Motivating Students using In-Class Questions

Elizabeth M Laws
School of Computing, Science and Engineering, University of Salford, Salford M5 4WT, UK
e.m.laws@salford.ac.uk

Abstract – Undergraduate engineering students have little time to absorb and assimilate technical knowledge. Many students, when faced with questions in examinations and formative assessment, frequently lack the skills to answer them and perform poorly. As a consequence they fail to gain confidence in their abilities and this impacts on future potential and contributes to poor retention levels. For some years this problem solving deficiency has been addressed by using the PRS system originally marketed by Educue, now marketed through Interwrite, encouraging students to answer questions in class using hand-held electronic devices. However the complexity associated with assigning handsets to students and ensuring their return took up too much valuable class time and the system could not be used to its full potential. More recently a new style of hand-held unit which connects through radio frequency has become available and acquired. Since any student can use any device as the student actually signs in 'live' to join a class the removal of the requirement to give a particular unit to an individual student eliminated much of the time element associated with their in class use making the technology useful. This paper focuses on the experience of using these units from both the lecturer and students perspective.

Index Terms – Interactive, Motivating, Problem solving, Retention

INTRODUCTION

Teaching engineering students is demanding and the workload for these students is usually high in comparison to students of other disciplines. For those Institutions for which semesterisation is the norm (the majority) a student will invariably pick up 6 disparate (though linked) topics to be covered, assessed and examined within a 15 week study period. Thus both lecturer and student are hard pressed in what is becoming an increasingly pressured education system. Whilst some students can cope with this pressure easily having, prior to coming to University, acquired good organisational and study skills many will be overwhelmed by the tasks they are faced with and rely on the anonymity which comes from large class sizes and sink into poor methods of keeping abreast of the work to be done. This coupled with the freedom associated with life on campus frequently produces a negative learning environment.

The only time that it will become clear to the academic that an individual student has not been working productively on their studies will be when the end of semester examination results become available. By then the only opportunity for recovery will be through a student resitting an examination with the likelihood that a student who failed to work during the semester is unlikely to work during the summer to recover the module with a knock on effect on retention.

Certain indicators for success are known, one of these being student attendance at timetabled activities, and considerable effort is usually placed on monitoring this. In my own school a dedicated achievement coach is devoted to chasing errant students and attempting to ensure that they do attend. Because of the financial pressures on students many are balancing the heavy class-contact time with part-time (and sometimes full-time) work and no amount of persuasion will enable them to attend 100%. Experience also shows that attendance alone is insufficient to ensure academic success this only comes from the work that students put into their studies.

A variety of methods of encouraging students to work steadily have been employed including use of the Blackboard VLE [1] and a change in assessment methods so that part of the overall module mark was given for a number of on-line tests undertaken in Blackboard. This approach has been shown to contribute to student success, [2-4], and in parallel with this approach the use of in-class questions was employed.

THE PRS SYSTEM

A number of different types of electronic voting systems are available, often these are linked with the software used with an interactive whiteboard and many dovetail with PowerPoint. These include the Classroom Performance System marketed by Ambra [6] and Powerclick (marketed by Aclass Technology [7]). Many of these products have only recently become available. The system employed in the present study was the PRS system initially marketed by Educue and now by Interwrite [8].

FIGURE 1 INFRA-RED RECEIVER

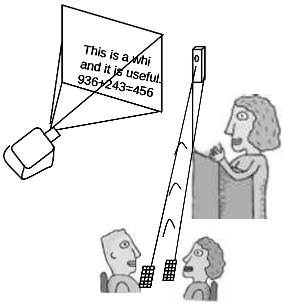

FIGURE 2 CONNECTION ARRANGEMENT FOR INFRA-RED RECEIVERS

The hand-held units shown in figure 1 link to the classroom computer through fixed receivers as shown in figure 2. Whilst for those Institutions that have taken a collective decision to employ this technology in teaching it would be a simple matter to have the receivers installed in class rooms so that only the hand-held units needed to be carried it was necessary to take both the units and the receivers into each class along with a computer and data projector. This was further complicated because the receivers connected through a serial port and most computers no longer have these as standard so a serial port to USB adapter was also needed. The logistics of being able to bring all the equipment to a class was addressed by having a custom made trolley produced on which it could all be mounted with shelves for the units which could simply be moved from class to class this permitted the complex wiring needed between units to be hidden as far as practical. Whilst trundling this around was labour intensive given that timetabling constraints usually meant that classes moved frequently between one room and another it was a practical solution and the only method which could be used at the time.

Despite the functional trolley arrangement it took some of the class time available for students to collect their unit (each unit carried its own number and needed to be associated with an individual student) and for the units to be returned at the end of the class. Though the students enjoyed the use of the approach and engaged positively the overall logistics problems proved too great and after several years of using the units they fell into abeyance.

THE RF CLICKERS

At the start of the 2006 academic year a second attempt to use in-class questions was made and a new set of hand-held units acquired. These new units connected to the computer through radio frequency (eliminating the need for the receivers) and had the significant advantage that any student could use any unit so the time needed for setting up was significantly reduced. The new units also came with updated software which linked directly to PowerPoint and whereas with the original system it had been necessary to switch between the PRS software when asking questions and PowerPoint when delivering lecture material now this switching was automatically done by the software itself from

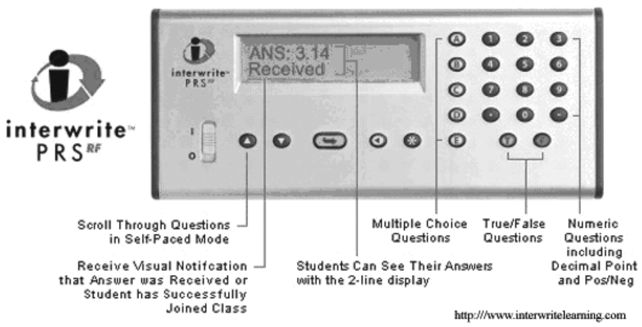

FIGURE 3 RF HANDSET

PowerPoint. These two improvements improved the ease of use of the in-class units greatly. A new style unit is shown in figure 3, these units connect through a small radio receiver which simply connects to the PC through a USB cable. (eliminating the need for the serial port to USB adapter).

The arrangement by which the RF units (called Clickers) connect to a computer is shown in figure 4.

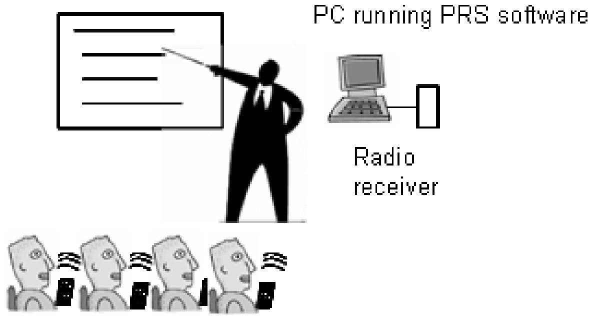

FIGURE 4 CONNECTION ARRANGEMENT FOR RF RECEIVERS

In class usage the system in figure 4 was deployed with an interactive whiteboard which connected to the computer using a blue tooth dongle so that many of the cables previously needed were redundant.

USAGE OF CLICKERS IN SEMESTER 1

During semester 1 the clickers were used for two different cohorts of students. Level 1 Engineering Thermodynamics a module taught to a class of 85 students spanning programmes in Engineering, Aviation and Physics and level 2 Aerofluid Dynamics a module taught to 35 students spanning programmes in Engineering and Aviation. For the level 1 students the technology was new but some of the level 2 students had experience of using the old hand sets in earlier years of their programme in other modules.

The materials made available to each cohort of students at the start of the semester included a booklet of questions associated with individual lectures eliminating the need for these to be handed out in each class and hence saving valuable class time. Initially a set of only 50 clickers were available so that the level 1 students were required to work in pairs but the level 2 students could each have their own clickers. Both groups engaged positively with the clickers and the question sessions and for the level 1 students, new to campus, it provided a good opportunity for them to work with others. However for the level 1 students it was impossible to determine which students had answered questions correctly. Whilst those students working in pairs were asked to sign in with a code which allowed the software to determine which pair of students had formed a particular group (the score would then be split equally between the two) not every pair of students did so and the data available on occasions could not be analysed properly. This problem did not arise with the level 2 students and for this cohort it was possible to see who had answered or simply failed to answer questions and for those who answered who answered correctly.

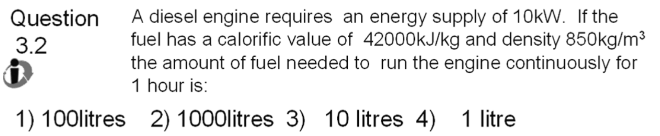

FIGURE 5 SAMPLE QUESTION ENGINEERING THERMODYNAMICS

A sample question is shown in figure 5 the Interwrite logo which appears below the question number is the trigger to the software that the PowerPoint slide contains a question and the lecturer is then given the option of using the Interwrite software associated with the clickers.

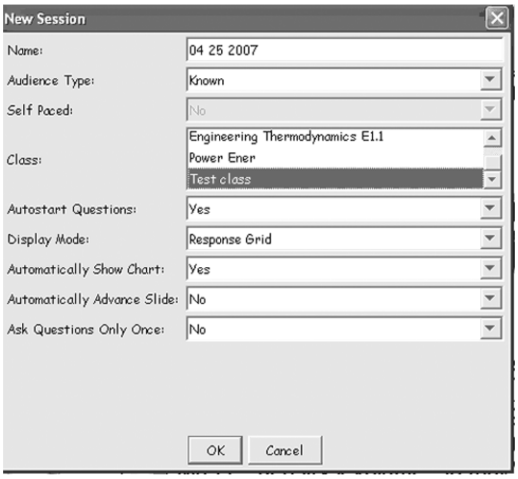

FIGURE 6 SAMPLE RESPONSE GRID

A yes response indicating that the lecturer wishes the students to answer in-class questions produces a response grid as shown in figure 6 and also associates the clickers to a particular port on the computer. This also allows the lecturer to select the correct class and set the parameters which will operate during the question session. Once the clickers are linked to a port and the session is started by the lecturer the students can join the question session through their handsets and they sign in with either their name or a unique identifier. This will come up in the software and when a question is answered the responses will be logged against this identifier for analysis after the class session is completed.

The lecturer allocates an appropriate time allowance for each question and as the time progresses the lecturer can see how many students have answered and if the number is low the time limit can be manually increased. Equally if all students have answered before the time limit is reached the question can be manually ended saving class time.

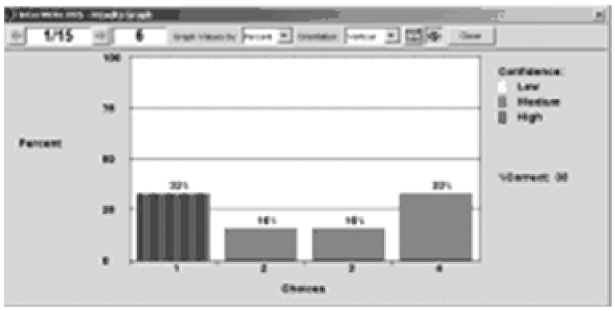

FIGURE 7 SAMPLE RESPONSE GRID

When the time limit is exceeded a response grid as shown in figure 7 is displayed. From the response grid it can be seen at a glance how many students answered correctly and if considered necessary the lecturer could go over some material again or go through a worked solution of the problem before moving on to the next question.

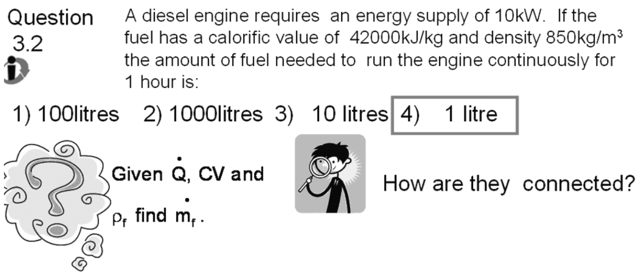

FIGURE 8 SAMPLE WORKED SOLUTION

The approach adopted in working through solutions with level 1 students was to encourage them to focus on the data supplied in the question and the quantity they were required to find and then to identify the link between them as shown in figure 8.

This technique appeared to work well and the majority of students made positive progress and also found the question sessions enjoyable. When the complete solution was made available they were also given the opportunity to go over the questions again though the VLE. The attendance at classes was good and if time constraints prevented the use of the clickers' the students were actually expressed disappointment.

For the level 2 students a running score was kept over the semester and the results announced at the last class session. The scores from clicker sessions can be easily exported to the Blackboard gradebook. The clickers were also used as a means of surveying student reaction to various aspects of the modules (including their response to using clickers) and over 90% of the students considered that they motivated them to learn.

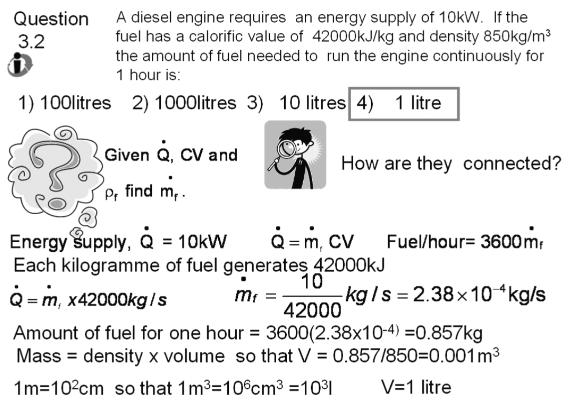

FIGURE 9 SAMPLE PROBLEM SOLUTION

USAGE OF CLICKERS IN SEMESTER 2

The clickers were used again in semester 2 in three further modules two at level 1 and the third at level 0 the foundation year. Given the experience of semester 1 50 additional clickers had been purchased so that all of the students could have their own. This greatly improved the general work effort and enabled accurate statistics to be produced throughout the semester. The facilities offered within the software for monitoring individual student performance allow the progress of individual students to be regularly monitored. Over the academic year a total of 300 students used the clickers and a healthy competitive element developed in each class. Students would discuss amongst themselves solutions to particular questions and work on the questions outside of the class.

FUTURE DEVELOPMENTS

The use of the clickers was largely viewed as a positive learning experience which encouraged students to learn, provided some enjoyment and encouragement and also developed problem solving skills. In addition to the usage of clickers the students were encouraged to study steadily because of regular assessments they were required to undertake through the Blackboard VLE. The students also considered that this motivated them to learn. However, particularly in the case of multiple choice questions in Blackboard some felt aggrieved that they got no marks for the method used but only for a right or wrong answer. It is the intention in future years to move one of the assessments currently undertaken in the VLE to a clicker session in which students can work at their own pace (this is possible in 'self-paced mode') which is automatically marked in the clicker afterwards but from a written submission of the work the methods used would be assessed later manually and a proportion of marks would be added for method.

STUDENT PERFORMANCE AND ATTENDANCE

No matter how much effort is supplied by the lecturer the success of individual students is largely achieved by the effort supplied by the student. Whilst the lecturer's task is to supply materials and to teach, motivate and encourage learning this can only achieve positive results with co-operation from the student. A careful analysis of the examination performance of the students from level 1 Engineering Thermodynamics was undertaken in which student performance was correlated against both attendance in timetabled classes and usage of the VLE (taken to be an indicator of work being done in addition to formal class contact sessions.

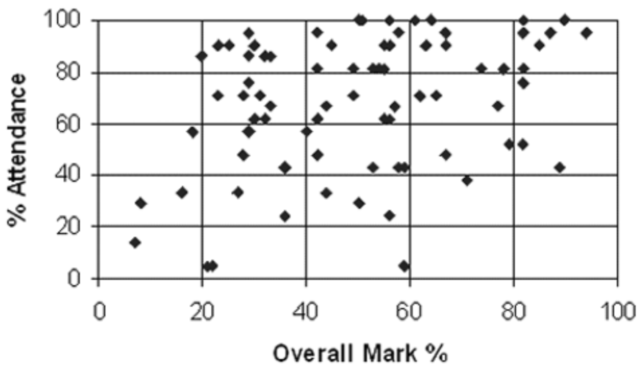

FIGURE 10 ATTENDANCE AGAINST OVERALL MODULE MARK

Figure 10 shows a graph of attendance against the students overall mark. The pass mark from the module was 40% and it can be clearly seen that though some students who attended badly did fail some students who attended very well failed also.

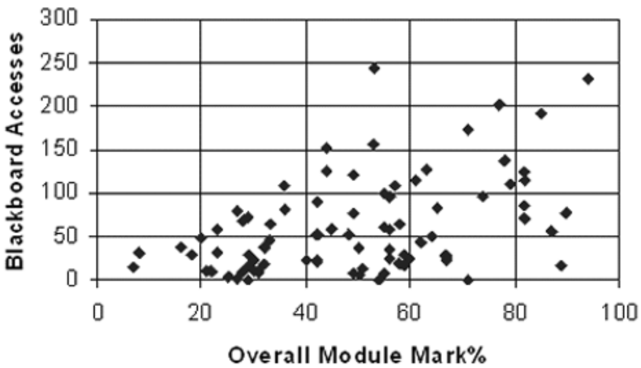

FIGURE 11 BLACKBOARD ACCESSES AGINST OVERALL MODULE MARK

As all students had to use the VLE for the assessments the accesses needed to undertake the assessments was subtracted from the total accesses for an individual student before this correlation was carried out. Figure 11 shows a correlation of Blackboard usage against overall module mark this shows clearly the students who did fail the module had used Blackboard (other than for assessments) less than 100 times over the semester.

Thus being in class is not sufficient to ensure success and a combination of class attendance and work outside the class is necessary. Without embracing some form of technology it would be impossible for an academic to gauge the amount of work that a students was doing until it was too late. The clickers have a part to play in ensuring that students in classes are more than passive watchers and actually are required to do something.

CONCLUSIONS

The use of the clickers definitely enhanced the student learning experience and had a beneficial effect on the enthusiasm of the different cohorts of students on which it was used. The class sessions were dynamic, interactive and enjoyable and the students contributed positively once their initial apprehensions had been overcome. The experience gained during this academic year will allow improvements to be put in place for next year and fuel a modification in assessment as described previously. The ultimate goal will be to move part of the module assessment onto clicker questions answered in class since this will encourage and promote attendance in classes since many students are motivated to work only when assessments are in prospect. The various approaches adopted in the teaching of engineering students have been employed with the single goal of encouraging students to learn. Each cohort of students has its own characteristics and dynamics and though the module material may not change significantly from year to year the delivery of a module must be adjusted to meet the needs of particular student groups.

The technology made available with the clickers, the facility of monitoring individual students usage over the semester and its ease of interface with the Blackboard and University gradebook mean that this technology has a lot to offer the academic who engages with its use, to the benefit of the student and their overall learning experience. Though there is a learning curve to being able to use the various features that the clickers offer that time is well spent when the facilities which they offer are fully capitalised on.

REFERENCES

[1] Blackboard Home Page, http://www.Blackboard.com.

[2] E. M. Laws, A Pilot Programme into the Use of Blackboard to Support the Teaching of Engineering Undergraduates. ICEE (Manchester), September 2002.

[3] E. M. Laws. Innovation in Engineering Education., Internationl conference in Engineering Education, Olomouc, June 2004.

[4] E. M. Laws. Promoting Understanding using a Virtual Learning Environment, International Conference in Engineering. Gliwice, Poland, June 2005.

[5] PRS, http://www.educue.com.

[6] Ambra, http://www.ambra-solutions.co.uk.

[7] Aclass Technology, http://www.aclastechnolgy.co.uk/pwerclick/index.html

[8] Interwrite, http://www.interwritelearning.com