1st Annual Conference on the Aiming for Excellence in STEM Learning and Teaching
12 – 13 April 2012, Imperial College, London & The Royal Geographical Society.

ZAPPERS IN TEACHING MATHEMATICS

Vesna Perišić
Mathematics
University of Southampton
SO17 1BJ Southampton
V.Perisic@soton.ac.uk

Abstract

It is widely recognized that interactive teaching activities have a huge beneficial impact on student learning. One example is the use of Personal Respond System, (PRS), also called clickers or zappers. In this paper it is shown how the technology has been applied in two teaching activities carried out with Engineering Foundation Year (EFY) students: a diagnostic quiz carried out at the beginning of the course and two revision sessions organized towards the end of the course, and how students benefit from this approach.

Keywords
Mathematics, personal response system, zapper, interactive teaching activity, diagnostic quiz, revision session.

1. INTRODUCTION AND BACKGROUND

We have gained a good understanding of the learning process and we know how important student's engagement in this process is. Learning cannot happen without engagement.

From evidence based research in learning and teaching, it became apparent that personal response systems (PRS), also called clickers or zappers, not only support student engagement but also increase student-lecturer interaction, hence facilitating active learning even in large lecture classes. (Lass, D. et al, (2007)).

Zappers are small handsets which allow students to respond to (usually) multiple choice questions displayed on PowerPoint slides. A bar chart representing students' votes appears on the question slides. This can be seen as a discussion springboard for lecturer and students alike. Participation can be made anonymous. The data are exported and saved using convenient Excel report formats for further analysis.

There is a wide range of examples where zappers are successfully integrated into teaching, including technical subjects such as mathematics, engineering and science (d'Inverno, 2011; Retkute, 2008).

At the recent Turning Technologies User Conference, University of Surrey, current state of the technology has been presented including examples of good practice across different disciplines. A team from Southampton has presented a rich collection of examples how zappers are used at the University of Southampton where they are successfully integrated in activities such as outreach, teaching courses, evaluating teaching and across various disciplines, from mathematics and chemistry through medicine and nursing (Parr, S. et al, (2011)).

Globally, one of the best known promoters of the technology is the “Mazur Group” initiated and led by Eric Mazur at Harvard University, (see mazur.harvard.edu). He and his group promote a question based approach to teaching and learning, and therefore challenging the traditional approach, or as they say ‘teach by questioning, not telling’. The zappers together with the supporting software are crucial for delivering teaching they are advocating.

d’Inverno (2003) summarizes the reasons for using zappers in teaching as to increase the interactivity of lecture courses and, at the same time, to enhance the feedback on the progress of understanding and learning during lectures for students and academics alike.

Diagnostic quizzes and tests are popular forms of both formative and summative assessments and are often composed of multiple choice questions, an environment where zappers can be easily implemented. The paper will motivate the need for change using the case studies of a diagnostic quiz session and revision sessions and provide practical insight how that has been done with the available technology.

2. TEACHING WITH ZAPPERS

Figure 1 shows a typical layout of a zapper as used by the author. These handsets are easy to use. When a PowerPoint slide with a question and answer options is displayed, students respond by pressing the button matching the favoured answer.

Figure 1 Zapper

The system is composed of a handset, a receiver and software that enables voting, collects answers and displays those answers using statistical graphs as well as creating reports.

The diagnostic quiz and the revision sessions, important activities within teaching mathematics to Engineering Foundation Year (EFY) students, were identified as the activities where zappers would best improve the learners’ activities. The EFY cohort is academically and culturally (age, country, ethnic origin) a very diverse cohort and to identify a teaching approach that serves best to all students is challenging. To get to know the students, to gain at least a vague picture about the knowledge they bring to university and to be able to develop appropriate teaching methods and strategies, it is good practice to ask students to perform a diagnostic test at the beginning of their studies as part of the Induction activities. A traditional test at this early point was never popular with the students. The students, often being out of education for some time would find the test situation very stressful. With increased number of students timely marking and feedback became an issue.

In another case, we were looking into how to use limited revision and exam preparation time most effectively for a cohort of 140 EFY students. Encouraged by findings in using zappers, the decision has been made to incorporate the technology in both activities.

2.1 Diagnostic Quiz

A diagnostic quiz session supported with zappers represents an interesting and innovative approach to access and assess students’ knowledge.

The diagnostic quiz Power Point session typically contains of up to fourteen conceptual GCSE level questions, each displayed on a slide together with a list of suggested answers. The students work on the displayed problem for a couple of minutes. The slides can be equipped with a timer. Each student gives an answer pressing the relevant button on her/his zapper. After the time has elapsed, the polling has been closed, the correct answer is indicated and a statistical chart summarizing the results appears on the slide as shown on Figure 2 below. The charts regularly initiate discussions between the students and the lecturer but also among the students.

The diagnostic quiz delivered in this way became very popular with the students. It has proved to be an effective, vivid interactive educational activity creating a welcoming experience. The students are engaged, everyone is participating and they find it interesting to use the new technological tools. This interactive session creates an environment in which it is easier to get to know each other.

Additional aspects that are in favour of the system are that no marking is involved and the students got immediate feedback, they can also assess their own performance in relation to the cohort. Anecdotal feedback from the students shows that they also liked the anonymity when answering the questions which has encouraged them to participate without risking embarrassment if they were wrong, "no worries about getting something wrong, and you can see that you are not alone" as one of the students stated. At the same time the lecturer obtains an idea about the knowledge of the students that she/he is about to start teaching.

2.2 Revision Sessions

Using the zapper technology in the revision sessions, the exam preparation can become more effective. The technology gives us a new, effective way to address and discuss typical errors made by students. The key of effective revision using this system is in careful and considerate design of both the questions and the answer options which need to incorporate the errors that students usually make. Often the students find the same topics difficult and make similar mistakes as illustrated on Figures 2 and 3. In both years the correct answer was not the most popular one.

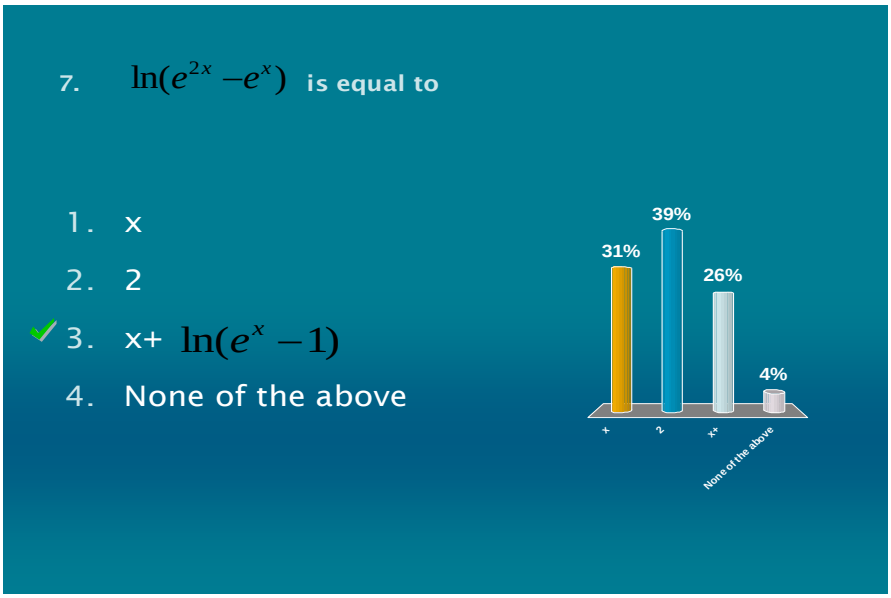

Figure 2 Revision session 2010

The question displayed in Figure 2 and 3 tests students' ability to apply the logarithmic laws. The polling results for two different years are shown. The students are excited about the charts summarizing their answers.

After displaying the voting results the students can see that they are not alone with their problems and misconceptions. They are encouraged to discuss the options with their peers and to rethink the concepts. In this way not only the students are obtaining feedback on their understanding of the material taught, but also the lecturer is getting feedback on how the students have understood the thought concepts. The overwhelming majority of the students consider the session an effective means to revise for the exam.

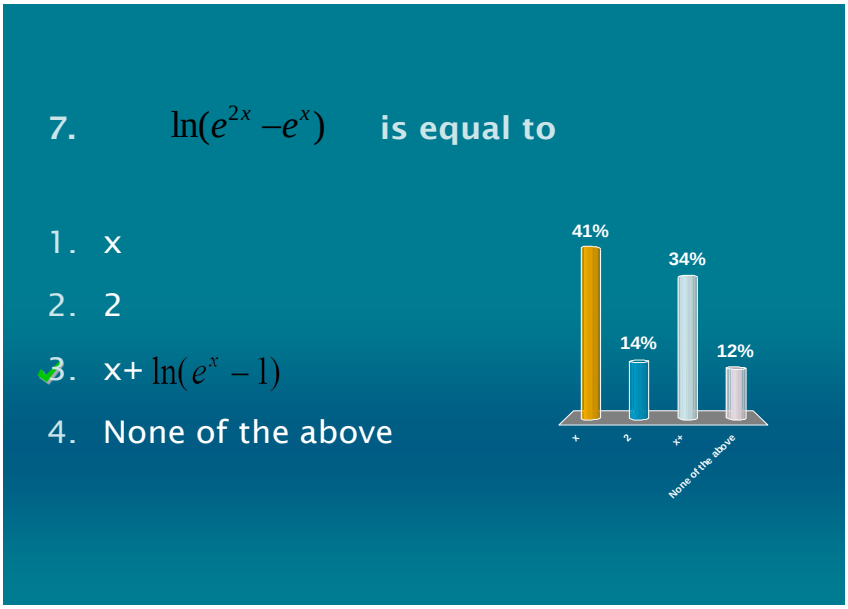

Figure 3 Revision session 2011

2.3 Feedback from the students

From discussion with the students about the use of zapper technology we can conclude that the overwhelming majority of the students consider the use of the technology as beneficial for their learning and would like to use it more often in their teaching activities. In addition to the diagnostics or revision questions we also ask the students for our own evaluation "Would you like to use zappers more often to support your learning?" Usually at least 70% vote in favour for zappers which suggests that this technology, when used effectively, provides learning benefits to students as well as enhances their learning experience.

3. PROS AND CONTRAS

The identified learning gains using the technology for delivering the diagnostic quiz or the revision sessions are:

- It enables to achieve higher student engagement and participation.
- It improves student-lecturer interaction.
- It enables lecturers to address typical errors in revision sessions effectively.
- It enables individual students to compare themselves with the cohort.
- It provides instantaneous two-way feedback.
- It enables to create an engaging friendly atmosphere.
- No marking.

Anonymous participation is one of the key features that the system supports:

"In line with other established uses of the PRS (Personal Response System), the anonymity afforded by the system promotes individual student involvement in a way that is non-threatening, so that all students have the opportunity to participate". (Lorimer and Hilliard, (2009))

Main challenges of the system experienced in connection with these two types of activities are mainly of the technical nature, such as:

- Writing good multiple choice questions is not a trivial task.
- Preparation of Power Point slides which include mathematical formulae is time consuming and connected with difficulties (Figure 4).
- Necessity to plan the activities much in advance to be able to book the zappers in time and taking responsibility for handsets including distributing and collecting them to/from the students.
- Anxiety – will everything work properly in the lecture theatre?

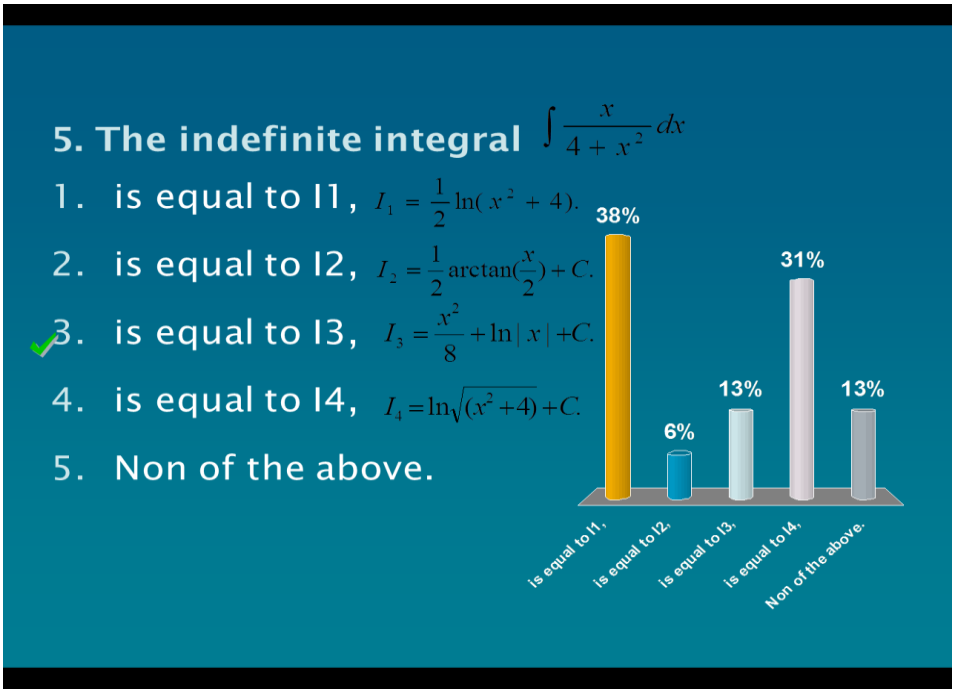

Figure 4 The slide illustrates difficulties to fit in formulae

4. CONCLUSIONS

To summarize, zappers facilitate interactive teaching methods and as such they are earning an important place in learning and teaching. There is strong evidence in support of not only occasional but more extensive and regular use of zappers in teaching. With the possibility to use smart phones in place of the handsets many technical problems would be overcome. The Turning Technology software can already be used with smart phones, leaving the question: ”Can we assume that every student has a smart phone?”

The “zapper community” is however growing. A new global social network, the Peer Instructor (PI) Network (www.peerinstruction.net) seeks to facilitate global collaboration and interaction.

5. REFERENCES

1. Duncan, D., (2005), Clickers in the Classroom, Pearson Education
2. d'Inverno, R.A., (2003), Making lecture Interactive, MSOR Connections, 3 (no.I),(2003) pp 18-19
3. d'Inverno, R.A., (2011), Student Feedback .... A Lesson for the Teachers http://www.personal.soton.ac.uk/rdi/zappers/mee.htm ,accessed July 2011
4. Lou, F., Lorimer, J., (2010), How to use TurningPoint https://uhra.herts.ac.uk/dspace/bitstream/2299/4709/1/904191.pdf, accessed February 2012
5. Lass D., Morzuch B. and Rogers R., (2007), “Teaching with technology to engage students and enhance learning”, University of Massachusetts, Amherst Department of Resource Economics Working Paper
6. Lorimer, J. and Hilliard A., (2009), "*Use of an Electronic Voting System (EVS) to facilitate Teaching and Assessment of a Decision Making Skills in Undergraduate Radiography Education".* 8th European Conference for E-Learning, Bari, Italy, ACI
7. Masikunas, G., Panayiotidis,P. et al, (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 15 Issue 1 pp 3-20
8. Parr, S. et al, (2011), *Examples of Zapper use at the University of Southampton*, Turning Technologies User Conference, University of Surry https://www.youtube.com/watch?v=1QcEaVhaBO8&list=PL7826727AC8A9436C&index=3&feature=plpp video accessed February 2012
9. Retkute, R., (2008) “*Exploring technology based continuous assessment in Mathematics*” http://personal.maths.surrey.ac.uk/st/R.Retkute/EVS_Maths.html accessed February 2012