Chapter 13
Calculus 1 Course Comparison:
Online/Blended or Flipped?

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ABSTRACT

The chapter examines three approaches to teaching a Calculus 1 course at a private Mid-Western university. These approaches include an inquiry-based lecture/discussion environment, a flipped classroom, and an online/blended environment. The author examines the approach to each of these environments, reflects on how well they worked, and includes student feedback and course performance.

INTRODUCTION

Walk in the door of the author's classroom and one will see students with their peers discussing strategies to solve mathematics problems. Students can be seen presenting at the board and large class discussions on questions that deal with the essential concepts of the course. The classroom is not lecture driven, but rather it is student driven. Students in the author's classes are actively involved in learning course material during class sessions. In this chapter, the author will discuss three strategies used which incorporate technology into her classroom to engage her students in active learning. Active learning is defined as a classroom environment where students are required to do meaningful activities that force them to think about, make connections to and understand the mathematics being presented. These approaches include an inquiry based lecture/discussion environment using clickers, a flipped classroom, and an online/blended environment.

The course the author teaches is Calculus 1, which has traditionally had a bad image among college students, who think the course was designed only as a weed out class for students majoring in Engineering, and other STEM disciplines. She works at Benedictine University, a private Catholic University that has between 3000-4000 undergraduate students. Around 50% of the undergraduate students major in Science, with the most popular majors preparing students for the medical professions. Many of these students come into this course with apathy towards the material, and minimal desire to take the course because they do not see it as essential to their future career success. For many of her students the primary

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reason why they are required to take these courses is not necessarily the mathematics content but rather the fact that mathematics trains your brain to take an everyday problem, organize the information, and use logic to determine a reasonable solution. No matter where a student goes after graduation, they will be faced with problems that must be solved. The mathematical approach to a problem does not come naturally, it is something one must practice and develop. In the classroom the author works to create an environment which will support students as they develop this valuable skill. Students in an active learning environment can overcome their fears by providing a welcoming place to work with their peers and learn mathematics.

In addition to supporting student intellectual development, active learning has also been identified as an effective way to have a positive impact on student retention. In Cuseo and Farnum (2011) and Tinto (1999) the authors show that the very principles and practices that promote student persistence also promote student learning. Students', who are more involved in learning, especially with others, learn more and show greater levels of intellectual development. Therefore many universities in their retention initiatives are encouraging faculty to incorporate various pedagogical approaches that involve students in active learning.

Once the decision had been made to create an active learning environment the next natural question, is how best to achieve this desired environment. Clearly there are many effective approaches, so when deciding how best to proceed, the author determined that she wanted her classroom to be open and welcoming to all students, especially those who may not be comfortable with mathematics. She wanted students to participate openly in discussion, and not worry about giving a wrong answer. In fact wrong answers should be encouraged, as the discussion that follows can serve as a way for students to learn. Therefore, the author's initial approach was to incorporate audience response systems or clickers into her classroom.

CLICKERS

Audience response systems or clickers, is a way to incorporate technology into the classroom to poll students and check comprehension. In her classroom, the classroom computer is used to project multiple choice polling questions which will generate discussion relevant to the lecture material. Students read the questions, and are given time to think about the problems on their own. Once they have reached a conclusion they will vote electronically. Their votes are tallied by the software, and after the voting, the results of the poll are displayed. Then the author gives students time to discuss the question with their peers, trying to determine if they agree with the classroom consensus, or trying to explain why the majority of students are not necessarily correct. Once everyone has had the time to vote and discuss, the class comes together to debate the results. As the instructor, she does not give away the correct response but rather encourage the class to determine through discussion the correct response on their own. The questions are written in such a way, that it is not uncommon for the trending response to be incorrect. Questions are more interesting if they highlight common errors. If everyone gets the answer correct, there is not much for the class to discuss. While quick comprehension checking questions are a good way for the instructor to get feedback on whether or not students understood what was just presented, it is more helpful to use these questions to get students more engaged in developing their own connections to course material. Using clickers to encourage participation followed by peer instruction allows the classroom to become an active learning environment, which engages all students.

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