Interactive lecturing using a classroom communication system

Manjula Sharma, **Joe Khachan**, **Ben Chan**, **Chris Stewart**, **Kirsten Hogg** and **John O'Byrne**,
Sydney University Physics Education Research group (SUPER), School of Physics, The University of Sydney
m.sharma@physics.usyd.edu.au j.khachan@physics.usyd.edu.au

Abstract: Large lecture classes are a dominant feature of many first year university courses. Is there a way to transform passive lectures into environments in which students are actively engaged in learning? Interactivity can be introduced into lectures through mini group quizzes, buzz sessions and a 'show-of-hands'. Although these strategies are successful they are not very effective in informing students about what and how their classmates think.

Current instructional technology based on information technology, enables instantaneous and unbiased feedback from students during a lecture. Such systems are called classroom communication systems (CCS). In this paper we discuss the implementation of such an interactive lecturing system. The effectiveness of the CCS is being evaluated by comparing the results of examination questions addressed by the CCS during the lecture course with those from examination questions that probe similar concepts but which have not been addressed by the CCS. The method by which this evaluation is being carried out is described.

Introduction

The use of a classroom communication system (CCS) in large lecture classes provides a powerful technique for giving instant feedback to the class. A question with options is displayed on an overhead projector. Each student selects an option by pressing a number on a keypad. The responses are collected by a receiver, processed by a central computer, and displayed to the class in the form of a histogram. They can also be displayed in other formats that depend on the type of interaction that the lecturer aims to achieve. The lecturer can promote interactivity by assigning a keypad per three students and requesting group responses. Displaying the collective responses to the whole class helps improve students' confidence because they become aware that a fraction of the class thinks similarly to them (Shapiro, 1997; Poulis et al., 1998). In this paper we describe a trial of a CCS in the School of Physics, The University of Sydney.

The CCS can be used in various ways. The selection made by each keypad is stored allowing the CCS to be used for summative assessment in large lecture classes (Burnstein and Lederman, 2001; Shapiro, 1997). An improvement in student learning has been demonstrated where data was collected for two years prior to, and two years with the use of CCS. The study was extended to another two years without the use of CCS (Poulis et al., 1998). We have chosen to design and use multiple-choice questions using phenomenographical analysis (Marton and Saljo, 1976) of student responses to selected discussion type questions from previous year's examinations. In this paper we describe the design of multiple-choice questions and how the questions will be used to test the effectiveness of CCS.

Hardware, software and use of CCS

We have used the lecture hall package of a CCS called Personal Response System (from *Better Education Inc*. http://www.bedu.com/). The system consists of 2 infra-red receivers and 50 hand held keypads. The receivers are connected to a computer that collects, analyses and stores the data, which can also be imported into *Excel*. The computer is connected to a LCD display unit. Information about the time remaining to answer the question and which keypads have registered a response are displayed as the computer counts down. A histogram of results is displayed when time allocated for answering the question expires. The question itself is displayed on a separate overhead projector.

The CCS is being used in first year physics lectures for the Fundamentals and Environmental units of study in medium size lecture theatres, which have a capacity of 180 students. One keypad per group of three students is used as part of the group discussion approach. As a trial run in 2002, the CCS is being used in lectures every fortnight.

Evaluation and effectiveness of CCS

The CCS is being evaluated using minute papers, focus groups and written questionnaires. In this section we provide a brief description of the effectiveness of CCS. A set of multiple-choice questions are being developed and implemented with the CCS. The questions are based on specially selected past years' examination papers and answering them involves the use of several concepts to form a short written explanation. Student responses from previous years have been categorised using phenomenography. The categories then form the basis of the options in the multiple-choice question. This allows for the use of ideas as perceived by students. Because the questions are complex in nature, two step multiple-choice questions are being designed. An added benefit of the two step question is that students are required to reflect on, and reuse a concept before answering the second part. This consolidates the learning that has occurred. The two step multiple-choice question is derived from categorising student responses to a 2000 examination question. The categories and the number of students in each category, for the 2000 student responses, have been obtained. Lecturers have been requested to set some examination questions in 2002 based on the concepts used in the questions chosen in this study. A phenomenographical analysis will be carried out on the 2002 student responses. A comparison of the 2000 and 2002 data will provide information on the differences, if any, between student understanding of relevant concepts, and the effectiveness of CCS in understanding these concepts.

Students are using the CCS with enthusiasm and lecturers have reported that the hardware and software are easy to use. In addition, lecturers have noted that the interactivity in lectures has increased with the use of CCS.

Conclusion

A classroom communication system is being successfully used in large lecture classes. Student response has been encouraging and staff have readily adapted to using this technology. Evaluations are being carried out to determine the impact, if any, of CCS on student learning. During this process we have identified the use of two step multiple-choice questions as a means of consolidating the learning of concepts.

References

Burnstein, R. A. and Lederman, L. M. (2001) Using wireless keypads in lecture classes. *The Physics Teacher*, **39**, 8-11.

Marton, F. and Saljo, R. (1976) On qualitative differences in learning: 1-outcome and process. *British Journal of Educational Psychology*, **46**, 4-11.

Poulis, J., Massen, C., Robens, E. and Gilbert, M. (1998) Physics lecturing with audience paced feedback. *American Journal of Physics*, **66**, 439-441.

Shapiro, J. A. (1997) Electronic student response found feasible in large science lecture hall. *Journal of Computer Science and Technology*, May, 408-412.

© 2002 Manjula Sharma, Joe Khachan, Ben Chan, Chris Stewart, Kirsten Hogg and John O'Byrne

The authors assign to UniServe Science and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to UniServe Science to publish this document in full on the Web (prime sites and mirrors) and in printed form within the UniServe Science 2002 Conference proceedings. Any other usage is prohibited without the express permission of the authors.