

## Chapter 49

# Increasing Student Engagement and Extending the Walls of the Classroom With Emerging Technologies

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### ABSTRACT

*Some tend to view the use of technology as the panacea people have all been waiting for, and yet, if a piece of software or technology is not used properly, it can amount to little more than a high-tech pedagogical placebo. It is important to keep in mind that technology is a means to an end and not an end in itself. The goal is to impart knowledge, increase student understanding, and develop critical thinking skills. Further, if technology can be used to create learning experiences outside the classroom or enrich the educational experience inside the classroom, then it is a useful tool. This chapter reviews case studies of three emerging technologies: clickers (or audience response systems), Maple (computer algebra system), and screencasting (using a tablet PC) that have been implemented successfully on one campus to enhance student learning.*

### INTRODUCTION

Our primary goal for using technology is to engage students in an active learning environment in class and to extend the walls of the classroom. We do not want our students to be passive onlookers, merely watching the show, while the instructor imparts words of wisdom. Instead, we strive for a more engaging classroom environment where students actively participate in deep discussions about mathematical topics. Further, we do not want learning to stop when the students exit the classroom. Rather, we

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employ technology as a way to support our students as they continue to explore mathematical concepts beyond the classroom. Using technology to promote student learning is a longstanding tradition in the mathematics department at Benedictine University.

Although we use several types of technology to support our pedagogy, in this chapter we will focus on three emerging technologies that have been implemented successfully on our campus. We will describe how these technologies are applied in the form of classroom case studies. Within the description we will indicate not only how the technology is used but also our philosophy behind its use, and finally, we will comment on some of the challenges that inevitably arise. The three technology tools we will focus on are clickers (or audience response systems), Maple (computer algebra system), and screencasting (using a tablet PC).

## **BACKGROUND**

We begin by sharing some of the literature that motivated us to incorporate these emerging technologies into our classrooms. The first technology we focus on is audience response systems, generally called clickers. This technology has been used extensively in recent years in many disciplines including mathematics. The majority of the prior work focused on students' attitudes towards classes where clickers are used, but several studies compared the exam performance of clicker versus non-clicker classes. In our chapter we will focus on how to use clicker questions to create an environment that encourages active participation by students and meaningful discussion of essential topics in mathematics. Generally, it has been found that the majority of students enrolled in classes that use clickers enjoy using this technology. Our experience with clickers also supports this conclusion. Researchers at the University of Michigan found that clickers tend to increase students' attendance rates and encourage classroom discussion ("Teaching with Clickers: Students' Attitudes", 2010). In addition, some studies have found that clickers can lead to an increase in scores on the final exam compared to traditional lecture (Miller, Santana-Vega, and Terrell, 2006). Still others find no statistically significant change in test scores over other active learning environments, but students in these classes feel that they learn more (Martyn, 2007). We are currently finding results similar to Martyn (2007), however, we believe the students benefit substantially from the use of clickers – even when we do not see an improvement in exam scores. One reason for this is that exams can be limited in the types of questions asked due to the time constraints of the exam period. We believe that students who participate in discussions motivated by clicker questions develop an understanding of how material fits into the larger picture to a greater extent than those in traditional lectures. Prior to the inclusion of clickers we were using inquiry-based learning, where we required our students to actively participate in the classroom environment. The benefit of adding clickers has been that we are able to help the students make connections with prior course material and develop examples that would have been too time consuming to present in class using other techniques.

Even though using clickers has been found to have a generally positive impact on student achievement and student attitudes, some studies have found that this technology – if not implemented properly – may be negatively correlated with students' attitudes. Some studies found that the introduction of clickers can ruin the flow of the lecture and not add to students' understanding, if the clicker questions are not properly followed up by classroom discussion and reflection on the survey results. If the class only incorporates clicker questions, but not an active learning approach, then the use of clickers does not tend to have a positive impact on students' attitudes towards the material ("Teaching with Clickers:

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