Provost’s Learning Innovations Grant for Faculty
Request for Full Proposal
2006-2007

Project Title:
Using JoinIn on TurningPoint to Increase Participation in the Calculus Classroom

Applicant(s):

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1. Title: Using JoinIn on TurningPoint to Increase Participation in the Calculus Classroom

Summary

This project seeks to pilot a new technology in the calculus classroom (however, it does not request funds to purchase the technology). The technology, called JoinIn on TurningPoint, helps students to be more active in a lecture setting by allowing them to respond quickly and easily to questions posed by the teacher. Students use a small radio transmitter, called a clicker, to select their answers to multiple choice questions, and a receiving-unit on the instructor's computer gathers the response data. A plug-in to Microsoft PowerPoint compiles students' answers and displays aggregate results. In this way, teachers can instantaneously assess students' understanding during a lecture, and can provide students with a more active learning environment.

In order to make use of the technology, an instructor must have a repository of thoughtfully designed questions implemented as PowerPoint slides. Drs. Harkin and Lutzer propose to develop a cache of such slides from which instructors can draw. Specifically, during the summer quarter of 2006, they will develop a set of graphical, numerical, intuitive, and technical questions for 1016-281 Project-Based Calculus I. They will then pilot the JoinIn on TurningPoint system in one or two sections of Project-Based Calculus I in the fall quarter.

2. Targeted learners

For the proof of concept phase, we specifically target first-year calculus students in Project-Based Calculus I (1016-281). Upon successful completion of the proof of concept phase, materials will be developed for other courses in the calculus sequence.

3. Number of affected students

The materials we develop for this project will be beta-tested in one or two sections of Project-Based Calculus I (there are roughly 35 students per section in a typical calculus class). Beyond the proof of concept phase, the number of students affected will depend on how widely the system is adopted by the faculty; however, the pedagogical technique that Drs. Harkin and Lutzer propose to test, if successful, could eventually affect all of the students who are required to take calculus at RIT. The calculus sequence is one of the most important and widely taken sequences at the Institute, so any improvement in the teaching of calculus will have an enormous impact on the academic success of a large number of students at RIT.

4. How JoinIn on TurningPoint works

Each student purchases a “clicker” (for roughly $20) with his or her calculus text. During lectures, students use their clickers (which are small radio transmitters) to answer multiple-choice questions posed by the instructor, and a small receiving unit on the back of the instructor’s computer gathers the students’ responses. Plug-in software that works in conjunction with Microsoft PowerPoint then tallies and displays the results in the form of a histogram. If the instructor is projecting the slides to the class, then the students can see the tallied results as well.
Thomson Learning has provided Drs. Harkin and Lutzer with a free receiving unit and software for the project, and students will purchase their own clickers, so the budget of this proposal does not include money for equipment. The grant money requested will be used to cover the time we spend developing a cache of PowerPoint slides and working out how to best incorporate them into the Calculus curriculum.

5. Anticipated impact on teaching and learning

The availability of instantaneous feedback from students in a classroom setting could significantly increase teaching effectiveness. One of the most difficult aspects of teaching is discerning the state of the learner’s comprehension at any given moment. Teachers are often accustomed to asking for feedback during a classroom discussion and receiving blank stares from students. Sometimes this happens because students have a fear of exposing ignorance, and sometimes it happens when students feel that they can remain silent until one or two very bright students answer for them. No matter the reason, this passive approach to learning is problematic. By contrast, the clicker technology actively engages each and every student, and it gives the instructor an aggregate view of the extent to which students comprehend important ideas or are able to use fundamental techniques. By seeing the percentage of the class that has answered a question correctly, teachers can determine whether a sufficient number of students have understood the material before moving on.

Drs. Harkin and Lutzer conjecture that the technology will turn lectures into an interactive learning environment that promotes conceptual understanding. From the students’ point of view, they anticipate that the classroom experience will become even more…

- personalized to each particular class of students, because instructors will be able to draw from a large repository of PowerPoint questions in order to drive home ideas that particular classes find difficult or techniques that they find complicated.
• motivating, because students get immediate feedback about what they do or don’t know.

• safe, in the sense that students’ responses will appear aggregately (as opposed to when students answer verbally, which singles out individuals as understanding or not).

Most importantly, the data collected by the software will help teachers to help students.

While this proposal has focused on the class as a whole, in the lecture setting, the receiver can also record responses on an individual basis so that instructors can identify the particular students who are having difficulty (we do not suggest that the receiver will display individual’s answers, but only that it will record them on an individual basis). This will allow teachers to accelerate the Early Alert and intervention process.

6. Impact on student success and retention

The ultimate validation of a new technology in the classroom is improved student performance. The clicker technology should increase student success and retention in several ways. It is currently typical in calculus courses at RIT to give the first exam in the third week of classes so that Early Alerts can be sent by the fourth week. As mentioned above, the clicker technology will allow instructors to assess the individual’s comprehension and ability on a daily basis. This will allow problems to be addressed much sooner than the third or fourth week of the quarter. The ability to quickly identify those who are falling behind should improve overall student retention.

Another way that the technology can aid in student success is by motivating students to study on a regular basis. If students know that they will be actively engaged in every lecture, they will be more motivated to keep up with the material and to do the assigned reading.

While it is not the thrust of this proposal, we remark also that student attendance can be taken easily and automatically by using the clickers. When students arrive at class, they can press a button on their clickers and the JoinIn on TurningPoint software will log their presence in class. The software can keep track of attendance throughout the quarter and alert the instructor to students who are not showing up to class on a regular basis.

7. Measurement of impact

The final exam in Project Based Calculus has two parts: (1) a multiple choice exam that is common to all sections (called the Common Core), and (2) a free response portion. Drs. Harkin and Lutzer propose to use the Common Core portion of the final exam as a measurement of the impact. They will perform a statistical analysis that compares the performance of the experimental calculus sections (using the clicker technology) to that of the control sections (those not using the technology). In addition, students will be asked to fill out an end of quarter evaluation of the technology and whether they felt it enhanced their classroom experience.

8. Dissemination of results

The results of the pilot project will be presented to the full faculty of the Department of
Mathematics and Statistics at a department meeting during the winter quarter of 2006. Later, the results will be presented to the larger educational community at sectional meetings of the MAA, and then to the national community at the annual Joint Mathematics Meeting. (Travel to these meetings will be provided by the Department of Mathematics and Statistics.)

9. Rationale

JoinIn on TurningPoint is now being used at many institutions of higher learning across the United States, including the University of Notre Dame, Columbia Medical School, and The Ohio State University to name a few. As an institute of technology, RIT should be in the forefront, along with these other prestigious schools, in applying state of the art technology toward achieving highly interactive learning environments.

This technology is fairly new, and though it has been piloted in other classrooms at RIT, it has never been used in a mathematics classroom here. Drs. Harkin and Lutzer believe that the best way to introduce this technology into mathematics classrooms (and to test the hypothesis that it will enhance learning in that discipline) is to start with first-year calculus. Students in first-year calculus courses have not been indoctrinated into the traditional lecture format and should be more receptive to the experience.

The JoinIn on TurningPoint system is very modular, in the sense that the PowerPoint materials can easily be created, used, and transferred to anyone who wishes to try them in a class. As part of this project, Drs. Harkin and Lutzer will post all of the material they create on a web page that is accessible to all faculty of the Department of Mathematics and Statistics who desire to use them.

Drs. Harkin and Lutzer are both young and energetic faculty who have always had an interest in technology in the classroom and its pedagogical implications.

10. Timetable

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<tr>
<td>Summer Quarter</td>
<td>Create materials for the JoinIn on TurningPoint technology and incorporate them into lesson plans for Project-Based Calculus I</td>
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<td>Fall Quarter</td>
<td>Pilot the technology in Project Based Calculus I</td>
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<td>Winter Quarter</td>
<td>Give a presentation to the Department of Mathematics &amp; Statistics on the results of the project. Give a presentation to the national mathematics community at the Joint Math Meeting.</td>
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<td>Spring Quarter</td>
<td>Present results to the Seaway Section of the Mathematical Association of America at the spring sectional meeting.</td>
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