Evaluation of an Interactive Classroom Tool Applied in an Introductory Electric Circuits Course

Dr. Scott Dunning, University of Maine

Dr. Scott Dunning is the Director of the School of Engineering Technology at the University of Maine. He serves as the academic dean for approximately five hundred students and directs four engineering technology programs. He is a member of the Executive Committee of the Engineering Technology Accreditation Commission of ABET. He is a Director on the Engineering Technology Council of ASEE. He is also the President-Elect of the Association of Energy Engineers.

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Abstract

As universities struggle to control tuition costs class sizes have expanded annually to maximize revenue. Faculty members are challenged to find ways to maintain student engagement in this changing environment. Further complicating the issue is the changing expectations from internet-savvy students that are easily distracted by laptops and mobile phones. This paper discusses the results obtained after the introduction of an on-line tool that allows students to respond to questions via text message or laptop keystroke. Survey results are discussed along with practical implementation tips.

Introduction

One of the challenges facing higher education is the need to maximize tuition revenue while minimizing instructional costs. This is leading to growth in class size. An introductory circuit course was examined for this project. The course traditionally had enrollment of 25-35 students but due to course consolidation the enrollment for Fall 2013 swelled to 105. This caused a review of teaching pedagogy for the material. With a larger enrollment the typical interaction between the faculty member and individual students would be limited. The standard approach of posing questions and surveying individuals is far less effective since a smaller percentage of students are actively engaged.

Large classroom lectures can be ineffective when students become passive recipients of information. A faculty member can display beautiful PowerPoint slides yet find that students have their heads down as they send text messages to peers or surf the web. Depending upon students' specific learning styles, traditional lectures can have little value.

In 1987, Richard Felder and Linda Silverman discussed how to more effectively reach students whose learning styles are not well served by traditional lectures.[1] Many lectures follow textbook presentations where core theories are first presented followed by applications of the theory. This is known as the deductive approach and while it is well organized, it is not often the most effective approach. Felder and Silverman found that a majority of engineering students classify themselves as inductive learners rather than deductive learners. Induction is our natural learning style whereby we observe the world and draw inferences. It is thus preferable to engage students in active learning during lecture. Active learning is an approach where students are active participants in mastering knowledge. One approach to fostering active learning is to provide opportunities for students to apply a concept to solve a problem.

To promote this engagement, a student response system was employed. The institution had an existing electronic classroom response system available called Iclickers. The Iclicker program requires students to purchase a response device that communicates with a receiver in the classroom. Alternatively, a new program called Top Hat Monocle had recently become available using Short Message Service (SMS) via mobile phone. This program was selected for use in the course.

Top Hat Monocle

The Top Hat system works by establishing a course portal and allowing students to access it by using their mobile phone over the cellular infrastructure or by laptop over Wi-Fi. Since the university campus provides continues Wi-Fi for all students, either approach was always available.

The first step is for the faculty member to establish a course at the Top Hat Monocle web site. There is no charge for the faculty member to do this. Next, students establish an account with an ID that allows them to log into the system and access the account. Students pay $20 for a one semester account or $38 for a five year membership. Finally, the faculty member begins developing questions on the web site that can be made available to students during lecture and then restricted or provided for review later.

The system offers many classroom engagement features. Questions can be posed in multiple formats. Traditional multiple point questions can be posed with single or multiple correct answers. A "Click on Target" question may be posed that asks students to identify parts of an image. For example, students could be asked to identify a specific element on a circuit diagram. A tolerance can then be defined for how far off their clicks can be. Numeric answer questions can be asked with a defined decimal answer with tolerance range. Word answer questions can be asked requiring students to type a specific answer. Finally, matching or sorting type questions can be posed.

Additionally, problems can be posed as homework problems. Students can access the questions after class and the instructor can limit the time available to respond to the assignment. A series of questions can be grouped together to create a home quiz if desired. An added benefit is that the program maintains a class spreadsheet with calculated grades for all assigned problems. If questions are posed in each class, the answers are automatically recording student attendance in the course. The class list and grades integrates directly with LMS systems such as Canvas, Desire2Learn and Blackboard for total course integration.

Live responses can be displayed moments after a question is posed. The percentage of answers received is displayed immediately so the instructor can know when to close out questions. The results can then be displayed in multiple formats as bar graphs, heatmaps or word clouds. After class, the instructor can examine individual student's score, see when questions were asked, and compare performances of different sections.

Survey Approach

The goal of the survey was to determine students' perceptions regarding the value and effectiveness of the classroom engagement system. This was the first time that any of the students had used this system. However, students were all familiar with the iClicker system since they had used it during their prior physics course.

During each lecture, several questions were asked using the system with 2-5 minutes allowed for response. All questions posed were in multiple choice format. They were spread throughout the lecture to ensure student engagement throughout the period. Questions required students to consider conceptual information that had been presented and then apply it to solve a problem. Once the question period ended, the instructor demonstrated how the correct answer was determined and displayed the class results.

The question format was designed to correspond to questions used in a previous study performed by Krystal Drysdale that was promoted by Top Hat Monocle.[2] The key reason for this was to determine if the results would be duplicated in a different environment.

Results

The numerical survey results are demonstrated in Table 1.

Survey Question	Drysdale Response Data	Project Response Data
1. I found that the Top Hat questions helped engage me better in lecture rather than just following worked-out problems.	81% agreed 12% were neutral 7% disagreed	47% Agreed 27% Neutral 26% Disagreed
2. Knowing the instructor would be using the Top Hat system motivated me to attend class.	45% agreed 21% Neutral 34% disagreed	43% Agreed 30% Neutral 27% Disagreed
3. Working the in-class problems on Top Hat helped me better understand the material as opposed to take home questions.	68% Agreed 23% Neutral 9% Disagreed	48% Agreed 27% Neutral 25% Disagreed

Table 1 – Numerical Survey Results

Advantages of the Top Hat System

Students were asked to comment on those features that they liked about Top Hat. The results are displayed in Table 2. The advantages most cited were the ease of use of the product and the convenience of being able to use a phone for interaction. Many students appreciated the instant feedback provided by in-class problems.

Comment	Respondents
No need for clicker	5
Instant Feedback	8
Forced to try problems	5
Everyone participates	6
Ease of use	20
Convenient being on phone	14
Interactive	4
Motivated me to attend	4

Table 2 – Advantages of Top Hat System

Disadvantages of the Top Hat System

Students were also asked to comment on those features that they disliked about Top Hat. The results are displayed in Table 3. The strongest comment by far is the dislike of the cost. Students expressed frustration at having to pay to use the software after already purchasing a clicker for a previous course. There were also some issues noted by students regarding the ability to access the system by phone on some days.

Comment	Respondents
Phone connection problems	8
Already owned a clicker	16
Cell phone was a distraction	3
Cost	55
Didn't like using phone	2
Clicker system is better	10

Table 3 – Disadvantages of the Top Hat System

Conclusions

The use of a student response system appears to provide value for both faculty and students. This initial study primarily examined general student perceptions regarding the Top Hat Monocle system. It did not attempt to address independent variables and their correlation to results such as student grades and reason for taking course. The numerical results were less positive than those reported in previous work though they were still positive.[2] The negative results seem to be caused by student resentment of the cost of purchasing an alternate system after previously purchasing a clicker-based system. Overall, the system appears to offer a viable option to clicker-based systems and provide several instructor tools not currently available by other products.

Bibliography

1. Felder, R.M., Silverman, L.K., "Learning and Teaching Styles in Engineering Education", Engr. Education, 78(7), 674–681 (1988)
2. Drysdale, K., Grunewald, O., "Integrating Web-based Student Response Systems in the Classroom", Powerpoint Presentation.