Lowering the DFW Rate in Calculus 1

John Gruver
Michigan Technological University

Patrick McFall
Michigan Technological University

Keywords: Calculus, DFW Rate, Coordination

Educators and researchers have been working to help a wider variety of students be successful in calculus for decades (e.g., Steen, 1987). Researchers have made progress on outlining ways this can be accomplished (e.g., Johnson et al., 2022). We add to this literature by sharing our experience of implementing several small changes that considerably lowered the DFW rate in calculus 1. Specifically, the semester we implemented these changes the DFW rate was 18.8% rate compared to an average rate of 43.2% over the previous six years.

Context and Nature of the Changes

Both before and after the changes we report on were made, Calculus 1 was taught in several medium-sized coordinated sections (about 50 students each), mostly taught by graduate students. The sections met 4 days a week, with new content being introduced on three of those days and the other day being reserved for students to work on problems in class. In addition to typical homework, students also completed Mathematica assignments each week.

Increased Instructional Alignment and Strengthened Coordination

When considering how to change the course to better support students, the course coordinator began by clearly articulating learning objectives for each day of class. He then ensured that in-class activities, homework, and exam questions were aligned with these objectives. He also developed common handouts. These handouts listed the learning objectives relevant to the lesson at the top, with notes on key terms, ideas, theorems and problems below. While the handouts were intended to guide students' notetaking and problem solving in class, they also communicated a potential outline for a lesson plan to the instructors.

Additional Support and Feedback for Students

The course was also changed to include extra support for students and offer several additional opportunities for feedback. The course coordinator created short (3-6 min) videos for each class that students were supposed to watch and take a quiz on before class. The videos introduced the topics in a way that was aligned with the learning objectives. The coordinator also offered weekly reviews that covered just-in-time topics. Students who did poorly on an algebra quiz given during the first week of class were required to get additional support. One option was to attend these reviews. The course coordinator also created short daily "exit quizzes" to provide students with an opportunity to receive feedback on a per class basis. Finally, the course was modified to include three exams rather than two so students could get feedback earlier.

Discussion

The changes we reported here were relatively small in that they were not a major restructuring of the course or an overhaul of the content. Instead, these changes focused on creating strong instructional alignment and providing additional supports for students. However, they seemed to have a significant impact on the number of students who were able to be successful.

References

Johnson, E., Apkarian, N., Vroom, K., Martinez, A., Rasmussen, C., & Bressoud, D. (2022). *Addressing challenges to the precalculus to calculus II sequence through case studies: Report based on the National Science Foundation funded project Precalculus through Calculus II*. The Mathematical Association of America.

Steen, L. A. (1988). *Calculus for a New Century: A Pump, Not a Filter. Papers Presented at a Colloquium* (Washington, DC, October 28-29, 1987). MAA Notes Number 8. Mathematical Association of America, 1529 18th Street, NW, Washington, DC 20007.