

2012

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Recommended Citation

Dunne, J. & Ryan, B.J. (2012). Harnessing Technology to make Learning (and Teaching) more fun. *Proceedings from 5th Annual International Conference on Engaging Pedagogy (ICEP12) ITB, Dublin, Ireland, December 14.* doi:10.21427/hr3v-ed90

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Harnessing Technology to make Learning (and Teaching) more fun.

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Abstract

This paper describes how various technologies were introduced into foundation science modules both to enhance student engagement and feedback, and also to cope with increased teaching workload. It mostly deals with freely available software or tools available through a VLP (virtual learning platform, e.g. *Blackboard* or *Moodle*), but also includes audience response ‘Clickers’ which were purchased. The technologies discussed are user-friendly and do not require advanced IT skills. The paper includes successes, but also includes some less successful attempts to integrate technology and explores the possible reasons.

As third level funding is reduced, many academics are coming under increased pressure to deal with larger and more diverse classes. In addition, our ‘digital native’ students have increasingly higher expectations regarding the type of learning resources, activities, and communication tools we utilise. Furthermore with information at their fingertips, education is expanding from delivery of content, to focussing even more on developing critical thinking and employability skills. This all provides a challenge for academics to deliver a high quality service.

Here, we discuss technologies which were used to overcome some of the challenges facing us as educators, making our teaching more productive and efficient, and less tedious. We describe the substitution of a formal written exam to assess basic first year knowledge, to an automated online self-correcting MCQ (multiple choice question) assessment, with built in summative feedback. We also discuss the use of audience response ‘Clickers’ MCQ in-class quizzes as aligned learning and revision activities, which are engaging, and also provide formative feedback.

In addition, we describe the integration of ‘CATME Team Builder’ software to organise group work and automatically process anonymous peer marking. This replaced the traditional anonymous paper based peer marking forms, removing the tedious and time-consuming data extraction task, and allowing a far more comprehensive and rigorous peer assessment.

Finally, other technologies used to greater or lesser success including Twitter, Peerwise and Wallwisher are briefly discussed.

Keywords

Technology enhanced learning, Engagement, Feedback, peer assessment, online assessment, Clickers, Twitter, Peerwise, Wallwisher, CATME, MCQ quiz.

1. Introduction

This paper describes our approaches to combat the dual problem of increased academic workload, coupled to student expectation of technology integration into their learning.

With larger and more diverse classes, a significant reduction in staff resources, and additional class contact hours, the challenges facing us as academics to provide a high quality service to students have grown. Furthermore, students are becoming ever more aware and comfortable with technology (Sharples et al, 2010). It is part of their everyday life, and as such, academics must consider integration of technology into the classroom as a *'fait accompli'*. Students demand the most interesting and up-to-date technology as part of their learning (Skiba & Barton, 2006). Research has proven that an engaged student will absorb and understand more, with blended learning a key method of student engagement (Johnson & Lillis, 2010). This paper describes how we have used technology both to address the challenges of maintaining a high standard of delivery despite increased workload, and also to exploit student willingness and eagerness to engage in learning through technology.

The main themes discussed are Engagement and Critical Thinking; Managing Assessment and Feedback; and Managing Peer Review of Group Work. It is a practice based paper, and therefore focuses on the problems we identified, our solutions and rationale, how the technology was implemented, and an evaluation of the outcomes.

2. Engagement and Critical Thinking.

2.1 Personal Response Devices, *Clickers*.

Tangible student engagement, particularly in large classroom settings, can be difficult to achieve. Asking open ended or challenging questions directly to the class can result in silence and disinterest from the student population. Student response devices, also known as Clickers, provide a simple way in which to generate an atmosphere of student interaction that can simultaneously enhance critical thinking and problem solving amongst groups and individuals.

We conducted aligned action research projects focussing on the application of Clickers in Science education. In the lecture environment, a Clicker was anonymously

given to a group of students (n=3 or 4) at the beginning of the class. The class were asked to work together in their groups to answer a MCQ based on the fundamentals of chemical structure, organic chemistry nomenclature or reaction prediction. Once the group had decided on which answer they thought was correct, they clicked in the groups' decision. The Clickers were used in groups in the lecture for two reasons; firstly the limited number of Clickers (n=40) combined with the large class size (n=130) and also the students could peer-share if they worked together to answer the MCQ. Once the question was answered by all the groups the correct answer was revealed, the feedback graph was displayed and the lecturer facilitated a discussion based on the explaining why the distracter answers were incorrect and how the correct answer was right. Initially the lecturer led the discussion, however, with time and experience the student population (those who got the answer correct) lead the discussion and, as such, facilitated peer-teaching.

In the laboratory setting, a Clicker was given anonymously to each student (n=32) and the individual was asked to complete a pre-lab MCQ based on apparatus, experimental and safety knowledge. This was not graded, but did give the students and the academic an indication of the level of understanding and served as a starting point for further discussion. After the laboratory was completed the students were asked to submit their collated lab data via their Clicker. This served as a reminder to students to collect all personal data before the lab was finished and also it allowed each individual to see how they compared to the results of the rest of the class. It is important for the individual to compare and contrast results as part of their scientific report on the laboratory. Once the results were collected, the lecturer and the students discussed the general trends observed (facilitated by the instant graphical representation of the data) and this supported the students as they prepared their reports on the laboratory session.

Pedagogical evaluation of this action research took the form of an anonymous student multiple choice questionnaire (n=80), an anonymous feedback form (n=93) and a student discussion forum facilitated by an independent academic (n=15). Evaluation of Clicker usage in lectures and laboratories was overwhelmingly positive. Student statements included: *“best thing about the lecture, full stop”*, *“allowed me to chat to my neighbour to figure out the question ourselves”* and *“I looked forward to the Clicker questions, it kept me switched on to what was going on in the lecture as I*

knew I'd have to help my group-mates work out the Clicker MCQ". The vast majority of students (97%) enjoyed the use of Clickers. Students felt that using the Clickers was beneficial to their learning (94%); the feedback and discussion after Clickers usage was helpful to students even if they got the question incorrect (89%). Clickers were popular because they were fun and interactive; however the students noted the post Clicker discussion as a crucial component of Clicker time (92%). Although the students enjoyed the use of Clickers, a comparison of the final module grades attained with and without Clickers quizzes did not show a significant increase in student achievement.

2.2 Peerwise.

Outside the classroom students exist in a digital world; social media outlets allow for instantaneous collection and sharing of text and multimedia data. These '*digital natives*' intuitively create, modify and publish digital media to their online community and in return they receive feedback in the guise of "*likes*" and comments; however, they are restricted from using these innate skills in the learning environment (Richardson, 2008). One example of an effective and adaptable online socially constructed knowledge community is *Peerwise* (www.peerwise.cs.auckland.ac.nz). *Peerwise* is an online web-based database that allows students to create and review multiple choice questions (MCQs). Integrated within the online database are a number of key steps that elevate the learning from simple declarative knowledge regurgitation via MCQs.

Critical Thinking Development

Within Peerwise students are encouraged to write clear and unambiguous questions, to select carefully the five potential option answers (four suitable distracter 'wrong' answers and the correct answer) and to provide feedback for the MCQ end user.

Collaboration and Engagement

The Peerwise community engage with each other virtually through writing questions, adding feedback, rating question difficulty and quality, and leaving comments for other members of the community to view. Users can follow a question author and in this way the community develops a familiar feel (similar, for example, to *Twitter*, *Facebook* and *Pinterest*) that the students are comfortable using.

Gamification

Peerwise contains elements of games within the website, ranging from simple score keeping to rewards for attainment of selected criteria, similar to completing a level on a traditional video game. Echoing video games, the format encourages the user to continually engage with the content, leading the user onto the next question and deeper into “game” and the learning spiral.

We carried out action research investigating the use of *Peerwise* as a student centered virtual learning environment. Students (n=139) were encouraged to engage with the aligned online *Peerwise* course during their own independent learning time. Each student was asked to post six questions and answer six questions as a minimum, and this accounted for 4% of their overall module grade regardless of whether the questions were answered correctly or not. The 4% weighting was envisaged as a ‘*carrot*’ to encourage students to participate (Hooper et al., 2011). 71% of registered students engaged with *Peerwise* to some level; 60% of students asked the minimum number of questions and 66% answered the minimum number. Overall, students liked to answer questions more so than create questions; the average number of questions asked per student was four, whilst the average number of questions answered per student was fifty. The largest number of questions posted by an individual student was eleven; whilst the largest number of questions answered was five hundred and twenty-five, interestingly, these maximum interactions were from different students. The total number of student generated questions (with associated feedback) in the final data base was five hundred and sixty four.

The academic incorporation of *Peerwise* required minimal administration beyond the initial course set up and a weekly review of the types of questions asked. A basic tutorial on how to design good MCQs, with suitable distracter wrong answers, and provide appropriate feedback was necessary at the start of the module. Overall students liked that they could work at their own pace in their own time “*Peerwise was something I could do on my own and the questions were linked to what we were studying in lectures*”. The sense of community assistance was fostered online and students appreciated that the questions were written by students for students: “*The interactive nature of Peerwise was great, I’d check in regularly to see if anyone had posted a question or comment on my questions*”, “*even if I didn’t know the answer, the feedback was written in a way that I could get and it helped me understand*”

2.3 Twitter

Communicating with large cohorts of students has become easier by using class emails and notifications within the Virtual Learning Environment. However these methods of communication may not be suitable if an academic wants to quickly connect with students, provide '*just in time*' notification of class content, pass on supplemental information '*on the fly*' or integrate social media into the learning environment. Twitter can be incorporated as an engaging teaching and learning tool; our examples include; Twitter-based fora., Twitter based online e-tivities, group notification, communication and back-channelling. On a personal level Twitter can be used for dissemination and personal learning network development.

2.4 Wallwisher

Higher education campuses can be large, disjointed and fast moving. Space and money are at a premium and the provision of a space for students to share ideas and comments is often not a priority. Provision of a student notice board can achieve some of these aims (Hayes, 1997). In an attempt to circumvent the barriers listed an online tool, Wallwisher (www.wallwisher.com), was piloted with a first year foundation organic chemistry class. It was envisaged that this virtual noticeboard would grow over time to be a student generated learning resource; however, student engagement was non-existent. During module evaluation, students commented that they enjoyed using one tool (*Peerwise* in this case), but anything more than that was distracting. Although the majority of the students in this pilot belong to the 'digital generation', membership of additional online communities may be counter-productive. Students need space for their educational, social and personal virtual communities to co-exist.

3. Managing Assessment and Feedback

The introduction of technology-enabled assessment in the form of computer-marked online Multiple Choice Tests can provide many advantages to the learner, particularly by providing immediate expert feedback. It also provides significant advantages to the teacher, including automatic correcting which frees time to be spent in more

productive ways, and efficient submission and results data storage processes (JISC 2010).

As part of a general restructuring of several first year science courses in our school, many of the formal examinations were removed from first year modules. For basic chemistry modules, these were replaced with assessments which took the form of an online MCQ tests which were used to compile and generate using the Institute's Virtual Learning Platform, *Webcourses*.

From the academic's perspective, initial investment of time is frontloaded. However, unlike marking exams which has to be done yearly, it is a one off effort. Development of a comprehensive question bank requires care to ensure no ambiguity as students cannot qualify their response. Good 'distracter' incorrect answers are critical to prevent learners with little knowledge from eliminating them and artificially improving their chance of guessing the correct answer (Bennett and Wilson, 2007). In our school, academics teaching on related modules shared the workload of generating questions where there was curriculum overlap. Some questions were also sourced from the electronic teaching supports which accompany modern textbooks, for example Burrows (2009). However for proper alignment to learning outcomes and activities, it was more straightforward to generate assessment questions in-house. The incorrect 'distracter' answers were compiled based on several years experience of correcting first year student examination papers, consequently allowing the inclusion of distracters which take account of common student misconceptions. For each incorrect answer, an associated explanation was provided. This is in line with best practice for assessment, as research shows that feedback has been identified as '*the most important aspect of the assessment process in raising achievement*', Bloxham and Boyd (2007).

For each assessment, a bank of about fifty questions was compiled. These combined general questions from the shared bank, and module specific questions. They were grouped into categories aligned to subject units of the module. The assessment was set up to randomly choose a defined number of questions from each category, thus generating a unique assessment for each student. Furthermore, the answers were also randomised. This helps to limit the possibility of students being tempted to view the assessment of a nearby student to aid their own submission.

The MCQ assessments consisted of twenty questions, to be answered in one hour. Some were straightforward, requiring only the fundamental knowledge of the theory to identify the correct answer. However, many required the students to use 'pen and paper' to work out answers to problems.

The assessment was held on campus in a computer room, and was supervised as normal for an examination. For larger classes (up to 140), several sessions were run and this was facilitated due to each student receiving a unique assessment. Attendance was recorded, and it was also password protected to prevent online access from the outside. Following submission, the student immediately received their grade and could view the feedback on each question.

Student evaluation shows a very positive response to the online assessment, with all students (100%) agreeing that they were satisfied with the assessment by MCQ rather than a formal written exam, and also that they would like more MCQ assessments instead of exams. About 20% said they sometimes found the distracter answers were not sufficiently challenging, and allowed them to eliminate incorrect answers and artificially improve their grade, however this was not the case for most students or most questions. All students also agreed that it was useful to get the feedback directly after the assessment and 96% agreed that it helped them to understand where they had gone wrong for questions they had got incorrect.

In conclusion, an online self-correcting MCQ assessment has been incorporated in place of a traditional examination. While the work was frontloaded, it can be shared across common modules, and once developed the assessments can be reused yearly. The MCQs include feedback, and students receive their grade immediately after the assessment. Student reaction the assessment has been very positive.

4. Managing Peer Review of Group Work

We have incorporated group work into several practical modules. Group work is critical in preparing students for employment (Ohland, 2005), and has been highlighted by the IBEC Results of Employer Survey, 2003 as an essential transferable skill. Yorke (2004) describes employability in terms of management of self, others, information and task. The focus on development of key employability skills is increasing in the third level sector in general, with the needs of the employer as well as the graduate under consideration in the development of curricula. Student

perceptions of group work can be negative, with ‘social loafing’ and ‘free-riding’ of great concern. This is believed to occur when a student considers that their individual efforts are seen as dispensable (Kench, 2009). Peer assessment can act as a deterrent by placing a value on individual contributions. Other reasons for including peer assessment include evaluation of teamwork performance which the tutor cannot see (Brooks, 2003), and to help students identify what criteria are important in group work.

We initially used a paper based system of peer review. Our students were mostly (88%) satisfied that the peer assessment was a good way of assessing certain teamwork related contributions, however from our perspective there were some issues. The first was purely from an assessment management and collation perspective. The paper based system required distribution and collection of pages on a weekly basis, and the data entry was tedious. This also limited the scope and rigour of the peer review, as we could only administer a limited number of questions on the paper forms. Issues relating to both the management and rigour of the peer assessment have been overcome by the more recent introduction of the online *Comprehensive Assessment for Team-Member Effectiveness (CATME)* tool. This tool has been developed based on a comprehensive review and knowledge of Peer Evaluation theory, psychology and instruments, which would be beyond the field of many scientific practitioners. The impressive research towards the development of CATME is readily available on the website (<https://engineering.purdue.edu/CATME/research.html>), and should give confidence to any practitioner seeking to introduce peer assessment. According to CATME developers, the five main areas shown to be important for assessing team work are:

1. Contributing to the team’s work
2. Interacting with teammates
3. Keeping the team on track
4. Expecting quality
5. Having relevant knowledge skills and abilities

The tool is flexible, easy to use, and allows a tailored, behaviorally anchored rating scale survey to be developed. The rating scale describes behaviors that are typical of various levels of performance in each of the five categories. To set up a tailored

survey simply requires selection of the desired questions from the categories listed. We found the default survey to be acceptable in most cases.

Once the survey has been set up, it needs to be opened to the students. To use the software, the student groups must first be set up on the system. This requires input of a spreadsheet of information, including student name, team number, identifier number (e.g. student number), and email address. We were able to download a spreadsheet from our institute's database *Infoview* for this purpose. Once the students have been set up, they automatically receive an email link to the survey. We found that all students were easily able to manage the technology and complete the survey with no difficulties. Student raters select the category of behaviors that most closely matches the actual behavior of each student on their team (including themselves). The results from the peer evaluation provide the tutor with a rating for each student. Students who have been given good ratings have a factor above 1.0, and those who have not will have a rating below 1.0. This factor can be used to multiply the group assessment mark awarded by the tutor, which yields an individual mark for group work which is weighted according to the peer assessment. The results of the anonymous peer assessment can be released to students if the tutor chooses to do so.

The CATME software also highlights 'exceptional conditions' which may indicate unfair or biased ratings, or team conflict. These are explained on the *CATME* website. However, as there may be more than one reason for a student being flagged, it is essential that Exceptional Conditions are investigated further.

In conclusion, we have found that the incorporation of CATME software into our anonymous peer review process has been very successful, allowing a more rigorous and in-depth assessment, helping to identify issues within teams, and streamlining the process whilst removing the tedious data entry of a paper based system.

5. Conclusions and Future Work

We have outlined our approaches to combat the dual problem of increased academic workload, coupled to student expectation of technology integration into their learning. We have identified issues of concern to academics and students, and described implementation and evaluation of technology based solutions.

Future work will depend on further reflection on issues, investigation of new technologies, and the general uptake of technology to enhance learning at both a School and Institute level.

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