What is Your Response? It's Time to get Personal.

Jenny Lorimer, Alan Hilliard.
University of Hertfordshire, Hatfield, UK
J.Lorimer@herts.ac.uk
A.P.Hilliard@herts.ac.uk

Abstract: This paper describes a study which used a personal response system (PRS) for formative assessment and feedback during taught sessions. The aim of the study being to see whether there was a positive impact on the students' final grades in the end of module summative multiple choice question assessment.

Previous research into the use of a PRS demonstrated the effectiveness of the tool to increase classroom interactivity. On evaluation, 98.5% of students identified the PRS as being easy to use, 92.5% perceived that the PRS was beneficial to their learning and 86.5% stated that it was a useful tool for preparation for examination.

At the beginning of the module each student was issued with an individual, identifiable handset, which was programmed with a unique code. During the module delivery, six to eight multiple choice questions were given to the students each week as formative assessment on the topic covered. The data was saved and collated. The formative scores were then made available to the students to enable them to monitor their own progress.

Each handset was linked to a database which contained the students' demographic details. This process allowed the module leader to identify individual student achievement. Student confidentiality was maintained, as the formative scores were released only using the unique code.

The aim of the study is to identify whether the teaching and learning strategy improved overall cohort achievement in comparison to the previous cohort. Additional objectives being to discern whether the individual PRS scores can be used to predict individual student performance at summative MCQ examination, and whether attendance at the PRS sessions was in itself an indicator of success.

1. Background:

The study was undertaken in a level 2 undergraduate module titled 'Pathologies for Imaging' which forms part of a BSc (Hons.) Diagnostic Radiography and Imaging programme. The module offers achievement of thirty credit points (15 ECTS points), and in the researchers institution accounts for three hundred hours of effort by the average student. The module aims to move the student forward from understanding of the healthy human body to understanding how disturbance of homeostasis caused naturally by aging and human development, by illness or by trauma, will affect the individual and be manifested on the resultant radiographic image. It should be noted that a significant part of the summative assessment is by multiple choice questions (MCQs). The student sample size was 119 students, all of whom were enrolled on the module. The student group is diverse in terms of geographical location, ethnic origin, age and background.

In a previous study the course design utilised a PRS during module teaching to ensure a blended learning approach. It was evaluated and was very well received by the students. It was easy to use (98.5%), perceived as helping the students to learn (92.5%) and useful for exam preparation (86.5%). These figures are aligned with the work of Masikunas et al (2007), who identified in their study that students perceived the effectiveness of their learning was improved by the use of the PRS.

During the previous study, when invited to comment on the use of PRS a high proportion (41%) of the students used the opportunity to comment on the use of the PRS with 83% of the comments being enthusiastic. The positive comments are revealing; examples include having the opportunity to learn from ones mistakes while not being embarrassed at getting the wrong answer as the system is

anonymous, such as the quote *'so you don't feel stupid when you get one wrong and you lie and say you got it right'*. Other comments included words such as '*interesting*' '*fun*' and '*different*'. Many of the students commented that its use helped their learning such as the comment *'let me know my weaknesses and helped me to learn what I needed to look up'*. A significant constraint of this previous study was that the only PRS set available was limited both in it's size and in it's design. There were not enough handsets for the students to have one each and not was it possible to record individual responses for analysis.

In order to move the research forwards a TurningPoint™ PRS was purchased prior to the start of delivery of the module for the academic year 2007-08. Each student was allocated their individual numbered handset which they retained for the whole academic year. The students were given the option of keeping their handset and paying a deposit to guard against accidental loss or damage. As a group they to decided to leave the handsets with the academic staff between teaching sessions. The PRS allows generation of reports based on the responses received during the teaching session. Reports can be based on attendance, individual response, group response, team response or related to individual questions.

The current study aimed to move the previous ad-hoc use of the PRS to a more structured tool for formative assessment. It was recognised that use of a PRS both creates a shift in the expected behaviour of students from either watching or listening to active participation, and that a 'learning environment with higher expectations for student preparation' is generated (Trees and Jackson, 2007, p 25). Alongside these perceptions was the desire to use improved formative assessment and feedback to both enhance the student's experience and to increase their likelihood of success in the summative assessment (Nicol 2007, Kennedy & Cutts, 2005). Additionally, it was hoped to counteract two of the four reasons for student attrition cited by Yorke and Longden (2004). The two reasons thought to be particularly pertinent can be described as a less than optimal student experience and failure to meet academic demands. A "spin off" of using the PRS, with handsets being identified to individuals, meant that it was possible to know who was not in attendance at the PRS sessions. This raised the interesting point of looking at the data, to see was there a correlation between attendance and success in the summative assessment. Previous research undertaken exclusively within the US found that attendance has a positive and significant on grade (Kirby and McElroy 2003; Schmidt 1983; Romer 1993; Park and Kerr 1990; Marburger 2001).

The aim of the study is to identify whether the teaching and learning strategy improved overall cohort achievement in comparison to the previous cohort. Additional objectives being to discern whether the individual PRS scores can be used to predict individual student performance at summative MCQ examination, and whether attendance at the PRS sessions was in itself an indicator of success.

2. Methodology

The TurningPoint™ hardware and software was purchased at the beginning of the academic year, and this allowed time for staff training before the start of teaching. The module is delivered in a 'system approach', with a lecture being delivered using Powerpoint™ and a podcast across the virtual learning environment (VLE), with one system being taught per week of teaching. The afternoon teaching session which followed was then delivered as small group seminars using activities and games which were designed to enhance and reinforce the learning. For each topic area the PRS session was included as one of these as a summary activities.

Prior to the start of the teaching, the list of names of all the students in the cohort was exported from the VLE into the TurningPoint™ software. Each name was assigned an individual handset, which was then labelled with identifiable numbers. The list of student names and numbers was available to the students at the start of the seminar session, although in practice each student knew their own device number within a couple of weeks.

Using the TurningPoint™ software, 6 – 10 multiple choice questions were compiled on each topic. The aim of the questions was to assess students' understanding of the material taught and to ensure any likely misunderstandings or misconceptions had been clarified. The questions were presented to the students and the students voted on each question. Although the software contains the facility for a student to change their mind as to the answer and then re-vote this facility was not used because of

the 'practice exam' element of the PRS. Towards the end of the module delivery, as the summative examination drew nearer, a timer facility was added to each of the question slides so that the students became used to answering the questions in a prescribed time. Once the students had voted on each question, the correct answer was given to the group with a correct answer indicator and then the voting results were presented in graphical form. Both students and staff received immediate feedback as to the groups understanding of the material (Masikunas et al, 2007) The tutor then discussed the results with the group, clarifying any misunderstandings and expanding on any difficulties encountered.

At the end of all the seminar sessions all of the scores were amalgamated, and the resulting score sheet was then made available to the student group on the VLE. An overall sheet was kept, with scores being added weekly so that students were able to identify their total of correct answers across the teaching. They were also able to compare their performance to the rest of the cohort. Student confidentiality was maintained, as the formative scores were released only using the device number. Additionally, all of the MCQ's (annotated with the correct answer indicator) were posted on to the VLE.

3. Results

Figure 1, below, demonstrates a comparison of MCQ marks between the current (2007-08) and previous (2006-07) cohorts. The achievement of the current cohort is improved on the previous year. The previous cohort (2006-2007) had more students achieving marks below 35 out of 60. The current cohort (2007-2008) had fewer students achieving marks in this range. Though not so marked, the current cohort (2007-2008) had more students achieving marks above 50 out of 60 than the previous cohort. The highest achieving students scored higher marks than the previous cohort. There is clearly a more Gaussian distribution to the current cohort marks than previously achieved indicating a more typical distribution of marks achieved in the mid-range.
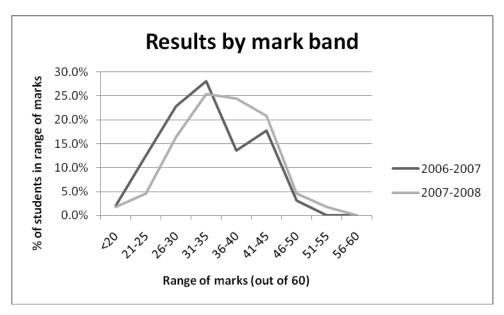

Figure 1. A Comparison of student achievement between the 2006-07 and 2007-08 cohorts.

Figure 2, below, illustrates the improved performance of the whole cohort across the whole range of marks achieved by the students.
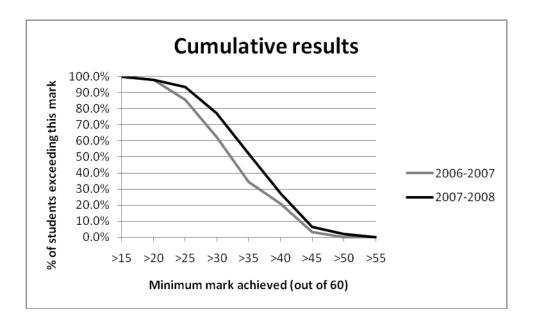
Figure 2. Comparison of cumulative results between the 2006-07 and 2007-08 student cohorts.

In further analyzing the data, three groups were identified. Non-attenders, poor attenders and good attenders. Non-attenders did not attend any of the four analyzed PRS multiple choice sessions. Poor attenders attended 50% or less of the analyzed PRS multiple choice sessions, and good attenders were those who attended all the analyzed PRS multiple choice sessions. As a percentage of the total cohort the figures are 4 (3.36%); 26 (21.85%); 33 (27.73%) respectively (See table 1, below)

Attendance	Number	% of Cohort
Non-Attender	4	3.36
Poor Attender (2 sessions or less)	26	21.85
Good Attender (All sessions)	33	27.73

Table 1. Numbers and percentages of the total cohort for the designated non-attender, poor attender and good attender groups.

Looking at the data in terms of numbers of students achieving a fail mark at summative MCQ assessment, by group, it was observed that no students in the non-attender group failed the MCQ, 1 student (3.85%) in the poor attender group failed the MCQ , and no students in the good attender group failed the MCQ. See table 2, below.
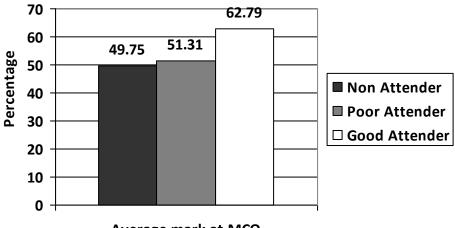
Attendance	Number of fails	% of Fails by group
Non-Attender	0	0
Poor Attender (2 sessions or less)	1	3.85
Good Attender (All sessions)	0	0

Table 2. Number of failed marks at Summative MCQ for the designated non-attender, poor attender and good attender groups.

The average marks achieved at the summative MCQ by group are shown in table 3 and figure 3, below. The average marks by group increase from 49.75% in the non-attender group to 62.79% in the good attender group.

Group	Average mark at MCQ (%)
Non-Attender	49.75
Poor Attender (2 sessions or less)	51.31
Good Attender (All sessions)	62.79

Table 3. Average mark at MCQ by group

Figure 3. Average mark at MCQ by group.

Figure 4, below, illustrates the trend that in general students who performed at a high level in the formative MCQ's were generally among the high achievers in the summative assessment. The data

used here was from the student's described as 'good attenders'. In general, poorer formative performance correlates with a lower summative result.
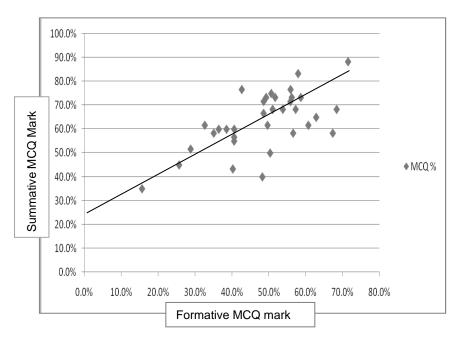

Figure 4. A Scatter graph to illustrate the relationship between performance in formative and summative MCQ's in the good attender group.

4. Discussion

As with the study on the 2006-07 cohort, the students' enjoyed the PRS sessions, and found the teaching tool of benefit to their learning. The focus of the current paper has moved away from increasing student engagement during teaching sessions to a more active learning focus; establishing whether the PRS encourages the students to engage with the module learning outcomes, measured by achievement in summative assessment. In contrast to Martyn (2007) the evidence from across the cohort demonstrates the Integration of the PRS did improve summative assessment performance.

Increasing diversity in a student body can be regarded as a source of challenge in learning and teaching. The researchers suggest that the PRS is an example of a computer-based media that is a useful tool for a constructivist design where students are eager to take responsibility for their own learning experience (Bostock, 1998). In agreement with Draper and Brown (2004) the PRS use was supplemented with the tutor asking the students to volunteer answers and explanations. Having used a PRS before, this was more easily achieved and the technology was used as the basis for the session rather than the focal point. Although the PRS session formed part of a seminar series it is thought that the same format would be amenable to large group delivery. The 'tools' available with the software were a valuable adjunct to the slides. The correct answer indicators and timers were available in a variety of designs that the students enjoyed. Of less benefit was the variety of graphical displays available for the range of answers achieved. It was found that the histogram was the most acceptable way of displaying the recorded votes.

Making the anonymised scores available on the VLE was a straight-forward process that was beneficial to both staff and students. Students were able to review their knowledge of teaching material with reference to their scores and the correct answers. This reflection either gave them confidence in their knowledge of the topic or highlighted the need for further study (Stuart, Brown & Draper, 2004). Effort was made throughout the module that neither the teaching staff nor the students' should find the process demoralising in any way. Emphasis was continually placed on the students being in a more informed position with regard to their learning. With two topic areas the tutor was able to identify that there appeared to be difficulties with understanding of the topic across the whole

cohort.   Although challenging to arrange, extra tutorials were given to review the teaching and learning of the topics, and these were able to be timed close to the time of the original teaching, rather than towards the summative assessment period.

One challenge experienced by the teaching staff was that of producing suitable, informative MCQ's, of a similar standard to the summative examination, throughout the period of module delivery, although it is recognised that many of the questions will be suitable for use in subsequent teaching.

Attendance at the PRS sessions could not the used to predict failure at MCQ exam. There were no fail marks at MCQ in the non-attender group, 1 fail mark in the poor attender group, and no fail marks in the good attender group. There are several possible reasons for this. The non-attender group size is small, and thus the result may not be a true representation. It may be that the final summative MCQ assessment does not sufficiently differentiate between different ability levels. This was not felt to be the reason, as there was a wide range of marks achieved for the assessment (30% - 88%), which were well distributed in a Gaussian curve. The researchers believe that the most likely explanation for this result is that the materials from the PRS sessions were all made available on the VLE after the sessions had been run. It was therefore possible that the non-attending students were maintaining engagement with the module by accessing the resources outside of the taught sessions. Retrospective monitoring of student usage of resources on the VLE has shown this to be true.

The Average mark at MCQ based on attendance was very similar between the non attender and poor attender groups (49.75% and 51.31% respectively). The average mark in the good attender group was, however, higher at 62.74%. One possible explanation for this is that whereas the non-attenders and poor attenders could access the resources retrospectively instead of attending the PRS sessions, the good attenders who attended every session would have benefited from the instant formative feedback that is enabled through the use of the PRS and the subsequent interaction with the tutor regarding clarification of misunderstandings and difficult concepts.

The study did not, in general, support the statement that "individual PRS scores can be used to predict the individual student performance at summative MCQ examination". When considering the scatter graph (figure 4) illustrating the trend between performance in formative assessment against that in summative examination there does appear to be some correlation demonstrating that the standard of a student's achievement in formative assessment was continued through to summative assessment. It should be noted that the scatter graph illustrates only the formative and summative performance of those students who were nominally called 'good attenders' From an academic exercise the interpretation of this graph is limited, as when the poor and non- attenders were included no clear trends could be identified. Statistically, the situation is further confused by students who did not attend, but yet consistently engaged with the material through the VLE. It could be interpreted that the important factor is the use of continual formative assessment that is constructively aligned to the summative examination, so long as the format is amenable to be made available to students in an electronic format.   The use of the PRS was seen as attractive to the students, and attendance throughout the year was good. While this is seen by the teaching staff to be important, the diversity of the student group always has to be relevant, as many students have family or employment commitments that prevent them from always attending teaching sessions. That the PRS was used as a tool, allowed the formative material to be made available to all students via the VLE in a format that was attractive and easily utilised by students who had not been in attendance in the sessions. There is evidence to support this statement as the VLE has a monitoring facility and teaching staff observed that students who were poor in attending the teaching sessions were consistent in accessing the teaching materials across the VLE.

5. Conclusion

When PRS was used throughout the module for formative assessment in a structured manner, marks were increased and more normally distributed compared to the previous cohort. Good achievement in the formative assessment using the PRS gives an indication that students' will achieve higher marks at summative assessment. Attendance alone in the PRS sessions did not predict success at summative assessment, although there is a suggestion of correlation between good attendance and higher marks achieved at summative assessment. This is felt to be due to the increased interactivity and opportunities for immediate feedback that the PRS offered. The PRS increased classroom interactivity and is perceived by both staff and students as a useful tool for their learning.

6. Acknowledgements

References

Bostock S (1998) *Constructivism in Mass Higher Education; A Case Study* British Journal of Educational Technology Vol. 29 No 3 p225 - 240

Draper S Brown M (2004) *Increasing Interactivity in Lectures using an Electronic Voting System* Journal of Computer Assisted Learning 20 p 81-94

Kennedy G.E. Cutts Q.I. (2005) *The Association between Students' use of an Electronic Voting System and Their Learning Outcomes* Journal of Competer Assisted Learning 21 p 260 -268

Kirby, A. and McElroy, B. (2003) The Effect of Attendance on Grade for First Year Economics Students in University College Cork, *The Economic and Social Review*, Vol. 34, No. 3, Winter pp, 311-326.

Marburger, R. D. (2001) "Absenteeism and Undergraduate Exam Performance", Journal of Economic Education, Vol. 32, Spring, pp99-109.

Martyn M (2007) *Clickers in the Classroom: An Active Learning Approach* Educause Quarterly Vol. 30 no. 2

Masikunas, G., Panayiotidis, A. and Burke, L (2007) The use of Electronic Voting Systems in Lectures within Business and Marketing: A Case Study of Their Impact on Student Learning, ALT-J Research in Learning Technology, Vol. 15, No.1, March, pp 3-20.

Nichol D (2007) *Laying a Foundation for Lifelong Learning: Case Studies of E-assessment in Large 1st Year Classes* British Journal of Educational Technology Vol 38 No 4 p668 -678

Park, K. H. and Kerr, P. (1990) "Determinants of Economic Performance: A Multinomial Logit Approach", *Journal of Economic Education*, Vol. 21, Spring, pp101-111.

Romer, D. (1993) "Do students go to class? Should they? *Journal of Economic Perspectives*, Vol. 7, No. 3, pp167-174.

Stuart S Brown M Draper (2004) *Using an Electronic Voting System in Logic lectures: One Practitioner's Application* Journal of Computer Assisted Learning 20 p95 - 102

Schmidt, T. R. (1983) "Who maximises what? A Study in student time allocation", *American Economic Review*, Vol. 73, No. 2, pp 23-28.

Trees A, Jackson M (2007) *The Learning Environment in Clicker Classrooms: Student Processes of Learning and Involvement in Large University-Level Courses using Student Response Systems* Learning Media and Technology Vol 32 No 1 p 21 – 40

Yorke M Longden B (2004) *Retention and Student Success in Higher Education* Berkshire Open University Press & McGraw-Hill Education