

Title: How Do iPads Facilitate Social Interaction in the Classroom?
Preliminary Research Report

Authors: Brian Fisher and Timothy Lucas, Pepperdine University

Abstract: Traditionally, research on technology in mathematics education focuses on interactions between the user and the technology, but little is known about how technology can facilitate interaction among students. In this preliminary report we will explore how students use iPads while negotiating mathematical meaning in a community of learners. We are currently studying the use of iPads in an introductory business calculus course. We will report on classroom observations and a series of small-group interviews in which students explore the concepts of local and global extrema. Our preliminary results are that the portability of iPads and the intuitive applications have allowed students to easily incorporate the iPad into their collaborations.

Keywords: business calculus, social constructivism, classroom technology, iPad

Proposal: For the past half-century mathematics educators have been contemplating the role of technology in mathematics education. Recent decades have seen significant growth in student access to technology in the classroom. Among the key strands of research are:

- Handheld devices and calculators, e.g. (Burrill et al., 2002).
- Technology designed to accumulate real data for student exploration, e.g. (Konold & Pollatsek, 2002).
- Dynamic geometry software and other microworlds, e.g. (Jones, 2000).

Like the strands mentioned above, the bulk of research on technology in mathematics education focuses on interactions between the user and the technology. Little is known about how individuals use technology to interact with one another. However, the current generation of undergraduates is likely to incorporate technology throughout their social interactions with one another. In this preliminary report we will explore how students use handheld tablet devices while negotiating mathematical meaning in a community of learners.

Our theoretical perspective is built upon the significant body of research which views learning as an inherently social process, e.g. (Vygotsky, 1978; Cobb & Yackel, 1996; Stephan & Rasmussen, 2002). From this perspective, knowledge is socially constructed through interactions with other members of a learning community. Classroom technology may take on many different roles inside the community of learners, such as: a tool for computation, a medium for communication, a microworld for exploration, or an extension of the individual's voice in negotiating meaning. In particular, it is this final role that we intend to describe in greater detail through the results of an ongoing study into the use of iPads in undergraduate mathematics.

In the fall of 2010, two sections of Calculus for Business and Economics were chosen to be part of a university wide study of the effectiveness of the iPad as a classroom tool. The university distributed iPads to one section of 20 students along with two applications, a spreadsheet program called Numbers and a graphing calculator called Graphing Calculator HD. Students were able to

use the iPads both inside and outside the classroom for the entire semester and returned them after the final exam. The second section of the course is using laptops throughout the course with Excel and a java graphing applet developed by one of our faculty members. The instructor, textbook, homework, quizzes, tests and in-class activities are identical for both sections. The course itself designed to allow students to reconstruct mathematical principles within a small group setting.

This report is focused on the degree to which the iPad enhances the classroom dialogue. We are using the following qualitative methods to conduct this study:

1. Classroom Observations: We are conducting classroom observations of both classes throughout the semester. We are most interested in recording student behavior during in-class activities in order to understand how the students work together within each section of the course.
2. Group interviews: We are meeting with a small group of 2-4 students and asking them to solve several questions related to the course. The focus is on how they use technology to help solve problems and whether the technology has an effect on their interactions.
3. Activity Logs: We are asking the students to keep a log of their use of any technology over the course of a few days. This helps us understand how students use technology in general, as well as specific technology for the course, on a daily basis.

Of particular interest to us is a series of small-group interviews focusing on the concepts of local and global extrema. Students often approach these concepts from a purely computational perspective, but would benefit from the use of technology to visualize the problem. This is an excellent opportunity to observe whether students will incorporate technology while negotiating the problem with their classmates. These sessions have been designed to illuminate student interaction involving technology.

Through classroom observations, we have already seen evidence of the positive role that the iPad can play in the classroom. In early lessons that did not necessarily require the use of technology, students chose to turn on the devices and explore the graphs of cost, revenue and profit functions without prior instruction on the application. We also observed a lesson on limits where a spreadsheet and graphing calculator is required. During the course of the lesson, we witnessed that the size and portability of the iPad allowed students to share their screens as part of their dialogue. The fact that the class is using a uniform device also facilitated students assisting each other in the learning process. Throughout the class activities the students were fully engaged and did not stray to online distractions.

Based on our experiences this semester, we would like to ask for feedback on future iterations of this study. We ask the audience to consider the following questions:

- Is there relevant literature that we have not considered?
- Are there other means of collecting data that we have not considered?
- Are there other topics in the business calculus curriculum that would help illuminate student interactions with technology?
- The university conducted a survey of general technology use for the students involved in the study. Should we use these surveys to classify students by technological comfort and track how that influences student interaction with the technology and each other?

- The criteria for the university-wide study included having one section taught with iPads and one section taught without. Is the comparison between the iPad section and the section where students use personal laptops of interest to the mathematical education community?

References

- Burrill, G., Allison, J., Breaux, G., Kastberg, S., Leatham, K., & Sanchez, W. (2002). *Handheld graphing technology at the secondary level: Research findings and implications for classroom practice*. Texas Instruments.
- Cobb, P., & Yackel, E. (1996). Constructivist, emergent, and sociocultural perspectives in the context of developmental research. *Educational Psychologist*, 31(3), 175–190.
- Jones, K. (2000). Providing a foundation for deductive reasoning: Students' interpretations when using dynamic geometry software and their evolving mathematical explanations. *Educational Studies in Mathematics*, 44, 55–85.
- Konold, C., & Pollatsek, A. (2002). Data analysis as the search for signals in noisy processes. *Journal for Research in Mathematics Education*, 33(4), 259–289.
- Stephan, M., & Rasmussen, C. (2002). Classroom mathematical practices in differential equations. *The Journal of Mathematical Behavior*, 21(4), 459 – 490.
- Vygotsky, L. S. (1978). *Mind in society: Development of higher psychological processes*. Cambridge, MA: Harvard University Press.