Engaging students with e-activities

Mark Evernden*, Antony Darby and Tim Ibell

Department of Architecture and Civil Engineering, University of Bath, BA2 7AY

Abstract: The following report summarizes some of the most recent computer-based activities developed as part of the *blended-learning* approach currently employed within the Department of Architecture and Civil Engineering at the University of Bath. For each activity, the content, method of delivery, level of engagement and enhancement in student experience are discussed. The development of such activities within the Department of Architecture and Civil Engineering has had a positive and far-reaching impact beyond the intended student body inviting the academic community in a discussion on appropriate teaching methods. It is hoped that the following review of our own experiences will help fellow academics to engage in active discussion relating to the development of effective teaching methodologies.

Introduction: The applied nature of engineering can result in front loading of undergraduate curricula in which knowledge is built up in the first two years when the students are expected to become familiar with specific topics and techniques. A delay in applying this essential knowledge to real world engineering problems widens the gap between the student's expectations of engineering and the curriculum. Such an approach usually results in shallow learning and disengagement with the discipline (May *et. al.* 2008). As shown by Ibell *et. al.* (2012), the inclusion of project-based learning within both essential knowledge units and more advanced units provides an engaging syllabus, helping to bridge the gap between learning and application whilst building student satisfaction. In 2012, all 5 undergraduate programmes in the Department of Architecture and Civil Engineering (BEng in Civil Engineering, MEng in Civil Engineering, MEng in Civil and Architectural Engineering, BSc in Architecture and Master of Architecture) achieved 100% student satisfaction in the 2012 National Student Survey.

An increase in student numbers in recent years has resulted in the fact that essential knowledge units, such as those in which the foundations of structural engineering are taught, are often characterised by large class sizes; a challenging environment whereby continued individual formative assessment by traditional methods can be problematic. The introduction of a blended-learning style of teaching – an approach commonly referred to as 'flipping'[1] because it inverts the traditional approach by delivering targeted content outside of the classroom, whilst using the face-to-face time engaging in problem solving – opens up new routes for the provision of continued individual feedback, essential for learning enhancement. To this end, the use of e-activities within these essential knowledge units allows students to engage with targeted content outside the classroom, whilst providing academics with a means of supplying formative assessment and immediate, automated feedback to students.

The following case studies provide an overview of 3 separate e-activities currently in use within the Department of Architecture and Civil Engineering. Each case study presents a critical review of the activity, the level of engagement, and its effectiveness as a tool for increasing understanding within these essential knowledge units.

* Corresponding Author, me234@bath.ac.uk

[1] http://flippingproject.wikispaces.com

Case study 1: Supplying continuous formative feedback through computer-aided assessment

Overview: This initial case study focusses on the development and trial use of a computer-assisted assessment (CAA) activity capable of providing timely automated formative assessment and feedback, with the aim of improving students' understanding of the key concepts of structural engineering. Through the automated provision of formative feedback, it is hoped that engagement with the activity will allow each student to both self-assess their understanding, and identify specific areas of weakness in their knowledge. By doing so, it is anticipated that we will be able to empower and pace students in their learning, whilst promoting deep and self-directed learning (Price, 2006).

Structuring the assessment: To ensure the activity is focussed directly on the fundamentals of structural understanding, the topics considered are limited to the interrelation between deflected shapes, moment and shear force diagrams and equilibrium and compatibility. All of these concepts are introduced in the first year, but are regularly called upon in following years. A total of 210 core questions were developed over the summer of 2012, while random variations have been introduced to core questions significantly increasing the question database. Structured and immediate formative feedback is provided for each question guiding weaker students through it, and so ensuring a positive learning experience (an example of typical formative feedback is presented in Figure 1). In order to enhance learning through structured formative feedback within a CAA environment, it is essential that both the questions and feedback are appropriately styled and engaging. A mixture of question types including multiple choice, calculation based and more complex association style questions (as shown in Figure 2) have been implemented in the assessment to ensure that engagement is maintained.

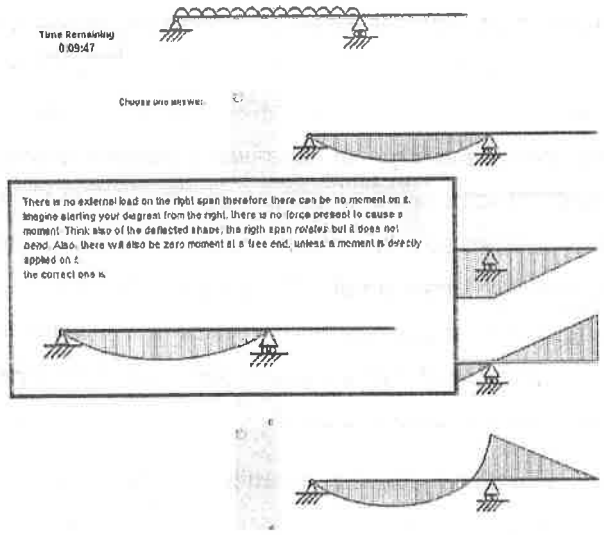

Figure 1: Screen print of Multiple choice question displaying formative feedback

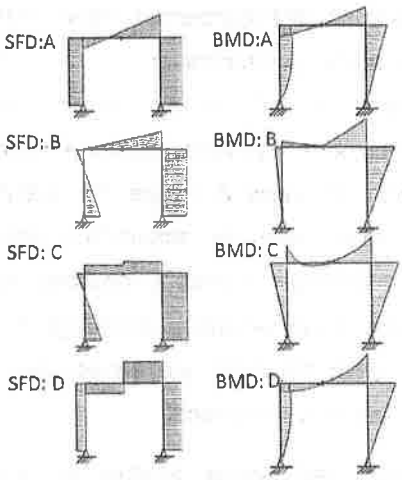

Figure 2: Association type question for shear force and bending moment relations.

(Correct answer SFD:BMD, A:C, B:D, C:A, D:B)

For this initial trial, a series of staggered assessments of increasing difficulty were compiled to allow students to progress through assessments sequentially, building upon the learning experience. To ensure quick and efficient closure of the feedback loop, the number of questions in each assessment was limited to 8, and a generous time limit of 20 minutes was imposed. It is important to note that for this first trial it was proposed that the CAA was to act only as a resource available to the students; hence, it was considered non-compulsory, but participation was actively encouraged by tutors.

Engagement: During the trial period, more than 1000 randomly generated assessments were completed by approximately 60% of the 1st and 2nd year undergraduate student body. Whilst the level of participation was lower than initially expected at around 1.8 attempts/student, a number of dedicated students showed a willingness to continually self-assess throughout the semester.

Evaluation and development: For the 28% of participating students who completed more than 5 cycles of self-assessment, significant enhancements in the level of understanding were recorded, as measured by the increase in the assessment scores. The increase in average score for this group, rising from 48% to 82%, clearly highlights the positive impact of self-assessment and formative feedback. The impact associated with automated and immediate formative feedback has been further identified through comparing individual student's engagement with the CAA against the outcome of their semester 1 exam results. It was found that there was a clear correlation between CAA engagement and structural understanding indicated by the exam score. Whilst course averages for both 1st and 2nd year structures units have remained stable compared to previous years, there has been a significant increase in student satisfaction. For the students who participated in the CAA, the feedback has been very positive and encouraging. The following student testimonies were collected as part of the unit evaluations for 1st and 2nd year structures courses run during the trial period:

- *I found the moodle quizzes great to go over stuff that we covered in first year but I forgot - 2nd year student*
- *These quizzes are needed for other courses, it would be great for geology – 1st year student*
- *I thought the coursework and moodle tests really helped me learn the material before the exam -1st year student*

In general the outcome of the trial has shown the positive impact that such an activity can have on student satisfaction; however the limited participation is cause for concern. On reflection, it is felt that the non-compulsory status of the e-activity provides limited incentive for those students who could potentially gain the most from engaging with self-learning through CAA. In the coming year, the CAA is to be integrated into assessed and graded coursework addressing this issue and ensuring engagement. The positive feedback from students and potential for improvement in learning has spurred significant interest in other academics. At present, we are investigating methods to incorporate similar essential knowledge subjects, such as mathematics and material behaviour, into the current CCA activity.

Case study 2: Disseminating key concepts through the structures@bath[2] blog

Overview: This second case study focuses on the development of the structures@bath. A web log (blog) which acts as a means to disseminate the good practice developed at Bath with others, both students and fellow academics on a global scale.

Dissemination routes: Whilst the blog itself is a simple HTML website, it facilitates two distinct methods of dissemination. In the traditional sense, the blog is a web resource which provides access to downloadable content, such as course notes and videos on the key concepts of structural behaviour, as well as technical guidance documents. Alongside this, the blog poses weekly questions aimed at the promotion and retention of key structural concepts (Figure 3). The weekly questions incorporate Google Docs data collection in order to provide immediate and automated feedback to the participants. This secondary route of dissemination requires user engagement and participation. It is the impact associated with this secondary route that is examined in the following text.

Whilst the CAA, described in the first case study, provides our own students with the opportunity to self-assess, few opportunities exist to engage in such activities and receive feedback when outside higher or further education. Under this light, the regular questions posed on the blog may be considered to act as a link between the teaching of the concept of structural engineering at Bath, and the wider world (Figure 4).

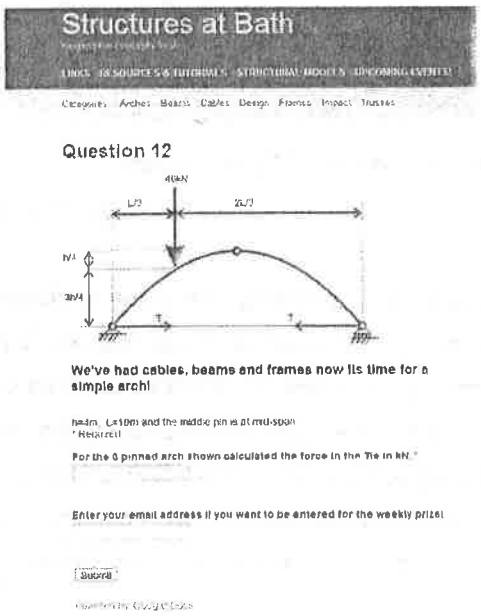

Figure 3: Screen shot of the structure@bath blog, illustrating the use of Google Docs for data collection.

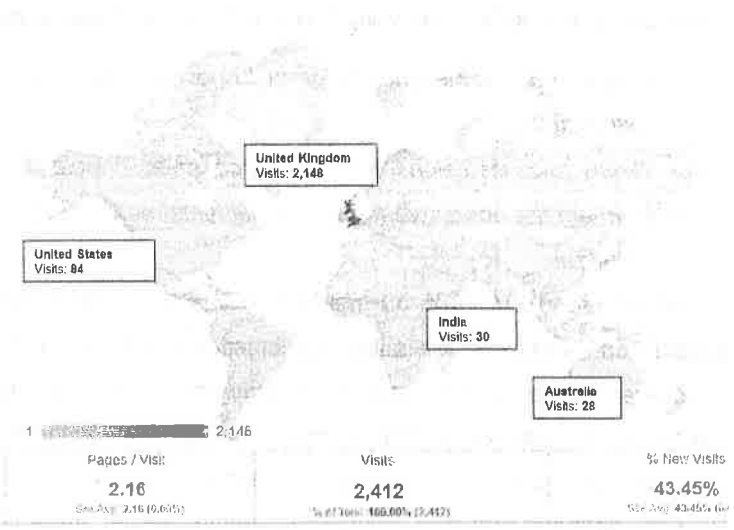

Figure 4: Location based web-activity for structures@bath between 5th Oct 2012 and 1st Feb 2013 produced using Google Analytics

2 Publicly available at http://blogs.bath.ac.uk/structures

Level of engagement: Since its launch in October 2012, web traffic to structures@bath has steadily increased, with activity on the weekly questions surpassing the more traditional resources. As illustrated in Figure 4, the majority of users are UK-based, however submissions from 41 countries worldwide have been received highlighting the far reaching impact of the activity. To encourage engagement amongst Bath students, the questions presented on the blog have been incorporated into the face-to-face contact time. As a result, class participation levels have increased from 30 to 95% for the 2nd year cohort.

The most consistent participant group is formed largely of graduates and students currently on placement, highlighting the need amongst those away from higher education to engage in learning activities, as exemplified by the feedback received.

> *"I find it really interesting that you have the online questions and "competitions" every now and then and always keep a note to try them out (to refresh my structural skills because I haven't done anything structural in my placement so far)"*- Placement student Nov 212

Engagement with the activity has not been limited to only those wishing to self-assess their understanding. A number of academics at UK institutions have willingly engaged with the blog since its launch, sharing resources and experiences of teaching an understanding of structural behaviour.

Evaluation and development: The blog itself has proved incredibly successful as a means of engaging students in a learning activity in a less confined environment than the CAA discussed previously. At the same time, it provides opportunities for those external to the university to engage in learning activities, and will continue to be supported by the Department of Architecture and Civil Engineering as a publicly available resource. In the coming year, it is hoped to use the structures@bath blog as a link between academia and local secondary schools in our efforts to widen participation in science and technology subjects. Perhaps most importantly, the blog has acted as a tool to identify academics who wish to improve the learning experience of their student body and are willing to engage in a dialogue on how to teach.

Case Study 3: Development of a student led resource

Overview: This final case study focuses on the use of a *community online mapping* project[3] to engage students in a discussion relating to Bridge Engineering, and builds upon success of a previous web-based resource. In contrast to the previously described activities, this e-activity is student-led and has received minimal input from academics other than using it as a resource for discussion.

The teaching of Bridge Engineering at Bath relies in part on developing an understanding of structural form and function, and has historically made use of a collection of images to initiate discussions relating to the course content. Presently, this historical collection of images is being substituted for a shared internet map of local bridge structures. This map is constructed and maintained by students (Figure 5).

---

[3] Publicly accessible at http://goo.gl/maps/No25p

Engagement: By allowing students to upload their own, or others', photographs and documentation of bridges in the surrounding area, a sense of authorship is developed leading to increased participation in class. As a result, the level of engagement amongst students has been astonishing. At the time of writing, the shared map has been edited more than 6000 times, since its launch in January 2013, while the number of bridge structures identified currently stands at 216.

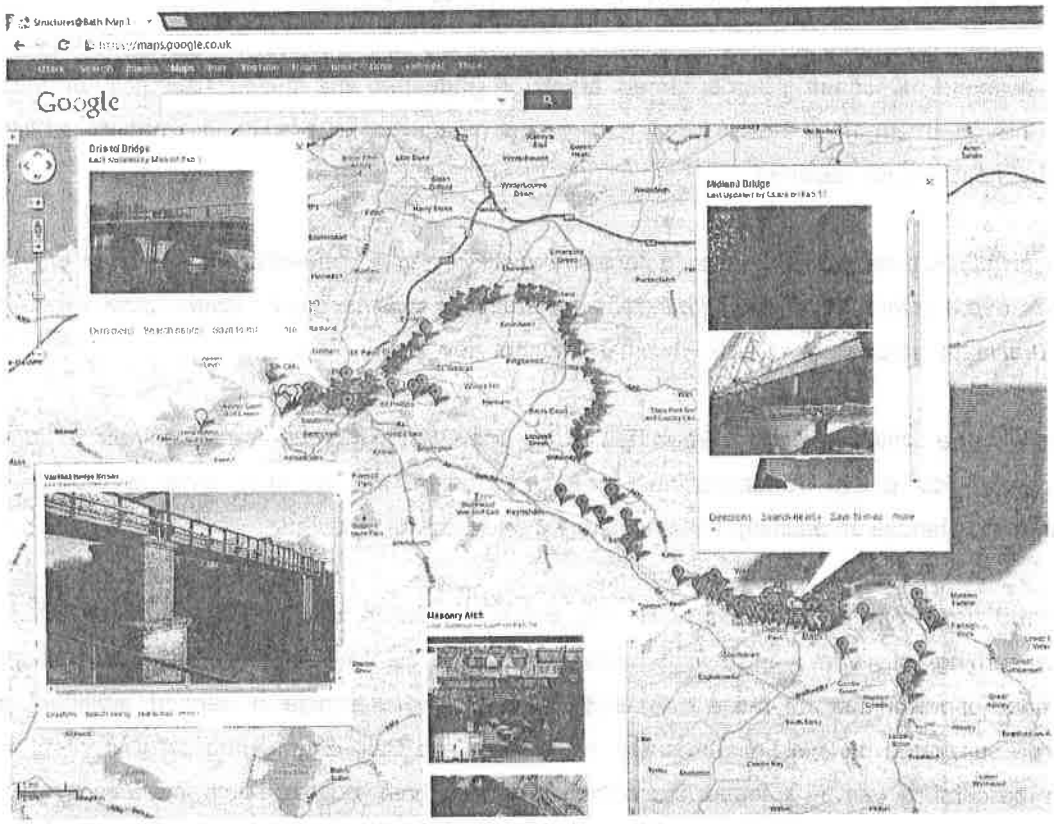

Figure 5: Shared map of local bridge structures displaying 216 structures of interest identified by students, produced using Google Maps.

Evaluation: Giving students a means to record and express their own understanding of familiar structures in an environment that they are familiar with, such as blogging and social networking, has rapidly changed the way the course is taught and the level of student participation. The success of the mapping exercise in engaging students in building a shared learning resource is currently being extended by embedding the work produced by students in previous years into a global map further enhancing the value of this resource as a tool for discussion.

Conclusions

A critical review of the broad range of e-activities developed in the past year has been presented, highlighting the innovation and dedication present in teaching within the Department of Architecture and Civil Engineering, and its far-reaching impact. From consideration of the work presented, it has been shown that the use of e-activities within essential knowledge units, as part of a blended-learning approach, can provide increased student satisfaction and learning enhancement for those who actively engage. To ensure student participation the incentive to engage must be clearly visible and understood by the participants. For this to occur, the authors now understand that it is essential that e-activities taking place *outside* of the classroom should be directly linked to the face-to-face time *inside* the classroom, as illustrated in the second and third case studies. Additionally, it has been shown that high levels of participation and engagement can be achieved when students are given ownership of the e-activity, as highlighted in the final case study, in contrast to the strict user role defined in the first case study.

Finally, it is hoped that dissemination of our own experiences in developing and working with e-activities may act as a catalyst for academics to reflect upon their own teaching methods, and engage in an active discussion on how best to teach an understanding of structural behaviour.

References

Ibell, T., Evernden, M. and Darby, A.,(2012) Innovative Structural Engineering Teaching at the University of Bath. Available at http://blogs.bath.ac.uk/structures/reports/

May, I.M. and Johnson, D., (2008) The teaching of structural analysis: A report to The Ove Arup Foundation., Joint Board of Moderators. Available at http://www.jbm.org.uk/uploads/StructuralAnalysiswithCover.pdf

Price, G.J., (2006) 'Computer aided assessment and feedback - can we enhance students' early experience at University?' *New Directions in the Teaching of Physical Sciences*, (2): pp. 29-34.