contribute to student comprehension, engagement, and confidence in mastering challenging mathematical concepts. The study also explores the instructional strategies employed by GTAs and how their roles influence the learning environment. The work provides valuable information on how recitations can be optimized to enhance academic success in both calculus courses and other STEM courses overall.

The dissertation offers practical implications for improving teaching practices in higher education mathematics, particularly through better structuring and support of recitation-based instruction.

Article: [3] Identified key practices that improve student outcomes in calculus, including active learning, recitation support, and data-driven curricular adjustments. It found that traditional lecture-based instruction often lowers student confidence and engagement, while collaborative environments foster deeper understanding. Successful programs emphasized the use of student-centered pedagogy, regular feedback, and support systems for at-risk students. Institutions that implemented these strategies reported higher participation and improved retention.

Conclusions

…class participation increased from 60% to 85%-90%, and TBL sections scored higher, on average, on a departmental midterm and final exams, and on an overall calculus knowledge assessment."[1]

- Inclusion of recitation sessions increases student evolvement and willingness to participate in the class as well as **retain** students throughout their calculus journey

- Recitation sessions have also revealed that students are able to retain information at a **greater rate** than those that did not have recitation sessions

"…17% improvement in performance on exams of the students in recitation sessions compared to the students that did not attend recitation."[2]
"Faculties observed that recitation provided students with more active hands-on activities and peer-to-peer group work and improved student confidence."[2]

- Students have the opportunity to showcase their knowledge and reveal struggles in their learning through sessions and allow for student collaboration to assist their peers and/or **reinforce** calculus concepts from lectures.

- Recitation sessions encourage peer interaction and students have shown vast improvement in overall scores and concept retention compared to students who have never been in a recitation session

"Students learn more when they are intensely involved in their education and have opportunities to think about and apply what they are learning in different settings."[3]

- Recitation-based sections encouraged this active-learning approach, which helped students engage the material more deeply and confront their own misconceptions.

- As noted in successful calculus programs, fostering environments where students "feel academically **challenged** in ways that went far beyond their high school courses" helps **encourage** productive struggle and deeper understanding.

Significance

We believe that fostering active engagement and peer collaborations, recitation can significantly improve student comprehension, performance, and retention. These findings offer valuable insights for institutions seeking to reduce DFW rates and increase retention in STEM programs. Future studies should be done to analyze the effectiveness of recitations led by the instructor, TA, or peer tutors.

References