

Student and staff feedback on using an electronic group response system in a Mechanical Engineering lecture at the University of Sheffield

The learning context in which the electronic group response system was introduced

Mike Diprose, a lecturer in the Department of Electronic and Electrical Engineering at the University of Sheffield put in a bid to the Curriculum Development Fund in 2001 to introduce an electronic group response system into a first-year module in electrical engineering for mechanical engineers (EEE111). The aim of this project was to find out whether this kind of technology could enhance the student learning experience in a lecture environment. The bid was accepted and a system was bought. The complete system consisted of text processing and presentation software for the production of questions and answers, a voting facility and hardware consisting of a radio receiver and 34 voting handsets.

The technology was used from week eight of the semester (twice a week during a one-hour lecture with the same student cohort). The 34 handsets were given out at random to the c. 90 students present. Multiple choice and true/false questions were prepared in advance and then displayed during the lectures (via PC and data projector). Students were given approximately 30 seconds to select an answer and to submit their vote. The results were displayed and the correct answer was shown instantly, although in one instance, it was decided not to show the results until later. In most cases, the lecturer explained the correct answer. In three of the four lectures in which the system was used, students were given a few revision questions at the beginning of the lecture that related to material covered in the previous lecture. Mid-way through the lecture a few more questions were asked which either referred back to content presented in the first half of the lecture (to test their understanding) or in advance of content (for example, in order to predict the outcome of an experiment). Finally, some questions were asked at the end of the lecture to test the students' understanding of the overall lecture. Each of these individual question sessions took about five minutes (c. 15 minutes in total, i.e. 1/3 of lecture time). In the final lecture, a different approach was used. The system was used for revision purposes, providing a constant flow of questions, answers and feedback. Moreover, students were encouraged to work with their peers and to discuss the questions and answers before voting.

Evaluation method and tools used for this project

The introduction of the electronic group response system was of an experimental nature and therefore, the evaluation did not measure the success of any predefined objectives. Instead the evaluation set out to investigate what kind of impact the use of the system had on the learning and teaching experience. Through discussion with the project leader, some themes emerged for evaluation, such as student perceptions, ease of use of the system and the effects on learning and teaching and student interaction. Furthermore, it was decided to find out whether the use of the system during lectures had positive effects on student attentiveness. (Researchers at IBM training centres claimed that this kind of technology increased student attentiveness in lectures, Horowitz 1988.) The primary evaluation tools were lecture observations, questionnaires, an end-of-semester focus group with students and discussions with staff (Audio Visual Services, Learning Media Unit guest observers and the lecturer). Eight lectures were observed in total. The system was integrated into four of these. The first two lectures were delivered in a traditional lecture format, although they included paper-based questions at the end that tested the understanding of the lecture content. In the third lecture a PowerPoint presentation was used to display questions at the beginning, the middle and the end of the lecture and students provided the answers on paper. No feedback

was provided to students in those first three lectures. The system was then used until the end of the module. (It had to be abandoned on one occasion (lecture 7) due to some organisational difficulties.) Short questionnaires were distributed to students in the first five lectures but the number of returns gradually dropped from 74 to 40 and no questionnaires were distributed in the last two lectures. During the lectures, the evaluator sat at the front or back and observed the behaviour, interaction, body language and approaches to learning and teaching, as far as this was possible. For the purposes of this pilot project, the chosen approach to data collection seemed suitable and sufficient. Valuable information is now available which provides a better understanding of the ways in which an electronic group response system can be successfully integrated into university teaching. The evaluation results are presented in the following.

The impact of the electronic group response system on the student experience

The information presented in this section is drawn from the focus group at which seven students were present, from the questionnaires that were distributed to students in the first five lectures and the actual observation of the lectures in which the system was/was not used.

Student perceptions of the system

The electronic group response system seemed generally well received by the students who thought that it was a valuable tool which helped them to understand the lecture content and to provide feedback on their learning progress. Students commented that they were quite excited when they first heard that they would use handsets to vote, associating it with popular TV programmes such as 'Who wants to be a Millionaire?' When it actually arrived, it seemed less adventurous than anticipated. However, they did not attribute too much importance to the 'fun' factor. Instead, their primary concern was the pedagogical effectiveness of the system and they believed that the system was generally a good educational tool that could be used in a variety of learning contexts. The students' main criticism referred to the level of intrusion of the technology in the classroom and they made a number of suggestions on how the technology could be integrated more successfully.

The system should be operated by the lecturer, rather than by support staff and the operation should be smooth and without technical glitches. Voting time for students should be kept to a minimum, otherwise students spend too much time waiting. Finally, the visual appearance of the questions and answers should be interesting, varied and professional looking. They also recommended that all students should be provided with handsets. One student who did not receive a handset commented that he did not pay any attention during the question sessions, as he felt excluded from it. In general, the student response to the use of the system was positive and students recommended the future use of the system throughout the university and at conferences.

Effects of the system on the lecture experience and on student interaction

The discussions in the focus group became quite intense when students looked at the ways in which the system could be integrated in a lecture environment. Students differed in their opinions which to some extent depended on their preferred learning styles (as one student pointed out.) The revision lecture was well received by the students. They felt that working with their peers to discuss the questions and answers before submitting a vote was a highly effective way of learning. It also made the lecture very interactive. This was notable during the observation: students discussed, explained and negotiated among each other in ways they did not in the previously observed lectures in this module. In general, the students felt that the technology should not be overused during lectures. They seemed very protective about lecture time and thought that this was better spent obtaining new information from the lecturer. It is therefore not surprising that they thought that the question sessions in the middle of the lectures disrupted the lecture flow. They stated that they preferred revision questions at the beginning of the lecture and a question session at the end, lasting no more than five minutes each.

Students were also asked to identify what effect the system had on their interaction with their peers. Some students thought that the interactive peer approach in the last lecture made

students quite competitive. As they could only submit one answer through a handset shared between two or three students, submissions had to be negotiated. This problem could be avoided if each student had a handset. The students' recommendation was therefore to enable peer discussion of answers but to allow students to give their answer on individual handsets.

Effects on student attentiveness

It turned out to be difficult to measure how the use of the electronic group response system contributed towards students' attentiveness during the lecture and a wider research project is needed to answer this question fully. The lecture environment was not a typical lecture environment in that there were many different stimuli that made students attentive, such as demonstrations, video clips and the use of other teaching aids (Child, 1986). In this particular teaching context, the electronic group response system therefore did not make as significant a difference to attentiveness as it might have made in another lecture context in which there are no other stimuli.

Generally, student performance during the lectures seemed very good, which would not have been possible had they not been attentive. Not only did the body language of the majority of students suggest that they were attentive but an average of 75% of students who chose the correct answer throughout the lectures in which the system was used suggests that students were attentive. The high success rate did not appear to be random indicating students did not guess the answers.

The end-of-year examination results did not appear to change significantly as a result of using the system. The research question should therefore not be whether it is the technology that makes a difference but rather whether it is the way the technology is used that makes a difference. Moreover, the difference does not necessarily relate to student performance. Using the system has in this project led to increased interactivity and enjoyment, which are important factors in the students' learning experience.

The role of feedback

In general, students greatly appreciated the immediate feedback that the system provided. It helped them in their understanding of content, identified strengths and weaknesses in their learning and gave them some idea about their learning progress. The revision session at the beginning of the lecture and the feedback provided also seemed to have an effect on their discipline. As one student pointed out: 'It tells me the consequences of not coming to last week's lecture...'. Another student thought that it would be useful if individual students could access a record of their results from the question and answer sessions that could help them later in their revision work. Generally, students agreed that feedback was required after every answer, even if most students selected the correct one, in order to reinforce the learning that had taken place and to ensure that students fully understood why a particular answer was correct. The discussion about the value of feedback brought up wider issues about the amount of guidance a teacher should provide. Some students suggested that questions should be used to summarise the main learning points of the lecture and to provide students with feedback on their understanding of the content and progress in their learning. Some students had a very narrow view of the way in which feedback should be given. They found it difficult to cope with verbal feedback in which the right and wrong answers were explained from a number of different perspectives. These students thought that feedback should be 'consistent', 'concise' and 'coherent' and that there should be only single explanations. One student thought that the only way this could be done was through written feedback displayed on the response screen, rather than verbal feedback from the lecturer. These remarks are rather worrying, as they seem to reflect an inability on the part of the student to cope with multiple perspectives and complexity. Some students also thought that the question sessions could have both positive and negative effects on student confidence. The discussion then broadened even further and it was discussed whether it would help the students to have the questions and answers available outside the lectures. For example, as online quizzes including more detailed feedback and references to learning resources that covered the points in question, so that students had the chance to investigate difficult questions further. While students generally seemed to welcome this idea and thought that it would be very

valuable (particularly during revision), some students warned that there was a danger of spoon-feeding students if there was too much help provided.

Ease of use – pedagogical considerations

From the students' point of view the system was easy to use. Sometimes, however, questions were not displayed long enough and there was not a 'don't know' option available. Consequently, some students guessed the answer and this might well have distorted the results to some extent. Good practice would be therefore to include a 'don't know' option. This would provide the lecturer and the students with a more accurate picture of the students' understanding of the lecture content and it would probably also reduce the time it takes the students to give their answer. The lecturer, however, pointed out that a 'don't know' option could make students lazy and prevent them from trying hard enough to work out the answer.

From the lecturer's point of view although the system had a significant impact on the way he planned and organised his lectures, he felt the time and effort was very well invested. At first he found it quite difficult to co-ordinate the use of the system with the many demonstrations, videos and other technologies he used as a standard repertoire, although this did not come across in the lecture observation. The major challenge in this project was the effort and time it took to generate the questions and answers. The questions had to take into account many different issues: What are the students supposed to gain from the questions and answers? What questions should be asked? How should the questions be asked? What type of answers should be provided that will be of greatest benefits to the student learning? When should the questions be asked? How can the questions be integrated into teaching and how do the questions impact on the planning of the lesson? What feedback should the lecturer provide? (See the Computer Assisted Assessment Centre for more detail on the educational considerations in the design of questions and answers.) The lecturer found it also difficult to produce wrong answers. They had to be wrong, yet not obviously so to aid guessing, i.e. choosing and answer by eliminating wrong ones, rather than knowing the correct one. Once generated, however, they can be used each time the course is delivered. The final challenge for the lecturer was when students voted on the handsets and the results were displayed. He had to respond to the results and provide instant adequate feedback which would help the students in their understanding. He found this aspect, however, interesting and challenging and an unknown quantity within a lecture course delivered year on year.

What makes the technology very attractive is that it is context-independent. The technology is very flexible and versatile and it can support any number of teaching and learning approaches and contexts of use (Abrahamson, 1999). In this particular pilot project, the system was used mainly for memory questions, but also for calculations. It was used to test students understanding of lecture content and for revision. Finally, it was also used for peer work, which seemed a particularly successful way this technology could be integrated. (The University of Strathclyde also use it successfully for peer work, Littlejohn, 2001.) It would, therefore, seem that the technology can be used creatively in any kind of academic discipline to help retaining student interest - as long as it is properly managed from a pedagogical point of view.

Ease of use – technical considerations

The introduction of technology into learning and teaching is often dependent upon adequate learning infrastructures, particularly with regard to access, training and support. Due to the late start of the project (late allocation of the funding) the system could not be used with students until week eight of the semester. Moreover, there was not enough time to train the lecturer in using the software in preparation for, and during the lecture. The evaluation identified the following technical issues:

Preparing the question sessions

The Reply software was easy to use after the initial training had been received. It takes a small amount of time and effort to set up a template and to type in questions, answers and voting parameters. However, there are a few limitations to the software, which makes the data input more cumbersome than it need be. Scientific symbols cannot be inserted because the

font of individual characters cannot be changed in a text box without changing the whole text to the new font. As a result, PowerPoint slides and OHP slides were used in this project to display questions that included scientific symbols and the electronic group response system was in this case merely used for the voting facility. There are a few other minor quirks in the software and it is hoped that the software suppliers can eradicate these.

Using the system in the classroom

Due to the late start of the project and the fact that the lecturer used a large number of electronic equipment in his lectures, two additional members of staff from the Learning Media Unit and Audio Visual Services were needed to set up and run the question sessions. In an ideal situation, technical support staff would have only installed and tested the hardware and then disappeared, leaving the lecturer to 'drive' the software him- or herself. The lecturer suggested that it might be less intrusive to install the hardware permanently in one lecture theatre that could be booked by any member of staff. Room-booking decisions are based on student numbers which means that only a small fraction of university staff would actually be able to book such a room. Audio Visual Services therefore recommend that the equipment is not installed permanently in one room but booked by staff on a needs basis. The actual installation and testing of the hardware and the distribution of the handsets only takes about five minutes. In phase 2 of the project, lecturers will be trained in using the software, so that they are not dependent on support staff (although Audio Visual Services will still provide support in setting up the hardware).

Costs of using the electronic group response system

Although the initial purchase costs for the system were relatively high, both students and staff involved in this project thought that with regular use, e.g. by other staff and at conferences, the system would become cost-effective. The system is easy to use and requires only initial training. The licence agreement allows the installation of the software on an indefinite number of local machines which enables teaching staff to create the question file at their own computer workstation. The hardware itself is very durable and portable which means that it can be easily installed anywhere in the university. From a pedagogical point of view, the system can be used in many innovative ways and supports a variety of approaches to teaching and learning, which means that most staff in the university might consider using the system.

If you would like to use the electronic group response system in your teaching...

As part of the continuing project Mike Diprose will be extending his use of the system and would like to invite other staff to use the system in their teaching and to participate in further evaluation in the first semester of next academic year (2001/2; phase 2 of the project). Staff will be trained by the Learning Media Unit in the use of the system and will receive classroom support from Audio Visual Services in the setting up of the hardware. If you are interested in taking part in the second phase of the project or would like to find out more about this project or the use of the system in general, please contact the appropriate members of staff below.

Contact

For further information about the use of the electronic group response system in a lecture context, contact Dr. Mike Diprose in the Department of Electronic and Electrical Engineering. Email: m.f.diprose@sheffield.ac.uk; Tel: 25356.

For technical advice on the use of the system (hardware and software), contact Ian Knowles in the Audio Visual Unit who provided technical support for this project. Email: i.knowles@sheffield.ac.uk; Tel: 29294.

For pedagogical advice, training in using the system in your teaching and evaluation, contact Gabi Diercks-O'Brien, the Educational Advisor in the Learning Media Unit, who worked on this project. Email: g.diercks-o'brien@sheffield.ac.uk; Tel: 20428.

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