Use of Voting Systems in Lectures at Loughborough University - A Review of Staff Experiences

S.O. King, L. Davis, C.L. Robinson and J.P. Ward

Mathematics Education Centre, Loughborough University, LE11 3TU, UK

Abstract

Academic staff from the Mathematics Education Centre (MEC) have recently been using electronic voting systems (EVS) to teach Mathematics to undergraduate Engineering students. Staff from other departments at Loughborough University have also been using EVS to teach non-Mathematics subjects. This study was designed to investigate the views of affected staff about the use of EVS in lectures and associated pedagogic implications. The results show that EVS is generally seen as an effective teaching tool but that its value for Engineering Mathematics teaching requires further investigation.

Introduction

There has been a university-wide initiative at Loughborough University to make lectures more interactive and get students more engaged by, among other things, introducing electronic voting systems (EVS) into lectures. Consequently, a number of Loughborough academic staff have incorporated the use of EVS into their lectures. The staff come from a variety of disciplines, and among them, are two staff from the Mathematics Education Centre (MEC) who mainly teach Engineering Mathematics to undergraduate students. Although there is a perception that mathematicians are often reluctant to move away from traditional methods of teaching, this is not the case at Loughborough as MEC staff have embraced the use of technologies as tools to deliver lectures to Engineering undergraduates. Apart from EVS, electronic whiteboard-enabling devices such as tablet PC are also being used. However, this paper will focus only on the presentation of the findings of a study on EVS use in teaching Engineering Mathematics and other subjects at Loughborough University.

Electronic voting systems (EVS) are portable software systems that a lecturer may use to ask students to respond to a multiple-choice question (MCQ) during a lecture. The EVS used at Loughborough University was Turning Point (TP), 2006 version. This study reports on the use of Turning Point (TP) voting systems at Loughborough University, specifically during the first term of the 2007/2008 academic session. Consequently, this study was designed to provide insights into the following research questions: (1) What are the perspectives of staff on the use of EVS in lectures? (2) What are the implications of EVS use on teaching and learning? The outline of the paper is as follows: Sections 2 and 3 focus on literature review and methodology respectively, while Section 4 is an analysis of the findings. The conclusion and suggestions for future work are the focus of Sections 5 and 6 respectively.

Literature Review

Some of the earliest reports of EVS use in classrooms include those of Cue (1998), 1998) and Hake (1998). The single, most important benefit of EVS use, identified from literature review, is its capacity to enhance, catalyse or increase student engagement during lectures together with associated pedagogic applications like Peer Instruction (Mazur, 1997) and Just-in-time Teaching (Novak et al., 1999). Some of the EVS-related publications have been subject specific – Physics (Dufresne at al., 2004), Economics (Elliot, 2003), Engineering (Nicol et al., 2003), Philosophy (Stuart et al., 2004), and Medicine (Collins, 2007); while others have been more generic including Draper (2002), Duncan (2005), Caldwell (2007) and to some extent, Hake (1998) and Crouch & Mazur (2001). The main distinction of this study is that it will focus on staff perceptions on the use of EVS with a view to highlighting any peculiarities that may arise based on the use of the technology at Loughborough University.

Methodology

This section describes the methodological procedures adopted for this study.

Sample

Six members of academic staff at Loughborough University who have used EVS to deliver lectures during the first term of the 2007/2008 UK academic session participated in this study (going by current available data, only 10 members of staff at Loughborough University are known to have used EVS in their lectures). Two of the participants are Mathematics staff from the Mathematics Education Centre and teach Mathematics to Engineering undergraduates. The other four participants are from non-Mathematics departments. The participants are split equally between those who, according to their submissions, easily take to new technologies and those who do not. The participants mostly teach first or second year undergraduate students, with class size ranging from 12 to 300 students.

Methods

This study was conducted based on a triangulation approach and consists of a blog, observations, informal feedback, questionnaire and interviews.

I. Blog: A blog was created by MEC staff for them to ‘journal’ their thoughts and experiences about the use of the technologies that had just been introduced into Mathematics lectures for the 2007/2008 session. Only the two members of staff (of the six respondents for this study) from the MEC contributed to the blog.
II. Observations: One of the authors sat in on classes where voting systems were used and monitored staff and students’ attitudes towards the use of the systems
III. Informal Feedback: This consisted an author discussing with staff and students who had used or been in lectures where voting systems had been used about their views on the use of the systems

IV. Questionnaire: All six participating staff completed a Bristol online questionnaire. The questionnaire had been designed with input from the findings obtained from the blog postings, observations of classes and informal chats with staff and students.

V. Follow-up interviews: This consisted of interviewing all six participating staff after they had completed the questionnaire and further clarifying their responses to the questions posed

Results, Analysis and Discussion

The focus of this section is the presentation and analysis, under the relevant categories, of a selection of findings from the study.

Pedagogical considerations

A voting system such as TP is basically a way of using interactive software to pose questions, usually MCQs, to students and get their feedback in real time. What questions are used for, how they are used, when they are used and the quality of the questions used are thus important elements to consider in order to evaluate the pedagogical impact of EVS use on the teaching and learning process. One of the main goals of the questionnaire and interviews was to get feedback on the use of questions with EVS. The corresponding submissions, reported in Table 1, show that MCQs used with EVS fall into three broad groups and these are: ice breakers, mini-tests and ConcepTests (Crouch & Mazur (2001)). The type of MCQ used and the goal(s) for using it subsequently determine the pedagogical implications. The relationship between EVS use and pedagogy is not presented in this paper.

Impact on Teaching Practice and Style

Participant response to survey showed that all respondents struggled initially with the increased preparation time associated with creating MCQs and learning how to use the TP software in order to use EVS in class. The preparation time however tended to decrease as the term progressed and staff's confidence levels in using EVS increased. One participant noted that it was a challenge to cover lecture material in classes where EVS was used. This was due to a number of factors including the number of MCQs used (using more questions reduces the time available for a lecture); the difficulty level of an MCQ – tougher questions take longer to solve; student response time allocation; equipment setting up and closing down time; and (individual) lecture class management approach.

Analysis of data from respondent submissions indicates that EVS use has impacted the teaching practice of the participating staff in a number of ways. Two staff reported that they had revised their course notes based on feedback during EVS use in class. Two other participants also noted that use of EVS has made them put more thought into how lectures may be made more interactive and how to select the MCQs that will achieve this goal. But the most common observation is that EVS use has helped staff to identify the topics or areas that students find challenging. One participant remarked that often lecturers only get to know the areas students are struggling with when marking the end-of-term assessment; by which time it is too late to address student problems. Use of EVS enables student feedback in real time during the lecture phase

of an academic semester. A similar finding is the remark by one of the participants that it was surprising to discover, via EVS feedback, that students were struggling with material the lecturer had assumed they would find easy to understand.

MCQ type	What questions are used for i.e. goals	When (in lecture) they are used	Pedagogical implications
Mini-test	1. To determine knowledge level	Beginning	Contingent teaching
	2. To test recall of previous lecture/material	Paced	Formative assessment/ Identification of problem areas
	3. To maintain student interest throughout lecture	Paced	Class management
	4. To encourage interaction or discussion	Paced	Interactivity
	5. To get students thinking beyond material taught in the classroom	End	
Ice breakers	1. Lighten up the mood in class for better student receptivity to lecture 2. Test if the EVS handsets and system are working 3. To maintain student interest throughout lecture	Beginning, otherwise paced/end	Student Motivation
Concep Tests	Determine student understanding of a topic	Paced	Group interaction and discussion (Peer Instruction)

Table 1: The role of questions (MCQs) in EVS use at Loughborough

Another surprising finding is an observation by one of the respondents that EVS use can, instead of promoting engagement, actually distract students. Student distraction may occur when the MCQ is too easy, or if some of the handsets do not work, as has sometimes been the case – students respond quickly and then use the remaining response time allocation as a window of opportunity to chat with friends. It should be noted that a group of second-year students who seemed to have shown some signs of being distracted when EVS was used had previously been exposed to EVS, having been taught in their first year via the technology. It might thus be possible that they are either slightly bored or no longer so enthralled with the technology. This is a behavioural issue that the authors will investigate in future studies. However, review of pertinent literature suggests that boredom or student familiarity with the technology has not been a problem where EVS has been in use for longer periods. For instance, EVS has been in use at Glasgow University for over five years (Draper et al. (2004)) and none of the publications from the EVS project has reported explicitly any major downside that is purely due to a regular and prolonged use of EVS.

Perceived Usefulness

All participants rated EVS as either "useful" or "very useful" on the questionnaire. However, the responses to a question on whether EVS is appropriate for teaching Mathematics drew an interesting selection of responses. All but one of the four staff from a non-Mathematics background thought that EVS is appropriate for teaching Mathematics. However, the MEC staff seemed ambivalent about the appropriateness of EVS use for Mathematics. This is in contrast to the evidence in literature which suggests that EVS has been successfully used in Mathematics lectures – see, for instance, the GoodQuestions project at Cornell University.

The ambivalence conveyed through the MEC staff responses may be partly due to the difficulty of finding the right (Engineering) Mathematics questions to use with EVS. It is also difficult to set ConcepTest-type questions which require calculation and, at the same time, stimulate discussion. Another factor that may explain the ambivalence is that the two Mathematics staff have different motivations for using EVS. One initially embraced EVS so that it could be used to set ConcepTest MCQs, but has not been able to do so thus far due to reason cited earlier. The other staff uses EVS to mainly ask non-demanding questions. Thus the capabilities that EVS can offer have not been fully utilized in (Engineering) Mathematics lectures. It is the aim of the authors to further investigate the ambivalence surrounding the use of EVS in the teaching of Engineering Mathematics at Loughborough in future studies.

The **key benefits** of EVS use that participants identified are:

- EVS can be used as a formative assessment tool, which in turn can help identify the areas where students are struggling
- EVS use promotes interactive engagement including student-to-student interactivity
- Increases student participation and contribution levels (one key feature is anonymous voting which encourages students, such as shy international students whose first language is not English but are studying at an English university, who otherwise would not participate in class to contribute)
- Its use can catalyse student motivation and interest (e.g. use of ice breakers)
- It can be deployed for contingent teaching purposes

Key Requirements for Effective Use

The following were identified from participant responses as key requirements for maximising the effective use of EVS in Lectures:

- The selection and use of good questions which should include appropriate distractors
- Creation of a bank of relevant, subject-specific EVS questions
- Allocation of adequate time for student response and/or subsequent discussion
- Need to use EVS for stimulating thought and reflection and not just to test memory
- Not overusing the technology
- Creation of a university-wide support forum for sharing tips and ideas on how to use EVS glitch-fee and effectively

Barriers

Analysis of the responses to an open-ended question about the barriers to the use of EVS identified the following as being the most important:

1. Provision of adequate technical support and personnel – this was particularly important for the Mathematics staff
2. Time constraints which include (length of) equipment setting up and closing down time; increased lecture and MCQs' preparation time
3. The confidence level with which EVS is used by staff support and time constraints)

Implication of Findings for Future EVS Use

The findings from this study and the observation of actual EVS use in classes suggest that the following will be valid for future EVS use in Mathematics lectures and for other subjects at Loughborough University:

1. The confidence level with which EVS is used by staff will (continue to) increase with time
2. Technical issues will be less of a problem, partly because staff will be more adroit at fixing technical glitches
3. The EVS questions that have been created from scratch will form a pool which staff can draw from, thereby reducing time spent on question preparation time
4. The effect (if any) of overuse and previous student exposure to EVS will become more evident
5. Staff conviction about the impact of EVS use on student performance and their teaching in general will also become more evident
6. Staff preparedness to, if required, change fundamentally or significantly their pedagogic practices to maximise the effectiveness of EVS use in classes

Conclusion

This paper reported the findings of a study aimed at obtaining the views of Mathematics and other subject staff who use EVS at Loughborough University. The study also sought to evaluate the impact the use of EVS has had on pedagogy. The findings indicate that the participating staff generally see EVS as a useful teaching tool, with some having adapted their teaching methods based on feedback obtained from EVS use. In general, further research needs to be undertaken to evaluate the significance and effectiveness of EVS use on student learning and achievement. It is expected that pedagogic issues would be addressed more in future when staff have had time to reflect on initial EVS use.

Future Work

- Another phase of the research study described in this paper will focus on getting student views and perspectives on the use of voting systems
- Future study will also seek to measure the impact or influence of EVS use (if any) on student performance

- In addition, future studies will involve a closer investigation of the pedagogical issues that have been highlighted in this study
- This study represents the first phase of a longitudinal study which hopefully will lead to a comprehensive examination of the effectiveness of EVS use in Mathematics at university level

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