Title: INSTRUCTOR AND STUDENT FEEDBACK ON CLICKERS IN LARGE CALCULUS COURSES

Topic: Using Technology Effectively in the Post-Secondary Classroom

INSTRUCTOR AND STUDENT FEEDBACK ON CLICKERS IN LARGE CALCULUS COURSES

Petra Menz Veselin Jungic Amy Wiebe

Department of Mathematics, Simon Fraser University, Burnaby, British Columbia, V5A 2R6, Canada

ABSTRACT

The impact of clickers on the teaching of a large calculus class is investigated. The perspectives of students and the instructor as well as the effects on classroom dynamics are taken into consideration and analyzed. This study extends some other recent work in this area by considering all of these three aspects together instead of in isolation.

1. Settings

Especially in large mathematics classes, students' responses to questions and interaction with the class in general are kept to a minimum, simply because time is limited by the amount of curriculum material that needs to be covered (Jungic et al, 2006). This can be frustrating for instructors who strive to reach out to students during lectures. A concerned instructor wants to draw each individual student – no matter what type – into the subject matter, ask each of them lots of questions, know when the student is having problems, and be able to address these problems immediately. What is even more important is that recent data supports strongly that students who participate actively in their own learning will increase their comprehension of the course content (Lucas, 2007). For years we have used hand-raising, flash cards or other manipulatives to get immediate feedback from students and to engage them with the course material, but this exposed students' answers to the whole class, and it was clear that not all students participated in this form of activity. Recently, personal response systems (PRS), also known as Classroom Voting Systems or clickers, are being introduced as a relatively new, innovative, technological teaching tool into classrooms representing various disciplines across the country. Clickers are used to get immediate mass answers to multiple choice questions typically displayed on computer slides whether it is in the form of quiz questions or peer instruction. We wanted to find out, how these PRS impact teaching and learning in a large math class from the point of view of both instructor and student.

Two courses on integral calculus taught consecutively by the first author were selected for this study. The first course with 127 participating students was held in the spring of 2006 without the aid of personal response systems. The second course with 99 participating students was held in the summer of 2006, where 53 students were given a PRS and the remaining students had no PRS. The authors set up three similar online questionnaires through the free assessment summary tool called FAST at Mount Royal College (Ravelli and Patz, 2006), with questions from the following three pedagogical categories: motivation, learning, and interaction. The first questionnaire was meant for students in the spring course (Appendix A), the second questionnaire was meant for

students without a PRS in the summer course (Appendix B), and the third questionnaire was meant for students with a PRS in the summer course (Appendix C). Thomson publishers have graciously lent a classroom set of clickers based on the TurningPoint technology to conduct this study (Thomson, 2006). TurningPoint is fully integrated in Microsoft PowerPoint to create interactive slides used with clickers. In addition, TurningPoint collects all students' input and allows for a variety of data displays in Microsoft Excel.

2. Three Frameworks of Inquiry into Clickers

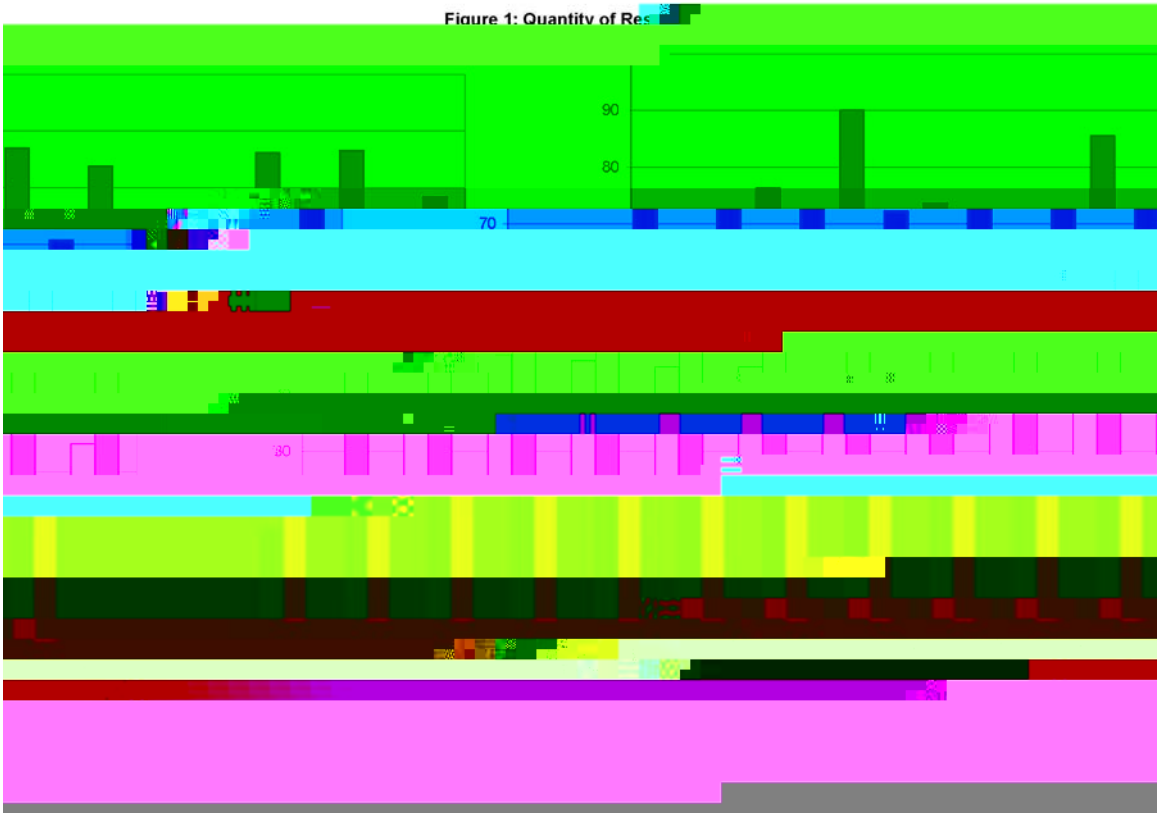
There were three sets of enquiries by the course instructor regarding the use of clickers in the calculus course. The first set of questions deals with the technical issues of employing clickers. How easy to use is the PRS in the lecture hall? How easy is the analysis of data? How time consuming is the creation of slides for each lecture? The second set of questions enquires into the impact on teaching. How much time will the clicker activity take during a lecture? What balance is needed between clicker activities and lectures? How do clicker activities change the dynamics of the lectures, if at all? The third set of questions address concerns with student learning. How well do students respond to the clicker activities, are they a motivator to attend lectures and learn more or seen as a gimmick? Do clickers increase interaction between students and instructor during a lecture? Do clickers increase learning of concepts, and how should this reflect on assignments and examinations? In the remainder of the article, we will present our answers to these questions.

a. Technical Aspects of Clickers

The instructor found that setting up the laptop and receiver was straightforward and did not experience any major set-backs with the slides during a lecture. In a study on a variety of personal response systems it was noted that TurningPoint is fast to learn and easy to use (Hanley and Jackson, 2006). The initial intent was to use the PowerPoint slides provided by the publishing company; however, in our opinion these slides did not suffice. To provoke students' understanding of the concepts introduced during the lecture.

c. Pedagogical Impact of Clickers

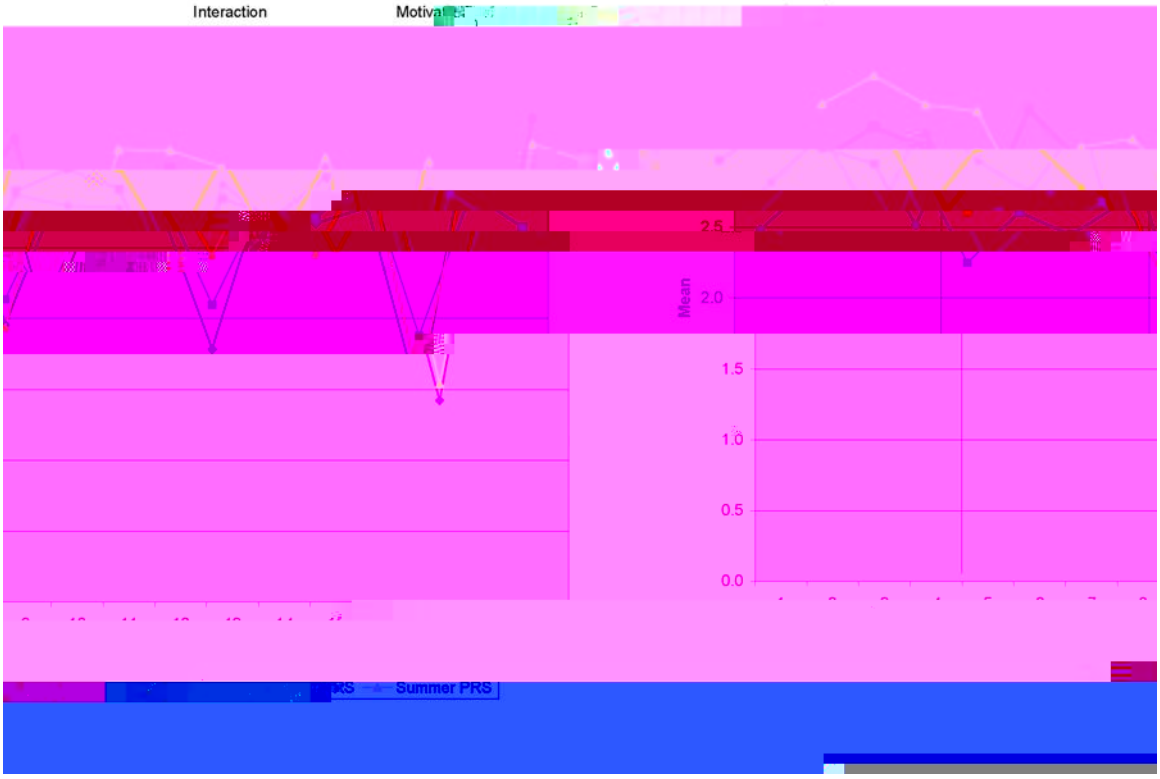
Now we address the third set of questions regarding student learning. First of all, students readily responded to the use of clickers in the calculus course as Figure 1 shows. This is



in support of other studies on clickers that po

Two results are of obvious interest. All three groups of st

Figure 3: MATH 152 Spring and Summer-1 Survey Means Comparison (without NA)



The result that surprised the instructor is the response to the third question on whether the instructor cares about student's learning. Amazingly, all three groups of students have almost the same mean as a response, which we interpret to mean the instructor herself plays an important role in how students perceive to be cared for. Lastly, Figure 3 shows disparity in the motivation section among the three groups as was already pointed out with question 7. Furthermore, attendance is deemed much higher by the spring group with no PRS compared to the summer group where all students were exposed to clickers.

Figure 4: MATH 152 Summer-2 Survey Means Comparison (without NA)

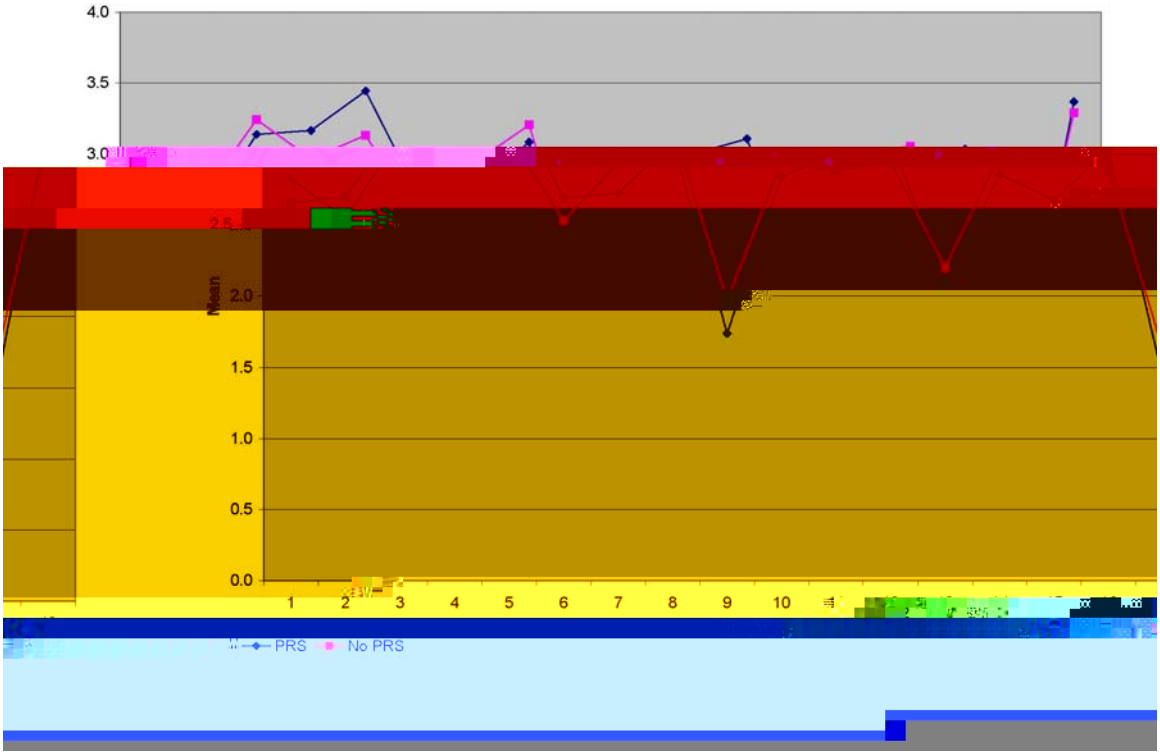


Figure 4 is a comparison of means between the PRS group to the no PRS group in the summer and shows the results of the second surveys about the last third of lectures where no clicker activities were held. This gives further evidence that the no PRS group identified with the PRS group. Even though the students had no clicker, they still read the questions and participated, thereby benefiting from the instructor's feedback. Hypothetically speaking, what if in a class of 500 students only a group of, say, 50 students is equipped with a clicker? We theorize that the majority of students would benefit from the clicker activities held during lectures. Questions 9 and 17 are control questions, which explain the sharp expected drops.

students in a large class; allow the instructor to address misconceptions which may otherwise have gone unnoticed; that students get on-going feedback on their understanding; and that clicker activities are yet another source of a valuable learning tool for students. However, coming up with appropriate questions and creating slides can be a time consuming job in addition to preparing the lecture material and should be taken seriously in an effort to make clicker activities worthwhile. Further studies need to be conducted to answer the question of whether clicker activities substantially increase students' learning and change test performance.

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Appendix A

Student Survey Spring – No PRS

The answer to each question is based on the Likert Scale:

strongly agree	agree	not applicable	disagree	strongly disagree
4	3	2	1	0

Interaction:

1. I feel that I participate during the lectures.
2. During lectures, I know how my answers compare to the rest of the class during participation activities.
3. My instructor cares what and how I learn during the lectures.
4. I enjoy participating.

Motivation:

5. I attend this class no matter what.
6. I think that I got good marks on the midterms.
7. I think that I will get a good letter grade.
8. I use the textbook and the resources it came bundled with.

Learning:

9. When the instructor asks questions, it takes too much class time.
10. I think I retain the material during the lectures.
11. I think I understand the material during the lectures.
12. I think about the newly introduced concepts.
13. I read my textbook in preparation of the lectures.
14. I stay focused in lectures.
15. The lectures seem rushed because the instructor has to hurry to cover everything.
16. The instructor focuses on topics that are the most difficult for us.
17. I think the lectures are a waste of time.
18. I think the lectures are effective for my learning.

Appendix B

Student Survey Summer – No PRS

The answer to each question is based on the Likert Scale:

strongly agree	agree	not applicable	disagree	strongly disagree
4	3	2	1	0

Interaction:

1. Even though I had no PRS, I feel that I am able to participate more in the lecture using PRS slides.
2. The PRS helps me to know how my responses compare to the rest of the class.
3.

20. What are the benefits/problems of using the PRS that are not addressed in the previous questions?