Staff perspectives on the use of technology for enabling formative assessment and automated student feedback

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ABSTRACT
Academic staff from the Mathematics Education Centre (MEC), Loughborough University began using Electronic Voting Systems (EVS) to teach Mathematics to undergraduate Engineering students in the 2007/2008 academic year. Staff members from other departments at the University, such as Geography, Chemical Engineering and Information Skills, have also been using EVS. 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, as its use can enhance student engagement by increasing their participation in class, give lecturers valuable feedback on student understanding, make the classroom more ‘fun’, and enable lecturers to change teaching practice and curriculum in response to student feedback. However, there are technical and pedagogical issues to be overcome in realising the full potential of EVS.

Keywords
Improving classroom teaching; evaluation of CAL systems; interactive learning environments; media in education; multimedia/hypermedia systems.

1. INTRODUCTION
How may academic staff increase student engagement and participation in a class with more than 100 students, and illuminate abstract concepts which students find difficult? To make lectures more interactive and facilitate student engagement, Electronic Voting Systems (EVS) are being made available for academic staff at Loughborough University for use in their lectures. Consequently, a number of academic staff have incorporated the use of EVS (Table 1) into their lectures. These EVS users come from a variety of disciplines including Geography, Business, and Chemical Engineering, and among them are two lecturers 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 some 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 PCs 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, hand-held computer systems that a lecturer may use to ask students to respond to a multiple-choice question (MCQ) during a lecture. Students respond to the questions by clicking the corresponding alphanumeric answer choice(s) on their handsets (Figure 1). Student answers are then displayed, in real time, in the form of a suitable chart (e.g. histogram, pie chart, etc) on a display screen in front of the lecture hall. EVS is therefore similar to the devices used in enabling audience participation via the ‘Ask the Audience’ section of the popular television programme, ‘Who Wants to Be a Millionaire’. This study reports on the use of TurningPoint\textsuperscript{1} EVS 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 question: What are staff experiences and perspectives on the use of EVS in lectures, and the associated pedagogical impact on teaching? 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.

\textsuperscript{1} http://www.turningtechnologies.co.uk /
<table>
<thead>
<tr>
<th>Lecturer</th>
<th>Module/Study Year</th>
<th>No. of Students</th>
<th>No. of Lectures /Semester</th>
<th>No. of Lectures EVS Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer 1</td>
<td>Mathematics Undergraduate – 2nd year</td>
<td>150</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>Lecturer 2</td>
<td>Mathematics Undergraduate – 1st year</td>
<td>100</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>Lecturer 3</td>
<td>Information Skills Undergraduate – 1st year</td>
<td>300</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Lecturer 4</td>
<td>Geography Undergraduate – 1st year</td>
<td>160</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Lecturer 5</td>
<td>Chemical Engineering Postgraduate - Masters</td>
<td>27</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>Lecturer 6</td>
<td>Data unavailable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lecturer 7</td>
<td>Criminal Justice System</td>
<td>150</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Lecturer 8</td>
<td>Engineering Mechanics</td>
<td>150</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 1 Data on EVS usage at Loughborough University in the first semester of the 2007/2008 academic session

2. LITERATURE REVIEW

Some of the earliest reports of EVS use in classrooms include those of Cue [1], and Hake [2]. 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 [3] and Just-in-time Teaching [4]. Some of the EVS-related publications have been subject specific – Physics [5], Economics [6], Engineering [7], Philosophy [8], and Medicine [9]; while others have been more generic including Draper [10], Duncan [11], Caldwell [12] and to some extent, Hake [2] and Crouch & Mazur [13]. 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.

Research on EVS at other universities in the UK, notably at Strathclyde [14], Glasgow [15], and Portsmouth [16], as well as in the US [17,18] indicates that EVS use may provide the following benefits:

- Enables student understanding or knowledge of a topic to be guaged;
- Provides instantaneous feedback to an instructor, which may then guide how an instructor approaches a particular class or cohort of students;
- Provides immediate feedback to students on how well they are doing, and where they need to expend more effort (and that is also in relation to the other students);
- Increases the number of students actively participating in class;
- Makes classes more relaxed and enjoyable;
- Reassures students that they are not the only ones making mistakes.

3. METHODOLOGY

This section describes the methodological procedures adopted for this study.

3.1 Sample

Seven 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 as of December 2008). In addition, another academic from Strathclyde University also participated. Two of the

2 Please note that ‘Lecturer 8’ is at Strathclyde University.
participants, including one of the authors but not the principal author, were Mathematics staff from the Mathematics Education Centre and teach Mathematics to Engineering undergraduates. The other six participants were from non-Mathematics departments (Table 1). The participants were split equally between those who, according to their submissions, easily take to new technologies and those who do not. The participants mostly taught first or second year undergraduate students, with class size ranging from 15 to 300 students.

Figure 2: Students using Turning Point (EVS) handsets to register their responses to a question in class. Used with permission of Turning Technologies

3.2 Methods
This study was conducted based on a mixed-methods approach and consists of a blog, observations, informal feedback, questionnaire and interviews.

1. Blog: A blog was created by MEC staff for them to record 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 eight respondents for this study) from the MEC contributed to the blog (see Appendix for a blog sample);
2. Observations: The principal author sat in on classes where voting systems were used and monitored staff and students’ attitudes towards the use of the systems;
3. Informal Feedback: This basically consisted of the principal 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;
4. Questionnaire: All eight participating staff completed a Bristol online questionnaire (see Appendix for the questionnaire), which was the main instrument for this research. 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;
5. Follow-up interviews: This consisted of interviewing the participating staff after they had completed the questionnaire, and further clarifying their responses to the questions posed.

3.3 Implementation
Data from the staff blog, supplemented with classroom observations (e.g. how many questions were used in class, whether students were paying attention or not during EVS use, etc) and insights from EVS research
literature, was used to identify a number of relevant themes or issues to be investigated. These themes were then used to delineate the questionnaire into suitable categories such as ‘EVS Questions and Pedagogical Considerations’, which focused on the motivation and methodology for creating the questions used with EVS; ‘Operational Issues and Effectiveness’; ‘Emotional Response’, ‘Background’ and ‘Reflection’.

The follow-up interview was principally conducted to ensure the reliability of the survey instrument. The principal author therefore conducted interviews (this was possible due to the relatively small sample size) with the academic staff who had completed the questionnaires to ensure that their submissions accurately reflected their positions on the substantive issues that the questionnaires’ items probed. The interview exercise helped to establish the stability of the survey instrument because it was discovered, that for a very small number of items, two respondents had indeed given responses that did not accurately reflect their positions. For instance, a lecturer who had indicated in a blog posting that ‘ice breaker’-type questions were used in class stated on a related questionnaire item (i.e. item 12) that ice breakers were not used. So it was possible to clarify this lecturer’s response to the item on ice breaker use in class during the interview that followed the questionnaire administration and completion.

3.4 Computer-aided Analysis

Bristol Online Surveys (BOS)3 is a Web-based survey tool, created by the University of Bristol, which may be used to develop and administer questionnaires as well as analyse research data. BOS can “cross-tabulate results, filter by question response, compare results between surveys, step through responses and download data for use in other packages”, as these analytical tools are embedded in the BOS package. Therefore, one immediate benefit of using BOS is that descriptive statistics are provided for each item (see Appendix for a snapshot of the output of the questionnaire for items 3, 4 and 5). Further, the survey instrument was intentionally designed to make use of these analytical tools, while aligning individual items in the questionnaire with (providing answers to) the research question. For instance, items 11, 18, 23 and 29 directly provide insights to the research question, ‘What are staff views on the use of EVS?’ Similarly, items under ‘EVS Questions and Pedagogical Considerations’ directly provide insights into how EVS has impacted teaching practice and style. It should be noted that the principal author was primarily responsible for the design and administration of the instruments used in this research, as well as the subsequent analysis and interpretation of results.

4. 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.

4.1 Pedagogical Considerations

A voting system such as TurningPoint (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 2, show that MCQs used with EVS fall into three broad groups and these are: ice breakers, mini-tests and ConcepTests [13].

From a pedagogical perspective, the goal(s) for using a question determine the type(s) of question used. A lecturer who wants to assess student recall of previous lecture material would use a mini-test, while a lecturer who is mainly interested in assessing student conceptual understanding of a topic is more likely to use a ConcepTest, with some element of active discussion and interaction involved. On the other hand, a lecturer who does not see EVS as a tool that may make meaningful contributions to student learning is more likely to use EVS for ice breakers or to set non-challenging questions. Here is a sample of respondent submissions to the question, ‘What were your guiding principles or goals in choosing questions? (item 6 on the questionnaire):

- It was a mixture of discovering what students knew and to encourage reflection and discussion;
- No guiding goals except questions should be short and sweet.... not too taxing;
- Not just questions - but question 'sets' are used - aimed at provoking discussion on conceptual issues mainly;

3 https://www.survey.bris.ac.uk/
- Something to which I could then add matters of educational importance;
- Testing recall of previous lectures Gauging understanding of concepts;
- Revealing level of detail of understanding expected in formal assessments (exam).

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

Table 2: The role of questions (MCQs) in EVS use at Loughborough

The type of question(s) used in turn largely influences when questions are used. Mini-tests, which may consist of 4-6 questions in a typical lecture, are far more likely to be evenly spread through a lecture than for ConcepTests, which usually take longer to administer or ice breakers, which are usually not more than two in a typical lecture where EVS is used. However, respondents seemed to favour a paced-through approach to the use of questions as reflected by these comments (item 7 on the questionnaire):

- Paced throughout lecture - to maintain student interest;
- Paced throughout lecture. The first few questions were for me to ascertain their knowledge (so I could pitch the lecture at the correct level) and to help motivate the students as they often think they know how to find information. Then the question were used to generate discussion;
- Use during the lecture, about 1 after 10 minutes, mainly after a main point was delivered. Students attention declines very quickly after 10 minutes if there is no interaction. I use EVS to keep their attention high;
- Yes, because.. 1. at the beginning...to motivate the students and have favorable teaching learning environment 2. In middle... to ensure the students are equally attending the process and to balance those behind…may be to give more energy 3. At the end...send them with question so that they will find their own ways in relation to the subject matter.

As regards the creation of the EVS questions, five participants indicated that they were entirely responsible for the creation of the questions that they used in their lectures. The other three had created the questions from a combination of sources, including their own creations, previous module questions, and online/offline resources. Moreover, distractors were seen as an important means for achieving the goal(s) for using a question as epitomised by these participants' comments (see item 8 on the questionnaire):

- Yes - questions must be clear an unambiguous, distractors must be realistic;
• Yes - questions that are too easy waste can waste time and lead to students thinking they know everything. Questions that are too hard can also be a problem, as the student can get disheartened. Choosing good distractors is important as otherwise the students may have, for example, a 50% chance of getting the answer correct (if 2 of the distractors are obviously incorrect);
• Yes - too obvious and it does not generate thought. Too hard and the students get de-motivated;
• It depends on the questions. Some of my questions meant for making students to think mainly;
• Yes. I don't expect answers from students all the time. In this case they are used as ensuring the communication/link between learning process;
• No. I expect students to try the problem not to guess an answer;
• Not always - sometimes vagueness (and lies) promote discussion.

Finally, the goal(s) for creating a question would determine whether a question posed to students in a lecture is judged, by the lecturer posing the question, as being effective or not. This was the view of most of the participants, based on their submissions to item 10 on the questionnaire. In addition, they also stated that ‘When student response leads to the identification of problem areas’ and ‘When student response produces unexpected results’ are valid indicators of the effectiveness of a question.

4.2 Impact on Teaching Practice and Style

Participant response to item 13 on the survey shows that most 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 the confidence levels of staff in using EVS increased. One participant noted that it was a challenge to cover lecture material in classes where EVS was used (item 17). 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 received via EVS use in class. Two other participants also noted that the 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 (as part of a contribution to a seminar on Mathematics education) that often lecturers only get to know the areas that students are struggling with when marking the end-of-module examinations; by which time it is too late to address student problems. In contrast, the 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.

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 (see Table 3 for how participants rated a list of technical issues in terms of importance level), as has sometimes been the case. This is because 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. Further, class observation showed that this generally occurred when a question was not particularly challenging, especially for the more capable students. 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 research domain, that we are aware of, has explicitly highlighted any major downside of EVS use that is purely due to a regular and prolonged use of the technology.

4.3 Perceived Usefulness

All participants rated EVS as either ‘useful’ or ‘very useful’ on the questionnaire (i.e. item 18). However, the responses to a question (item 11 on the questionnaire) on whether EVS is appropriate for teaching Mathematics drew an interesting selection of responses. All the staff from a non-Mathematics background who responded to this question indicated that they thought that EVS is appropriate for teaching Mathematics
i.e. they selected ‘Yes’. However, the two MEC staff selected ‘Somewhat’ as their submissions to this question. 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. To clarify this, the MEC staff who participated in the study were interviewed. One of them suggested that the ambivalence is partly due to the difficulty of finding the right (Engineering) Mathematics questions to use with EVS. Moreover, this respondent had specifically found it difficult to identify and/or create ConcepTest-type questions, which would challenge not only students’ problem solving skills, but also their conceptual understanding acumen. In addition, the participant reflected aloud on whether the observed outcomes of EVS use in lectures justified the considerable initial investment. Respondent submissions to item 13 on the questionnaire indicated, for instance, that most of the participants initially spent a great deal of time in adapting their lectures and preparing the EVS questions. Meanwhile, the other MEC staff responded that EVS should be seen as a motivational tool – to get students relaxed in a maths lecture, and as such used EVS to ask non-demanding, brain-teaser type of questions at the time.

<table>
<thead>
<tr>
<th>Significance Level</th>
<th>Technical (Operational) Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Important</td>
<td><em><strong>No operational issue was rated as being overwhelmingly significant across board</strong></em></td>
</tr>
<tr>
<td>Important</td>
<td>1. Using ‘B’ on PowerPoint to get system ready</td>
</tr>
<tr>
<td></td>
<td>2. Remembering to use same dongle</td>
</tr>
<tr>
<td></td>
<td>3. Not knowing who to contact when there’s a problem</td>
</tr>
<tr>
<td>Important only for Mathematics staff</td>
<td>1. Turning Point (TP) software sometimes either malfunctions or does not work</td>
</tr>
<tr>
<td></td>
<td>2. Software/hardware incompatibility issues</td>
</tr>
<tr>
<td></td>
<td>3. Using the TP wizard to increase the number of students who are able to vote</td>
</tr>
<tr>
<td>Unimportant</td>
<td>1. Amount of technical know-how required to operate EVS</td>
</tr>
<tr>
<td></td>
<td>2. Inadequate technical support/personnel</td>
</tr>
</tbody>
</table>

Table 3: The level of importance attributed to each technical or operational issue encountered during EVS use – based on staff submissions to item 21 on the questionnaire

4.4 Benefits

The key benefits of EVS use that participants identified are (item 22 on the questionnaire):

- 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;
- It 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.

Also see Table 4 for how participants rated a list of benefits in terms of importance levels.

<table>
<thead>
<tr>
<th>Importance Level</th>
<th>Benefits Associated with EVS Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Important</td>
<td>1. It’s fun</td>
</tr>
<tr>
<td></td>
<td>2. Helps lecturer to assess student understanding of course material</td>
</tr>
<tr>
<td></td>
<td>3. Helps identify problem areas/topics students find difficult</td>
</tr>
<tr>
<td></td>
<td>4. Provided valid student feedback</td>
</tr>
<tr>
<td></td>
<td>5. Makes lectures more interactive and engaging</td>
</tr>
<tr>
<td></td>
<td>6. Increases student participation via anonymous voting</td>
</tr>
</tbody>
</table>
Table 4: The level of significance attributed to each benefit on a list of benefits associated with the use of EVS – based on staff submissions to item 22 on the questionnaire

<table>
<thead>
<tr>
<th>Importance Level</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Makes students think more about course material during lecture</td>
<td></td>
</tr>
<tr>
<td>8. Advantages of EVS use outweigh disadvantages</td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td>1. May be used to measure student attendance</td>
</tr>
</tbody>
</table>

4.5 Requirements for Effective Use

The following were identified from participant responses as key requirements for maximising the effective use of EVS in Lectures (item 28 on the questionnaire):

- 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-free and effectively.

4.6 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 (item 27 on the questionnaire):

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.

Also see Table 5 for how participants rated a list of disadvantages/barriers in terms of importance levels.

<table>
<thead>
<tr>
<th>Importance Level</th>
<th>Disadvantages Associated with EVS Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Important</td>
<td>1. ‘Setting up and closing down takes too much time’</td>
</tr>
<tr>
<td></td>
<td>2. ‘Technical (i.e. operational) difficulties’</td>
</tr>
<tr>
<td>Important</td>
<td>1. ‘Students see question time as opportunity for chatting’</td>
</tr>
<tr>
<td></td>
<td>2. ‘Lecture note preparation takes too much time’</td>
</tr>
<tr>
<td></td>
<td>3. ‘Guess or random voting by students’</td>
</tr>
<tr>
<td></td>
<td>4. ‘EVS use can be distracting’</td>
</tr>
<tr>
<td>Important only for Mathematics staff</td>
<td>1. ‘Need to carry extra luggage/hardware to class to use EVS’</td>
</tr>
<tr>
<td>Unimportant</td>
<td>1. ‘It’s not a relevant/serious teaching tool’</td>
</tr>
<tr>
<td></td>
<td>2. ‘EVS more entertainment than education’</td>
</tr>
</tbody>
</table>

Figure 5: The level of importance attributed to each disadvantage on a list of disadvantages associated with the use of EVS – based on staff submissions to item 20 on the questionnaire

4.7 Implications 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 alter their pedagogic practices to maximise the effectiveness of EVS use in classes.

5. 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, together with an academic from Strathclyde 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. The results show that EVS use can enhance student engagement, increase participation in class, give lecturers valuable feedback on student understanding, make the classroom more 'fun', and enable lecturers to change teaching practice and curriculum in response to student feedback. However, there are technical and pedagogical issues to be overcome in realizing the full potential of EVS. Further, the Mathematics faculty seem to be ambivalent about the effectiveness of EVS for Mathematics modules. 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.

Acknowledgment
This is to express our gratitude to all academic staff who participated in this study.

6. REFERENCES


APPENDIX

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Subject Centre for Information and Computer Sciences
Use of Voting Systems - Staff Experience Questionnaire

Introduction
Hello, my name is Samuel O. King and I am conducting research into the effectiveness of new technologies in teaching and learning Mathematics.

The purpose of this questionnaire is to collect information about staff experiences regarding the use of Electronic Voting Systems (EVS) for lectures. Please be assured that all data is confidential and your anonymity will be preserved throughout.

<table>
<thead>
<tr>
<th>Background</th>
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<tbody>
<tr>
<td>1. Which class(es) do you teach using EVS?</td>
</tr>
<tr>
<td>2. How many students are in the class?</td>
</tr>
<tr>
<td>3. Is this your first experience of using EVS for teaching a class?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Other (please specify):</td>
</tr>
</tbody>
</table>

| EVS Questions and Pedagogical Considerations |
| 5. How did you select the questions used during lectures? |
| *select all that apply* |
| From past (course, test, etc) questions | From a designated (e.g. online or offline) resource | Created |
BLOG POSTING SAMPLE

10.00am Monday 1st October (2007):

Hi Both, I have just given my 9.00am Lecture to MAB110. I used promethean (whiteboard) and Turning Point, and also used radio microphone. Even though it was a first lecture I didn't cover half as much as I'd hoped.

I got into a problem leaving Promethean and opening Turning Point. I managed it but lost work on Promethean AAAAAAArgh..... honest guv it worked a treat in practice.

I had too much to carry (as usual) and the start up process and the close-down process takes two much time.

I appear to have LOST two hand sets!!

It may be better to record lectures outside the lecture room and only use Turning point for interaction, though handing out and collecting back is still a fad.

1:30pm Wednesday 4th October (2007)

Have spent quite a long time trying to set up my tablet pc this week. Thanks to the handout given to me by XXX and Wolfson's IT support (XXX), the addIn is now downloaded onto the machine (aka this useless piece of ****) but we could not get PowerPoint to add it which may be because it needs updating, so as I type it is in the IT office downloading various patches, etc from Microsoft. It didn't help that the wireless connection wasn't cooperating this morning and apparently I need (would benefit from) more memory. I'm very glad that I went for the simplest application as there is still a chance that it'll be ready for tomorrow. At this moment, I am feeling reasonably laid back as it shouldn't impact on my lecture delivery just what I do with the notes afterwards (which is usually leave them in the lecture room scribbled on the OHP acetate roll). If I can't get it to work in time I may prepare the notes separately so at least I can practice uploading it onto Moodle. Why are we doing this?

EDIT: 5:13pm - not been able to resolve problem, still unable to see AddIn, so not sure what to do next.