

Feedback on Personal Response Systems ('Clickers')

– lecturers' perspective

Daniela Gachago, College of Science and Engineering, May 2008
daniela.gachago@ed.ac.uk

Executive Summary

The College of Science and Engineering (CSE) has been using electronic Personal Response Systems (PRS) or 'clickers' in teaching for four years. Usage has increased extensively, reflecting interest from teaching staff and positive feedback from students. Adoption of the technology has been facilitated by a strong institutional commitment, in particular the purchasing of a significant amount of handsets for students and the provision of College-based clicker support.

This report details results from an evaluation exercise that aimed to assess: the successes lecturers had in using clickers, the problems they encountered, and their perceptions of using clickers with a particular focus on their training and support needs. The results of this study inform the current University project to replace the existing Infrared clickers with new Radiofrequency (RF) technology.

We received thirty-one responses (~60% of those asked) to an online questionnaire. The picture painted by lecturers is very positive overall. Staff enjoy using clickers and, with a few exceptions, find them very useful. The benefits of clickers are evident, especially: the increased interaction between lecturers and students; improvements in feedback for both students and lecturers by revealing common misconceptions; and giving students a feeling how they compare to their peers. Lecturers also report that using clickers has made them reflect on the content they are teaching in their lectures and the way they are teaching. It helps them judge which concepts to focus on, how to include more examples, and to consider how best to streamline their lectures overall.

However, there are also challenges when using clickers. Some of these focus on technical issues, especially with the current software and problems with using managed desktop machines. There are also issues that reflect the variance in experience of clicker usage by staff and students. These need to be addressed and will hopefully be alleviated by the introduction of Radiofrequency technology (e.g. by allowing lecturers to use their own laptop to run clicker sessions).

Consistent use is another issue, which affects students' uptake of clickers. Lecturers generally use clickers in all or nearly all classes, which is good practice. However, convincing the whole course team to use clickers, where courses are being co-taught, seems to be a big challenge. This leads in some cases to students forgetting their clickers and results in decreased response rates. There is also some evidence that students tend to disengage with clickers as the academic year progresses. This can be alleviated by varying the types of questions asked and the way clickers are used in lectures, such as encouraging students to revote and to vote in pairs. Other innovative ways of using clickers are using clickers to revise lecture blocks or to prepare for exams and to do 'pub' style quizzes.

In general, effective clicker usage needs time and practice, as this quote by one of the respondents depicts: "It takes a lot of time and practise to think of the best and most useful questions. It also needs a 100% commitment to wanting to use the clickers since they do eat into valuable lecturing time."

Support needs to be offered in various ways, from group training sessions to one-to-one training to extensive online resource materials. While a majority of lecturers will be able to run the software on their own, some might always need a support person there at the beginning of the lecture, to ensure a correct set-up. How this support can be provided on a sustainable basis, needs to be seriously discussed within the College of Science and Engineering.

Regarding the planned upgrade to RF clicker technology, a few important issues can be extracted from the responses of lecturers:

- Staff expect a significant improvement in the set up and running of system (it should be easier, faster and less error-prone than the current system).
- Staff emphasise the importance of cross-platform compatibility of software used, especially to facilitate the much-requested possibility of running clicker questions from individual lecturers' laptops in lecture theatres.
- Staff expect that support roles, responsibilities and procedures will be spelt out more clearly.
- It is hoped, that student response rates will increase when RF clicker technology is adopted (no line of sight needed, feedback to students if votes get received), but we still feel there is a necessity to investigate the potential student disengagement with clickers as the academic year progresses.
- With the planned increased role of the library in distributing clickers, we are banking on students to collect them instead of handing them out in lectures or at registration. This can lead to a potential risk of clickers not being collected by a large number of students (risk especially high in Semester 2 or Year 2 courses).
- There is a clear need for pedagogical support as well as technical support to continuously improve the ways clickers are used in lectures and the types of questions asked. This includes encouraging lecturers to review the questions asked and results obtained at the end of the academic year to improve questions for the next term. Experience of sharing and learning from colleagues in similar disciplines, but also across Schools, also needs to be facilitated.

Table of Content

Introduction / background.....	3
Methodology	4
Results.....	4
1. General.....	4
2. How were clickers used?	5
3. Usefulness of clickers	7
4. Challenges of clickers.....	9
<i>Technical issues</i>	9
<i>Consistent use and decrease in response rates</i>	10
<i>Reduction of content and adaptation of lectures due to clicker usage</i>	11
5. Support.....	12
6. Future plans and suggestions for improvement	13
Conclusion and recommendations	14
References	15

Introduction / background

The College of Science and Engineering (CSE) has been using clickers, also called Personal Response System or Electronic Voting System, since 2004 with first pilots running in Biology and Physics (funded by the Principal's eLearning Fund). The College Learning and Teaching Strategy provided a major push for a wider distribution of clickers and introduced clickers in various first year courses in the College from 2006/2007 and decided to distribute clickers on a large scale from Academic Year 2007/2008 (total number of distributed clickers per Semester = app. 2000, app. number of involved lecturing staff=60).

Clickers are often viewed as a tool, that should run as smoothly and easily as a MS PowerPoint presentation, with very little or no support needed (after a short introductory training session). However, the current software, Interwrite PRS, proved to be quite unstable in previous years. This made it necessary for Karen Howie, the former eLearning officer in the School of Biology and one of the pioneers in clickers use, to offer a high level of support to lecturers (e.g. Karen used to sit through most of the lectures where clickers were used, to ensure the technology worked fine).

Due to the increased number of lecturers using clickers and increased number of classes in which clickers are used, it was impossible for the current clicker support team (consisting of Daniela Gachago and Jon Jack) to continue supporting lecturers as heavily as in previous semesters.

This meant most lecturers used clickers on their own, after attending either training sessions or individual face to face demonstrations of the clicker technology.

This study was carried out to assess how successful lecturers were in using clickers, what kind of problems they encountered, what their perception of clickers was with a particular focus on their training and support needs. The results of this study are particularly interesting in light of the upcoming project to replace the existing Infrared clickers with new Radiofrequency technology at the University of Edinburgh. Therefore we also included a question on what lecturers would like to see in this new technology.

Methodology

In November 2007 and in April 2008 a questionnaire was sent out to app. 60 staff members in the College of Science and Engineering, who had expressed interest in using clickers in Semester 1 or 2 of the Academic Year 2007/2008.

The questionnaire, containing 28 questions (both closed and open-ended), was set up using the Bristol Online Survey tool. The Bristol Online Survey tool offers various kinds of results, such as cumulative data, but also individual responses. There are also ways of cross tabulating results and running filter queries. As a starting point a questionnaire designed by Dr Margaret Brown at the University of Glasgow was used (Brown, 2004), which was then modified to suit our needs. The questionnaire was sent out by email by Dr Nick Hulton, Director of Teaching and Learning in the College of Science and Engineering, inviting lecturers to take part in the study.

The questionnaire contains questions on lecturers' computer skills, experiences with clickers, whether they used clickers or not this semester, reasons for using or not using clickers, how clickers were being used, consequences of using clickers, e.g. had the use of clickers any influence of the amount of content covered in lectures?, problems encountered when using clickers, support received and future plans.

Results

1. General

We invited 57 lecturers to respond to our study and 32 did. One lecturer completed the questionnaire twice, which leaves us with 31 valid questionnaires (Table 1). Two lecturers sent us an email, telling us they did not use clickers and briefly describing the reasons for this. This means we got a response rate of app. 60%.

T1: Respondents by Schools

School	Use in Sem 1	Use in Sem 2	No use	#	%
Biology	2	4		6	19%
Chemistry	1			1	3%
Engineering	2	7	1	10	32%
Informatics	3			3	10%
GeoSciences	2	1		3	10%
Mathematics	1	1		2	6%
Physics	3	1	1	5	16%
Veterinary School	1			1	3%
Total	15	14	2	31	

Out of all respondents 29 (88%) used clickers this year, while four (including the two lecturers which responded by email) did not. Reasons for not using clickers were:

- time constraints to adapt course to include clicker questions (n=1)
- time constraints to test system properly, after failing to make software work in lecture theatre and after failing to install software on personal laptop (n=1)
- unenthusiastic feedback from second year students (n=1)

2. How were clickers used?

The majority of respondents were new users of clickers (60%). Four respondents have been using clickers since the Academic Year 2004/2005 (Table 2).

T2: How long have you been using clickers?

	#	%
since 2007/2008:	18	60%
since 2006/2007:	4	13%
since 2005/2006:	4	13%
since 2004/2005:	4	13%
Total	30	

Clickers were mainly used in lecture theatres in Appleton Tower, followed by the lecture theatre in Swann and in JCMB. Five respondents mentioned they used a mobile kit to run clicker questions in locations with no fixed receiver installation (Table 3).

T3: Location where clickers were used

	#	%
Appleton tower LT	13	36%
Appleton tower TS	1	3%
JCMB LT	4	11%
JCMB TS	1	3%
Black 250 LT	1	3%
Swann LT	5	14%
Ashworth lab	1	3%
Sanderson LT	2	6%
Hudson Beare LT	2	6%
Grant LT	1	3%
mobile kit	5	14%
Total	36	

LT: lecture theatre, TS: teaching studio

Most lecturers are Windows users (57%), but there are a fair number of Mac and Linux users (Table 4). This is particularly interesting, when selecting the RF voting software. If we are planning to promote the usage of clickers through individual lecturers' laptops, the system needs to be cross-platform compatible, as this quote by a Linux user depicts: "Linux is a supported OS in this university. If clicker questions cannot be prepared on a Linux box, we probably should not be buying the gear."

T4: What operating system are you using?

Operating System	#	%
PC	15	57%
Mac	7	14%
Linux	10	29%
Total	32	

Approximately half of the lecturers (47%) used clickers in all or almost all of their lectures (Table 5).

T5: Did you use clickers

	#	%
in all (or almost all) lectures you were teaching in this course	14	47%
in several lectures:	11	37%
in one or two lectures only:	2	7%
not in lectures, but in workshops, labs, practicals etc.:	3	10%
Total	30	

Interwrite PRS can be used in various ways:

1. standalone with questions prepared "on the spur"
2. standalone with questions prepared within the Interwrite software
3. standalone with questions prepared outside the Interwrite software (e.g. on an OHP slide or in MS PowerPoint)
4. questions prepared beforehand using the MS PowerPoint add-in, which integrates the Interwrite PRS software and MS PowerPoint

Most lecturers (60%) use the PRS Interwrite software as a standalone application, but prepare their questions beforehand, e.g. in a MS PowerPoint presentation (option 3), without using the MS PowerPoint add-in. The rest of lecturers integrated questions into MS PowerPoint. One explanation for the preference of using the standalone version could be the particular set up of the clicker hardware in the lecture theatres; in all but one lecture theatre, lecturers need to use the managed desktop machine to run their clicker questions even if they normally use their laptops to conduct their lectures (only Swann LT allows lecturers to run clicker questions from their own laptops). Especially in lecture theatres, where a dual screen projection can be used, lecturers often run their presentation including questions from their laptop and only use the managed desktop machine to run the clicker voting process (Table 6).

T6: How did you mainly use clicker questions?

	#	%
Integrating clicker questions into MS PowerPoint using the PPT add-in:	12	40%
Using the PRS standalone version, but with questions prepared beforehand (e.g. in an MS PowerPoint presentation):	18	60%
Making questions up "on the spur of the moment":	0	
Total	30	

The most basic way of using clickers is to ask students to vote individually and only allow one voting. However, quite a number of lecturers, use clickers in more innovative ways, such as encouraging students to discuss with their peers before voting (n=10). Lecturers also ask students to revote on questions (n=13), after having explained a question in more detail or allowing students to discuss with their peers. Voting in pairs, a form of peer learning, can be a very effective way of learning and students usually respond very positively to it (Nichol and Boyle, 2003, Draper, n.d.). Clickers are also used for revision (either of a previous lecture, lecture block or in a special session before exams). Three lecturers use confidence levels, which show how confident students are when selecting a voting option. Confidence

levels in conjunction with re-voting can give some interesting insights in students' increasing level of confidence in their own knowledge and understanding of a concept. A couple of lecturers use clickers for a 'pub-quiz' style assessment, individually or in groups, where clickers are assigned to specific identities and a cumulative score is being calculated at the end of the quiz (Table 7).

T7: How do you use clickers? How do you use clickers?

	#
I encourage peer discussion	10
I allow students to revote	13
Students use confidence levels	3
I use clickers for revision	11

3. Usefulness of clickers

All but two of the lecturers perceived the clickers as useful (n=28, 93%). Reasons for the two lecturers, who did not find clickers useful, were technical problems and time constraints (Table 8):

- "I found them difficult to get to work on a technical level, partly through lack of preparation (the lecture theatre set-up was different to what I had prepared for: PPT didn't work easily). I ran out of time and patience, as I felt I needed to concentrate on getting the lecture content right rather than the added bonus of clickers."
- "The students didn't respond well to them, and I didn't have enough time during the semester to teach what I wanted to, so I had to abandon using the clickers."

T8: How useful were the clickers as an aid to teaching?

Usefulness of clickers	#	%
Not very useful	2	7%
Useful	11	37%
Very useful	11	37%
Extremely useful	6	20%
Total	30	

The perceived usefulness of clickers seems to grow with usage. Four out of the six lecturers, who find clickers "extremely useful" have been using them for more than three years. Furthermore the majority of respondents finding clickers "extremely" or "very useful" have had no or few problems running clicker sessions. Similarly, those lecturers who "only" described clickers as "useful", are mainly new to clickers, experienced technical problems at the start and often report, to not have collected enough experience and student feedback to be able to judge the usefulness appropriately.

This might lead to the finding, that experience and finding a more stable and easier technical solution might influence the perceived usefulness of clickers.

Ranked by importance, clickers seem to be most useful to (max. score 500¹):

1. increase interaction between lecturers and students (score=456)
2. get feedback on students' understanding of content (score=437)
3. reveal common misconceptions amongst students (score=415)
4. help students understand difficult concepts better (score=406)
5. help students practice content (score=347)
6. keep students awake (score=339)
7. keep students entertained (score=310)
8. increase attendance (score=160)

Other benefits lecturers mention, are:

- "Clicker use demands engagement rather than note-taking for later"
- "Increases interaction between students and gives students immediate feedback on their own understanding and that of the class as a whole."
- "Questions were designed to prompt students to think deeply about matters such as experimental design."
- "Stimulate me to think again about lectures I have been giving for many years"
- "Collecting other general feedback"

Some feedback from the open-ended question on the usefulness of clickers:

- "Clickers allows lecture to be more dynamic and I got very useful feedback on the understanding, perceptions and preferences of the students."
- "They give a much better idea of how the class is keeping up than trying to read the minds of 50 blank-faced students! Better to go back immediately to the thing they have been puzzled by than to struggle on not knowing what they don't know."
- "Engagement is the biggest problem I have with some students. The first clicker question I used demonstrated that they hadn't been engaging, but as we progressed through the material, the students took it seriously and really followed along with what was being said."
- "Students engage better with material if challenged to answer. They then learn the perception of the rest of the class as does the lecturer who can then judge whether the issue has been learned or needs reinforced."
- "Tried and tested tool to enhance engagement."
- "I had previously been dissatisfied with revision sessions, finding it hard to judge the pace appropriately."
- "I think [clickers] encourage students to pay attention, to think, etc in lectures. They allow you to flesh out what you are doing. They encourage engagement. They encourage discussion about physics between students. They enthuse just from the use of such gizmos. They break the monotony. They make me, as a lecturer, think a bit more about what I'm doing. All good."
- "It has been very useful for me to be able to confirm that understanding is improving as I discuss concepts and content. Similarly it is good for the class to see that there is an overall increase in understanding, while those students who did not choose the correct option know that that they have a gap in their knowledge and understanding. Clickers also assist in making the lecture more interactive. I encourage students to discuss among themselves before voting and also gives a good basis for class lecturer interaction."

¹ Score based on Likert-scale voting: 1: very important (multiplying factor=5), 5: not important at all (multiplying factor=1). Maximum score: 100% * 5 = 500, minimum score: 0% * 1 = 0.

4. Challenges of clickers

Technical issues

Asked about whether anything went wrong during their clicker sessions, only nine lecturers said that they did not have any problems at all (Table 9).

T9. Problems experiences	#	%
no problems	9	21%
with clicker software	13	31%
data projector	2	5%
managed desktop machines	7	17%
receivers	6	14%
other	5	12%
	42	

The biggest problems seem to be the unstableness and user-unfriendliness of the software. Also, lecturers report difficulties with moving their presentations from their laptops (where they usually present from) to the managed desktop machines (connected to the clicker receivers). This causes all sorts of issues, not only-related to the clicker software, such as login failure, inappropriate file size on the network ('M:') drive, modification of number of options set for individual clicker questions.

There is no significant correlation with problems and length of clicker usage or the operating system lecturers are using (although PC users seem to have slightly less problems than Mac users). One factor which seem to influence the rate of problems with clickers are lecturers' perceived level of computer efficiency (e.g. 25% of lecturers who perceived themselves as excellent computer user had no problems with clickers, as opposed to 16% of lecturers who perceived themselves as good or fair users). Personal, one-to-one training sessions with clicker support people or other colleagues using clickers, also seem to have influenced the rate of problems (out of the nine lecturers, who indicated no problems, eight had either a one to one training session or a clicker support person attended their lecture). Five out of the nine people who had no problems, taught in Semester 2 (we managed to install a more stable software version early January 2008).

A few comments from respondents:

Respondent 1: "I had no problems,.. but I note that I am a terminal case of computer geekyness and am paranoid about stuff going wrong. I am aware that a colleague had a really hard time with the clicker equipment, and gave up on the wretched things.

His experience forewarned me to be very careful about the whole business. I therefore prepared the questions in advance. I then sneaked into the lecture theatre when it was not in use and made certain that I knew how to use the equipment. I double checked that the questions I had prepared on my own machine would work properly on the managed desktop machine in the lecture theatre.

Only after having done all that, was I sure that I could use the equipment in front of an audience without an embarrassing catastrophe."

Respondent 2: "Frankly, the system as it stands is a pain:

1. The desktop machines take a long time to log in (or reboot if in the wrong mode)
2. The disk space (5 MB) available to me is so small it can cause problems (I did not realise this until I was told after I could not get the software to work one week)
3. The software is clunky and glitchy - I can never rely upon it working, and I do waste a lot of time trying (sometimes having to give up).
4. It is a real pain that I cannot run the lectures from my laptop, as I know it works from there (I can trial it before I arrive, and it runs quicker, boots faster)
5. Only about 50 of the 100 students ever get to vote in the 2-3 minutes I allocate per question - the system is too slow."

Respondent 3: "It took me 4 lectures before I could get it to work:

1. EUCS changed my password without notice
2. broken PRS receiver
3. so inexperienced there were lots of mistakes
4. success"

Frequent technical problems with setting up the clicker system or running questions are a real issue, since it impacts students' impression of a lecturer: "In my final lecture the software was not working, as I was informed after spending some time looking pretty incompetent". The risk for lecturers, who feel embarrassed when something goes wrong, to drop the whole idea of using clickers, is very big: "I thought I had prepared [myself] and also had in-lecture support initially, but I didn't feel confident enough to continue use."

Consistent use and decrease in response rates

It seems to be difficult to have a whole course team subscribe to the use of clickers. Out of the 27 courses, which were co-taught, only eight course teams managed a cohesive approach to clickers (30%). Thirteen course teams managed a 50% and above usage of clickers, and six courses have a usage rate between 13-33%.

This seems to have some influence on the response rate of students. One of the main challenges that lecturers report when using clickers, is to encourage students to bring their clicker on a regular basis to lectures. The majority, 14 lecturers (45%) estimate that only 50% of students vote on clicker questions. Four lecturers (13%) report a 100% response rate, while ten lecturers (32%) have a 75% response rate and three lecturers (10%) a response rate as low as 25% (Table 10).

T10: How many of the attending students do, in general, vote on a clicker question (approximately)?

Response rates	Sem 1	Sem 2	#	%
25%		3	3	10%
50%:	6	8	14	45%
75%:	7	3	10	32%
100%	2	2	4	13%
Total			31	

Looking at the courses, which report a 100% response rate (n=4), these are courses where the whole course team is using clickers and where clicker questions are asked in all or at least several lectures. However there are some courses, where a whole course team uses clickers, but still the response rates range between 25 and 50%. These are mainly courses in Semester 2 of the Academic Year.

So in addition to the fact that clicker usage increases with consistent use, there also seem to be some disengagement with clickers with time. While the average

response rate in Semester 1 is 68%, in Semester 2 it decreases to 56%. Lecturers who report a 25% response rate all teach in Semester 2.

There might also be other reasons for low response rates, such as difficulties receiving votes due to the IR technology or unwillingness of students to commit to an answer, when in doubt about the correct answer (although the system is anonymous, some students responses in focus group discussions could lead to this conclusion).

Reduction of content and adaptation of lectures due to clicker usage

Asked about whether clicker questions reduce the amount of content lecturers can cover in their teaching, respondents seem divided. While 53% (n=16) answer with yes, 47% (n=14) don't agree with this statement.

Where lecturers feel, clicker questions take time away from lecturers, most of them prepared the lectures in a way that content was reduced. Only one lecturer mentions that he/she had to add one additional lecture at the end.

Respondents also mention to offer content in a different way, by "leaving out some details", "focusing on essentials", "making lectures more concise" or offering more examples, which could lead to better teaching and more in depth knowledge:

- "By focusing more on the essentials. In reality it meant that these were being better taught (in my opinion) as more of the class seemed to follow the material."
- "Well... it kind of changes it. Less formal content (syllabus) but more examples and hopefully deeper knowledge."
- "I tried to make the material I was presenting more concise and removed some unnecessary parts/derivations. I also restricted myself to choosing only one clicker question."
- "It was only marginally reduced and probably is better without the deleted content."

Although most lecturers only ask 1-2 questions per lecture, the amount of question seems not to heavily influence their perception on whether they had to reduce content or not. Only slightly fewer lecturers, who ask 1-2 questions feel they have to reduce their content than lecturers who ask 3-5 questions (53% as opposed to 58%, Tables 11 and 12).

T11: How many questions do you generally ask per lecture?

Number of questions	#	%
1-2:	17	59%
3-5:	12	41%
Total	29	

T12: Correlation between reduced content and number of asked questions:

Content reduced?	1-2 questions asked	3-5 questions asked
Yes	9 (53%)	7 (58%)
No	8 (47%)	5 (42%)
Total	17	12

Asked about whether the use of clickers caused lecturers to adapt their teaching during the lecture, the majority (67%, n=20) agreed (Table 13).

T13: Did the information obtained from students via the clickers cause you to adapt your teaching during a lecture?

Adapt teaching	#	%
yes	20	62%
no	10	38%
Total	30	

When asked to explain their answer, most lecturers mentioned increased time needed to explain concepts students did not understand properly, but two lecturers also mentioned that they moved to the next topic quicker, because all students got the answer right:

- "Increased focus on topics that the bulk of the class struggled with at the expense of topics students grasped easily"
- "On the basis of one or two questions I could see that some students were misunderstanding a concept or idea and was able to correct that and make a mental note for next year's teaching to explain the idea differently."
- "I realized that what I thought was a difficult topics requiring an additional half lecture was actually very well understood already and I could advance to the next topic."

When asked about the most unexpected result that happened when using clickers, most lecturers referred to a surprise in students' answers either (n=6), the enthusiasm students showed for clickers (n=3), students commitment and engagement with clicker questions (e.g. guessing correct answers when lecturers make a mistake, n=2) and how many students change their minds in a re-voting process (n=1):

- "How enthusiastic the students were when I said we were going to use the clickers."
- "Do occasionally get a majority picking a wrong answer..."
- "Topics revealed to cause difficulty which I expected students to understand with ease and vice versa."
- "That I messed up the answers, but [students] guessed what I was meaning to have had as an answer and put that, without complaining. Real engagement!"

On the more negative side lecturers mention student disengagement and dissatisfaction with clicker usage (n=2), a worsening of the lecture due to clicker use and the amount of time it needs to familiarise oneself with clickers and develop useful clicker questions (n=1):

- "Student apathy. This year students did not want to use clickers from the outset while a few years ago they loved the idea."
- "The students didn't like them."
- "I think it worsened lectures rather than improved them. That was unexpected."
- "It takes a lot of time and practise to think of the best and most useful questions. It also needs a 100% commitment to wanting to use the clickers since they do eat into valuable lecturing time."

5. Support

Lecturers were asked what kind of support they received and whether they felt it was appropriate. Most of lecturers (58%) attended a presentation or training offered on clickers, either by the clicker support team or other colleagues in the University. More than half of the lecturers (54%) also received some kind of support in the lecture theatre and 46% received individual one-to-one training (Table 14). This still quite intensive support yielded good results: 21 respondents (81%) felt appropriately

supported, while only five (19%) felt that they had either experienced better support before; had been supported, but still did not feel confident to use the system; felt, that although support was there, it couldn't deal with the problems posed; or would have preferred other kind of support, e.g. more online resources. It is clear that while some respondents prefer a very short demonstration and then try to make the software work on their own, others need a lot more support. Many appreciate help at their first lectures, to ensure that the system works fine: "Personally, I would always find it helpful to have someone present at the beginning of my lecture to help me setup" (Table 15).

T14: What kind of support did you receive (multiple answers possible)?

Type of support	#	%
one to one demonstration	12	46%
support in class	14	54%
help from colleagues	3	12%
attended a presentation or training	15	58%
total of lecturers responding to this question	26	

T15: Did you feel appropriately supported?

	#	%
yes	21	81%
no	5	19%
total	26	

A few comments/recommendations from respondents:

- "A 5-min talk through, one-to-one. The perfect amount."
- "Full demonstration and training session. Opportunity to talk to experienced users."
- "Excellent technical and practical support and fast provision of clicker service."
- "Technical support was excellent. I would like to have more practical support in coming up with efficient questions. By that I don't mean to have a question that reveals common misconceptions, but how can I set up a question so that it reveals common misconceptions I might not even be aware off."

6. Future plans and suggestions for improvement

Of all respondents that we had, those who did not use clickers and those who used them, only two said they would not use clickers in future: one because he was about to retire and one because he was disappointed by students' feedback and experienced technical problems. The rest of lecturers are planning to continue or start using clickers in future. However a few lecturers mentioned, that they would only continue using clickers, if the set up proved itself more reliable and convenient.

These are suggestions for future improvement:

- more reliable and convenient set up of clicker software and hardware
- possibility of using own laptop to run clicker questions: "I think its essential that we are able to plug our laptop into the system, so we don't have to use the very unreliable computer systems in the LTs".
- ease of installing software on own laptop / desktop machine

- keep lecturers' laptop up to specification
- possibility for numerical input
- better statistical analysis, e.g. male vs. female, response over the year, Scots vs. rest of world etc.
- keep data for students to view their answers as learning resource
- "punish" students who forget to bring clickers to the lecture

Conclusion

The College of Science and Engineering has now been using clickers for four years. This academic year approximately 60 lectures have been using clickers and 2000 clickers have been issued to students.

Feedback from lecturers on clickers is very positive, they seem to really enjoy using clickers and find them with a few exceptions very useful. The benefits of clickers are evident – especially the increased interaction between lecturers and students, improving feedback for both students and lecturers by revealing common misconceptions and giving students a feeling how they compare to their peers. Lecturers also report that using clickers has made them reflect on the content they are teaching in their lectures and the way they are teaching, helping them judge on which concepts to focus on, including more examples and in general streamlining their lectures.

However, there are also challenges when using clickers, such as technical issues, lecturers are encountering, less experienced as well as more experienced clicker users, especially with the current software and problems with using managed desktop machines. These need to be addressed and will hopefully be alleviated by the introduction of Radiofrequency technology (e.g. by allowing lecturers to use their own laptop to run clicker sessions).

Consistent use seems to be another issue, which affects students' uptake of clickers. Lecturers generally use clickers in all or nearly all classes, which is good practice. However, convincing the whole course team to use clickers, where courses are being co-taught, seems to be a big challenge. This leads in some cases to students forgetting their clickers and results in decreased response rates. There is also some evidence that students tend to disengage with clickers as the academic year progresses, which leads to decreased response rates in some courses in Semester 2.

This can be alleviated by varying types of questions asked and the way clickers are used in lectures, such as encouraging students to revote and to vote in pairs. Other innovative ways of using clickers are using clickers to revise lecture blocks or to prepare for exams and to do pub-style quizzes.

In general, effective clicker usage needs time and practice, as this quote depicts: "It takes a lot of time and practise to think of the best and most useful questions. It also needs a 100% commitment to wanting to use the clickers since they do eat into valuable lecturing time."

Support needs to be offered in various ways, from group training sessions to one-to-one training to extensive online resource materials. While a majority of lecturers will be able to run the software on their own, some might always need a support person

there at the beginning of the lecture, to ensure a correct set-up. How this support can be provided on a sustainable basis, needs to be seriously discussed within the College of Science and Engineering.

References

Brown, M. (2004): *Questionnaire for lecturers who have used PRS*. Retrieved February 7th, 2008 from <http://www.reap.ac.uk/public/Resources/lecturerPRSQnaire2004.doc>

Caldwell, J.E. (2007). Clickers in the large classroom: current research and best-practice tips. *Life Sciences Education*, 6(1), 9-20. Retrieved February 7th, 2008 from <http://lifescied.org/cgi/reprint/6/1/9.pdf>

Steve Draper (n.d.). *Electronically enhanced classroom interaction*. Retrieved April 11th, 2008 from <http://www.psy.gla.ac.uk/~steve/ilig/handsets.html>

Nichol, D.J. and Boyle, J.T (2003). Peer instruction versus classwide discussion in large classes: a comparison of two interaction methods in the wired classroom. *Studies in Higher Education*. 28(4), pp457-473. Retrieved February 7th, 2008 from <http://www.psy.gla.ac.uk/%7Esteve/ilig/papers/nicol2.pdf>