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TEACHING CYCLE III

Using an Interactive Student Response System in Teaching Corporate Governance

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Introduction

This Teaching Cycle describes the use of an interactive Student Response System (alternatively known as a Personal Response System) in a standard lecture environment, and reports the results of a trial using the technology in a Year 2 and 3 undergraduate module at the School of Management and Business at Aberystwyth University. Advantages and disadvantages of the technology are discussed, and the for using this technology more widely is explored in detail.

Student Response Systems (SRS) are an evolving interactive polling technology designed to create an engaging and motivating learning environment and are used to encourage active learning, especially in large lecture classes. This technology offers a lecturer the opportunity to ask a group of students multiple-choice and other types of questions to which they reply individually by selecting an answer on a hand-held wireless transmitter. Receivers connected to the lecturer's computer pick up these answers. Computer software then may aggregate the responses, reproduces these through standard display technology, and students compare their answer to that of the class. Hence, this technique queries the audience for a quick, anonymous where selected, response to questions posed in class. The question or problem is typically

\* There appears to be no standardization of terminology in the literature for this technology, and such systems are variously described by vendors and academic users as: audience-paced feedback systems (APF), classroom communication system (CCS), classroom performance systems (CPS), electronic response systems (ERS), interactive engagement (IE), interactive audience response systems (IRIS), interactive learning systems (ILS), interactive student response systems (ISRS), personal response systems (PRS), and group response systems (GRS). This report refers to this technology as a 'student response system' and applies the SRS acronym throughout.
displayed using a classroom projection screen; however, some more advanced student response systems can display prompts on the video screen of each student’s input device (‘smart’ keypads with LCD displays, PDAs, text-messaging mobile phones, notebook or laptop computers).

Depending on the particular SRS system used, question/response types may include: 1) the simple true/false, yes/no, or multiple-choice formats, or 2) more involved formats of numeric entry, multiple-choice with multiple correct responses, rating scale, sequencing, or even short essay answer and ‘fill-in-the-blank’ style responses. More advanced software allows the use of textbook-specific content software which can offer the lecturer ready-made chapter outlines, case studies, graphic images, tables and figures, video clips, animations, quiz and test question-banks, and polling questionnaires.

The particular SRS used at Aberystwyth University is the Qwizdom© 'interactive voting system'. Qwizdom© technology can combine response system interactivity, customized presentations, formative assessments, and online reporting. This allows any tutor to set up a quiz (in a PowerPoint style) and students can then give their answers to the quiz using remote control handsets. The system integrates well with existing whiteboards around the college. Specifically, its use enables the lecturer to capture instant feedback, and quickly allows for multiple choice, true/false and yes/no questions. Responses are automatically collated and can be graphically displayed through the standard overhead technology, making it possible to create dynamic presentations and lessons for any size audience.²

The use of an SRS was trialled in a Year 2/3 undergraduate module on Corporate Governance at Aberystwyth University in the 2007/08 academic year. The 110 students on the module were given 12 lectures in total and the SRS was used in a

² Although physical variations exist among different systems on the market, by and large, the systems are remarkably similar in use and have maintained a similar approach throughout their development over the past four decades. Electronic response systems typically allow students to immediately respond to questions through the use of a sending unit and the results are immediately visible through the use of a projection system. Most SRSs incorporate three basic components which include the student input devices, operating system software on the classroom computer, and a standard classroom projection system to display the questions asked and the distribution of student responses. While the particular technology has changed over the years, the underlying pedagogy has remained the same.
select number of these to gauge student responses. This gave students and the lecturer
the opportunity to compare the learning experiences offered by standard lectures and
lectures incorporating the use of a SRS. Delivery of a 50-minute lecture would
typically be interspersed by asking four to five multiple-choice questions, to which
the students would reply using their handsets.

**Rationale for the use of an SRS**

Having taught the Corporate Governance module for a number of years, I felt that it
was a subject that students have traditionally found challenging, and difficult in some
cases. In part, this can be explained by the very different educational backgrounds,
significantly different academic abilities, and vastly divergent intellectual interests of
the student body on the module, reflecting the common issues surrounding widening
participation and an increasingly international audience in Higher Education. While
the coursework component of the module was facilitated by designing an assessment
method to support and foster independent learning (See Teaching Cycle II), class
delivery still ran the danger of being interpreted by students as a mainly passive
activity, falling prone to the 20-minute attention span trap (Johnstone and Percival,
[976; Bums, [985), and potentially failing to sufficiently motivate students.

Traditional lectures and textbooks typically rely on one-way communication from
instructors and authors to students, a process which assumes that students are able to
assimilate the information, integrate it into existing understanding, and are
subsequently able to apply the learned knowledge to new situations. Practice shows
however, that this may be a somewhat optimistic assumption and the traditional
lecture may instead suffer from low attendance rates, poor comprehension, and
insufficient levels of deep learning.

Further, in a lecture environment students may be unwilling to volunteer information
regarding their level of understanding (or otherwise) of material covered, particularly
when openly asked by the lecturer. While the use of muddiest points, the one-minute
paper, hand response question-and-answer sessions, and paired discussions was
explored in Teaching Cycle I, it was expected that students would further benefit from
the immediate graphical feedback, and the privacy of student input (where this is selected as an option), which the use of interactive technology offered.

Collected feedback also provides the opportunity to adapt the lecture accordingly or to reiterate points which students found challenging. If, after observing the results of a question, there was a concern that students had not fully understood the material on which the question was based, the material could briefly be reviewed, and follow-up seminar content could be designed accordingly. Multiple-choice questions can also be used as a way of introducing a subject, asking students to apply their analytical reasoning skills prior to being formally introduced to a new topic within corporate governance, or to reinforce important concepts. Consequently, the use of an SRS and the particular questions asked were also used as a means of anonymously testing students' understanding of material recently covered and to further encourage deep learning. The overall aim of this Teaching Cycle exercise is to develop a more engaging course that increases students' interest in and appreciation of the topic, help students learn to work more effectively, and improve student's understanding of the subject matter.

The Corporate Governance lectures last a standard 50 minutes. However, there is considerable evidence suggesting that a lecture audience struggles to maintain concentration levels for such a long time period (Johnstone and Percival, 1976; Bums (1985). Earlier, MacManaway (1970) reported that for the vast majority (84%) of his students, lecture concentration was limited to 20–30 minutes. Hence, another motivation for introducing the SRS was to break the lecture into segments using an activity that periodically required the students to respond, and thereby varying students' lecture learning experience. Long established evidence also suggests that it may take students 5 minutes to settle down at the beginning of a lecture (Lloyd, 1968). Hence, it was hoped that using the interactive SRS to ask a series of questions at about 25 minutes into the lectures would have the additional benefit of reinvigorating students' attention and concentration levels.

It has long been recognised that the lecture environment typically fosters passive learning. Alternatively, an SRS offers a tool for active engagement. Hence,
“if students are to learn to think, they must be placed in situations where they have to do so. The situations in which they are obliged to think are those in which they have to answer questions because questions demand an active mental response” (Bligh, 1998, p. 15).

Prior to the development of SRS technology, lecturers experimented with posing multiple-choice questions in lectures, asking students to respond using coloured cards to indicate their answers (e.g. Harden et al., 1968; Dunn, 1969). Harden et al. (1968) concluded that, whilst the preparation of lectures using such methods (and the lecture questions) inevitably took longer, the result was more effective and interesting teaching.

Research into the benefits of using a SRS indicate a number of positive impacts. In a detailed review of student response systems, Judson and Sawada (2002) concluded that three decades of studies have consistently documented positive student evaluations of the use of student response systems in lecture courses. Hake (1998) reports on the adoption of a SRS in physics teaching, concluding that it can have a significant impact on students' problem-solving skills, this being reflected in significantly improved test results. Hake's (1998) results were confirmed by Cue (1998), who also found that the SRS increased active learning, depth of learning and student interest, again in the context of physics teaching (see also Draper, 2001, who details the potential array of SRS uses).

The recent literature on the use and educational value of SRS technology confirms the significant impact on student learning from the use of this technology. Classes are consistently found to be more interesting when using SRS (Woods and Chiu, 2003), while the use of SRS in assessment has been noted to improve attendance and the quality of student preparation (Bumstein and Lederman, 2001). Mean pass rates can be significantly higher compared to more conventional methods (Poulis et al., 1998), although this may depend on the type of questions asked, and analytical type thinking (consistent with Bloom's taxonomy of questioning) may fare better than questions that require strict memorization. (Slain et al., 2004a,b).
Active participation during class has been found to be enhanced, which is of particular note to large class settings where a small vocal minority typically provides most of the interaction in a more traditional setting (Birdsall, 2002). Even in small classes, including seminars, students tend to be reluctant to respond to questions and the anonymity of responding with a hand-held device broadens participation (Ward, et al., 2003). The use of SRS technology in anonymous mode can further increase participation rates (Burnstein and Lederman, 2003). Peer and collaborative learning can be encouraged by the use of this technology (Birdsall, 2002), where allowing students to confer before submitting their answers and provoking small group debates supports better understanding of concepts and unveils of misconceptions (Frey and Wilson, 2004a,b). By promoting participation, encouraging attendance, and by repeated exposure to the questions, concepts and key issues thought important by the lecturer the use of SRS technology can improve retention rates (Woods and Chiu, 2003).

SRSs can be used to query students at the beginning of lectures to encourage the reading of assigned reading so that the basic information in the texts does not need to be repeated in lecture (Knight and Wood, 2005). However, one of the most exciting potential use of educational technology is to facilitate interactions between students and instructors and among students which may be the most crucial element in fostering deep learning (Wood, 2004). In this Teaching Cycle, we encourage the interaction between the lecturer and students, and between students, by providing all class participants with immediate formative assessments of student understanding, encouraging discussion, and as a guide to inform subsequent material presentation (Paschal, 2002).

**Student Response System overview**

Student response systems enable each student with a uniquely registered set to answer questions by sending responses to a receiver. This has the benefit of directly engaging each student and has the potential to provide a significant improvement over the traditional approach of the lecturer posing a question, which typically results in a situation where most students passively watch the few eager to respond. The lecturer can immediately display a graph of the class responses while maintaining (where so
desired) the anonymity of each individual's answer. Projecting the class responses in summary form allows students to gain a better understanding of their class, while additionally providing the lecturer with an immediate feedback of students' understanding of a topic. This subsequently then offers the option of either moving on to the next section or to reiterate points which warrant additional explanation.

The operation of student response systems is a simple three-stage process: 1) During class discussion or a lecture, the lecturer poses a question or problem - previously prepared or spontaneously generated by the lecturer or a student; 2) Students key in their answers using wireless handheld devices; and, 3) Responses are received, aggregated, and displayed on both the lecturer's computer monitor and on screen. The distribution of student responses may prompt the students or lecturer to further explore a particular topic with discussion or follow-up questions.

When in operation, the SRS system can display the number of the question being asked, the time allotted to each question, and (where set) the number of opportunities each student has to answer the question. Once a question is asked, the clock is started and the time remaining in which to answer can be continually shown. A count of the number of handsets that have responded to the question asked is shown, and as each different handset is used to answer a question, another cell on the screen can be set to change colour.

The SRS system can be operated in anonymous and named mode which allows identification of individual students. In anonymous mode, when students respond to a question using their handset, a cell on the screen changes colour and the number of the handset responding is displayed. If students are allocated a handset, and the system is set up to associate handsets with student names, then cells can also indicate (to the lecturer or to the whole class) the name of the student answering. Each handset's response to a question can be shown on the screen or kept hidden. If it remains hidden from the audience, double clicking on a cell reveals the answer selected and the time taken to answer the question after the clock was started. This makes it possible, for example, to provide encouraging feedback to a student if they answer correctly.
The handsets have ten digits (including zero), corresponding to up to ten possible answers to, say, multiple-choice questions. Various handsets also have high-confidence and low-confidence buttons. When either the time runs out for answering the question, or the lecturer chooses to stop the clock, a histogram summary of the results is displayed, with the bars made up of different coloured segments to indicate the proportions of students answering with different confidence levels.

The computer keeps a record of the responses of the numbered handsets for the entire class session when the SRS is in anonymous mode, and records the responses of individual students when in named mode. The saved information can also include details of the time taken by each handset to answer every question, the number of attempts made by a handset when each question was asked, and the confidence levels of the answers selected.

Student response systems can benefit lecturing faculty in three areas of responsibility: teaching, research, and administration. The most commonly stated goal of student response systems (a goal shared with many other interactive educational technologies) is to improve student learning in the following areas: 1) improved class attendance and preparation, 2) clearer comprehension, 3) more active participation during class, 4) increased peer or collaborative learning, 5) better learning and enrolment retention, 6) and greater student satisfaction.

A second basic goal of all SRSs is to improve teaching effectiveness in at least two ways. Using an SRS to quiz students, immediate feedback is easily available from all students on the pace, content, interest, and comprehension of the lecture or discussion. This immediate and detailed feedback allows the lecturer to better judge whether and how to amplify, clarify, or review. In addition, the lecturer can also easily collect data on student demographics, attitudes, or behaviours to better assess the group characteristics of student needs. A third benefit of the use of student response systems is the potential to greatly reduce the paperwork and faculty labour associated with attendance taking, test administration, grade recording, calculation, and analysis. SRS operating system software typically automates data collection and report writing in a user-friendly and transparent fashion. In addition, most systems can output data to standard database, spreadsheet, and statistical analysis packages.
Teaching Cycle SRS initial trial results including student feedback

It was earlier suggested that using a SRS could enhance a lecturer's ability to monitor students' understanding of lecture material; provide an opportunity for students to engage in active learning; and boost students' concentration levels at times when they might otherwise disengage with lectures. The results of this Teaching Cycle confirm that the SRS can provide a very useful means of checking students' understanding of material covered, both quickly in the lectures and also after the lecture. This allows more accurate determination with regard to what material should be revisited in tutorials, as well as in the lectures, and provides further insights to possible revision of material for future module delivery.

Further, it is appreciated that this technology has offered students an approachable and transparent method of gauging their own understanding, and comparing their performance against that of their peers, in a way which avoids the potential embarrassment of giving a wrong answer. Whilst some of these benefits also transpire from the active learning methods reported by Harden et al. (1968) and Dunn (1969), an SRS has additional advantages. Bar-chart summaries of students' answers are visible to the lecturer and students alike, whilst responses can also be accurately recalled and analysed after the lecture has ended, especially when the responses of individual students are collected in named mode.

Lecturer observation confirmed that use of an SRS had a very significant effect on students' performance in lectures, stimulating their interest and concentration, as well as their engagement with lectures. It has shown itself to be an excellent method of encouraging active learning, whilst offering a means of varying the stimuli received by students in a lecture environment. Further, results of brief student questionnaires conducted after the introduction of this technology suggest that the SRS was generally perceived to be easy to use, and enhanced students' attention and comprehension of material.

Towards the end of the module, students were asked (anonymously) to complete a short questionnaire about the SRS as well as a standard lecturer feedback questionnaire. The SRS questionnaire contained a number of questions or statements
to which students could respond by selecting answers 1 to 5, 1 indicating strong
disagreement and 5 denoting strong agreement. Students were also given the
opportunity to add any additional comments at the bottom of the questionnaire.

Students overwhelmingly felt that the technology was easy to use. This was likely
also the result of gradually introducing the students to different features of the
technology. For example, the use of high- and low-confidence buttons on the
handsets was only introduced after the students had used the SRS a number of times.
Similarly, the named operation mode was only introduced after a number of lectures
in which the SRS was used in the anonymous mode. Encouraging responses were
also made to questions which explored the learning experience and comprehension of
lecture material.

Students also responded favourably to questions on confidence to deal with and
understanding of the subject matter, although (as expected) the view was expressed
that confidence suffered when the SRS was in the named mode, which allowed
identification of students with given answers. Mindful of this trial feedback, it is
suggested to use the SRS predominantly in anonymous mode, unless there are
particular reasons for monitoring the progress of individual students.

Typical student responses also indicated strong agreement with statements such as the
use of an SRS "helps me to learn the subject matter of this course in greater depth"
and "knowing how my classmates respond to questions in class increases my interest
in the subject matter." This mirrors results noted in a meta survey conducted by
Judson and Sawada (2002).

A strong majority of students gave favourable overall impressions of the use of an
SRS. Further, a similarly strong majority also stated that it improved their interest in
the course, class attendance, and understanding of course content. While not
quantitatively measured during the Teaching Cycle, the lecturer felt that the use of an
SRS clearly had a positive influence on students' attention, and the quality of their
coursework and in-seminar presentations. With regard to student presentations (an
integral part of seminar participation), it was noted that student confidence in
particular seemed to have been positively affected. Hence, the use of an SRS shows
promise in assisting students’ comprehension, increases their confidence, and fosters deep learning, perhaps primarily through the use of this technology as a facilitator of peer-to-peer communication to help foster conceptual understanding.

The application in this Teaching Cycle of an SRS over the course of one module delivery precludes any statistically meaningful analysis of the impact of this technology on academic achievement, especially their impact on exam performance, although informal evidence suggests that the quality of exam responses did improve compared to an earlier cohort which was taught without the use of an SRS. Nevertheless, extant evidence on the longitudinal use of an SRS is promising and points to the potential of this technology to support pedagogical objectives. Poulis et al., (1997) for example examined a six-year period use of SRS on physics courses and found that in years when an SRS is used (in union with supporting pedagogical elements), examination pass rates increase significantly. Findings by Mazur ( reported in Abrahamson, 1998) support the argument that SRSs can promote student achievement.

Overall, the positive impact of SRS use on student learning may be due to a variety of factors associated with using interactive technology. Such factors include increased student engagement as students commit to an answer rather than passively observing other students respond; minimization of the attention gap due to more periodic breaks from lecturer presentation; immediate formative assessments benefiting both the lecturer and students; and especially increased discussion among students and between students and the lecturer of concepts that students find challenging. This Teaching Cycle supports the findings of the literature that interactive engagement in particular, facilitated by the use of an SRS, correlates strongly to student comprehension and gains in achievement (Abrahamson, 1998).

Arguably, one potential drawback of the use of this technology is that less material can be covered in lectures. However, this is more than compensated by the greater awareness this provides to the lecturer concerning the amount of material that students understand. In addition, it may be argued that using the SRS enables the lecturer to relate the pace of presentations of material more closely to the pace of student understanding.
Conclusions

The higher education sector has undergone considerable expansion in terms of student enrolment and diversification in recent years and it is expected that this trend will continue into the medium term future. Widening diversification and internationalization of the student body results in an audience with very different educational backgrounds, different academic abilities, and vastly divergent intellectual interests. Consequently, lecturers need to be mindful of the most effective methods of teaching large numbers of widely diverse students. SRS technology offers one innovative method of maintaining student interest and concentration, enhancing active learning, increasing the level of interaction in a lecture setting, and allowing students as well as lecturers an opportunity to monitor the level of student understanding.

Using an SRS forces a lecturer to think carefully about the extent of active learning that is taking place in lectures. Attention has to be given both to questions that will test students' understanding of lecture material and how to incorporate these questions successfully in a lecture context. Further, the lecturer must be willing to revisit material if SRS feedback suggests that lecture material has not been well understood by a large section of the students. This can obviously impact on the amount of material covered in lectures and tutorials, and informs subsequent delivery of the course.

This Teaching Cycle demonstrated how an SRS may easily be adopted as a teaching method for material on Corporate Governance. A strong majority of students gave favourable overall impressions of the use of an SRS and also thought that it improved their interest in the course, attendance, and understanding of course content. The use of an SRS also had a positive influence on students' attention, and their coursework and presentation performance.

Hence, students not only have favourable opinions on the use of SRSs, but it would appear to increase student learning. Nevertheless, the value of the use of this technology in this and other subjects remains to be explored. Student response technology is a potentially useful teaching and learning tool that students evidently
enjoy using, but one that is more likely beneficial to the extent that faculty design appropriate questions and facilitate student discussions in order to foster an active learning environment.

It should be noted that the pedagogical practices of the lecturer, perhaps more so than the incorporation of a particular technology, is key to student comprehension. Student response systems may best be viewed as a tool that can facilitating discussion. Hence, while the use of this technology can promote student learning, it is highly recommended that lecturers who consider the use of an SRS receive the benefit of professional development focusing on pedagogical practice. The author of this Teaching Cycle wholeheartedly agrees with Abrahamson (1998) when he highlighted one benefit on teaching and learning from using this technology as follows:

"Good questions asked in the right context have a remarkable property to transform a classroom. The environment becomes more lively and active. The atmosphere changes and becomes more "happy"! Students report that they understand the subject better which is confirmed by quantitative studies. They work harder in class, but enjoy it more. There is also evidence that they do more work out of class. Teachers become more aware of student problems with the subject matter." (p.3)

In conclusion, the potential value and effective use of an SRS as a formal tool of assessment and to support deep learning is clearly demonstrated, but remains a rich venue for further research.
References


