Abstract

This case study report outlines details of a teaching innovation developed at Plymouth University that aimed to exploit opportunities derived from teaching large cohorts of engineering students. The specific opportunities that the innovation sought to exploit focused on the (re)creation of an authentic “real world” experience in which students could put into practice the theory being covered by the modules on which they were enrolled. As well as introducing new opportunities, large cohorts of students can exacerbate existing challenges to academics who struggle to maintain levels of engagement. This challenge is most apparent in subject areas where engagement is known to be difficult and the subject focus in this case, contract law, is one such subject. To address the challenge of student engagement, this report provides details of an evaluation system that was designed not only to measure the effectiveness of the simulation exercise in achieving learning outcomes, but also to provide a focus for the efforts of the academic team in terms of actions to enhance engagement. The evaluation system used for this case study was effective in identifying high levels of student engagement with the subject matter. The audit also demonstrated that the simulation exercise was effective in helping students to achieve academic outcomes, although the system was not easily mapped onto the framework for enhancing student engagement. The framework was found to be a useful tool for creating action plans, but the findings from this study suggest that a bespoke feedback mechanism was needed to maximise its effectiveness.

Keywords: large cohort teaching, student engagement, experiential-based learning

Background

Over recent decades, universities have seen substantial increases in student enrolment and class sizes have grown to numbers that often exceed 100 students. This increase in class size has put pressure on traditional pedagogies that are often designed for smaller class sizes and which can often lead to a reduction in student engagement (Tormey and Henchy, 2008; Mulryan-Kyne, 2010). Recently, a study by Zepke and Leach (2010) distilled ten proposals for improving student engagement. The simulation exercise used for this project presented a means of exploiting a large class size to address the top five of these proposals. Figure 1 lists the five proposals which Zepke and Leach classified within two pedagogic perspectives, one of which was student-centred and focused on motivation while the other focused on transactions and engagement between the students and teachers. From these perspectives and proposals 20 actions were defined and used to build a framework for action when developing the simulation exercise (Figure 1).

Williams (2008) revealed that during the time that class sizes have been growing, educators have been put under additional pressure to ensure that teaching programmes are contextually relevant for the industry to which graduates will be expected to apply their skills. Pressure to make assessments contextually relevant is particularly apparent in engineering, where the majority of
higher education academic programmes are accredited by professional bodies which represent various parts of the industry (Engineering Council, 2008). The accrediting body for civil engineering programmes is the Joint Board of Moderators (JBM), which represents the Institution of Civil Engineers (ICE), the Institute of Structural Engineers (IStructE), the Institution of Highways & Transportation and the Institute of Highway Incorporated Engineers (IHIE) (JBM, 2007). Graduates from accredited civil engineering programmes are expected to have achieved a minimum set of skills, all of which are set out in a guiding document referred to as the UK-SPEC (Engineering Council, 2010). For this project, the University of Plymouth’s Civil Engineering Industrial Advisory Panel (IAP) was used to ensure that the simulation exercise was aligned to these requirements.

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Proposal</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation and agency</td>
<td>1. Enhance student self-belief</td>
<td>a) Present challenges as learning opportunities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Foster a belief in students that they have the resources to complete the task</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Help students to develop a positive perception of their level of competence</td>
</tr>
<tr>
<td></td>
<td>2. Enable students to work autonomously</td>
<td>a) Promote secure relations with others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Create a sense of social belonging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Help students to identify with ideas</td>
</tr>
<tr>
<td>Transactional engagement</td>
<td>3. Recognise that teachers are central to engagement</td>
<td>a) Be approachable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Be well prepared</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Be sensitive to student needs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d) Establish an inviting learning environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>e) Demand high standards</td>
</tr>
<tr>
<td></td>
<td></td>
<td>f) Create challenging tasks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>g) Discuss academic progress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>h) Engage with IT</td>
</tr>
<tr>
<td></td>
<td>4. Create learning that is active and collaborative</td>
<td>a) Highlight the benefits of collaborative learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Encourage the creation of a learning community</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Highlight the development of interpersonal skills</td>
</tr>
<tr>
<td></td>
<td>5. Create learning experiences that are challenging and enriching</td>
<td>a) Issue detailed, swift and focused feedback</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Encourage analysis, synthesis and evaluation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c) Encourage reflection on ideas, knowledge and experience of self and others</td>
</tr>
</tbody>
</table>

Figure 1. Five proposals for improving student engagement (adapted from Zepke and Leach, 2010)
Warwick and Ottewill (2004) explained that pressures on academics teaching large classes are more acute when the subject matter is already a problematic one for the discipline. This project focused upon one such subject, namely construction law, which can present challenges to those teaching civil engineering undergraduates. The project engaged the services of the Society for Construction Law (SCL) to explore ways of easing this particular pressure. The SCL was established in 1983 and has over 2300 members and aims to support higher education institutions (HEIs) by promoting interest in construction law and was a very apt partner for this project. This project utilised past and present SCL members to help ensure that the module content was up-to-date and conveyed with a deep level of understanding of both the law and the civil engineering context to which it was being applied.

Simulation exercises have long been recognised within the higher education sector as a means to stimulate student engagement (Lean et al., 2006), but within engineering there are few examples of simulations as a learning tool and more case studies are needed (McKenna and Yalvac, 2007). The Society for the Advancement of Games and Simulation in Education and Training (SAGSET) was a willing partner for this project. SAGSET was happy to share the expertise they had gathered from several decades of research and practice in the use of simulations as a tool for education and training. SAGSET membership includes academics and commercial practitioners and their contribution was of particular value for analysing the role of IT systems in simulation exercises. SAGSET input was used to define the appropriate level of detail needed for the case study project and for setting appropriate milestones to map progress through the simulation (which spanned a 12-week term).

**Rationale**

This report presents the findings from an analysis of feedback gathered from students engaged in a simulation exercise that was run for the first time between October and December 2010 and then for a second time between October and December 2011. The simulation exercises involved 147 and 125 civil engineering students respectively. The students were all enrolled on two level 6 modules that brought together MEng, BEng and BSc programmes of study. The modules had similar aims, namely to cover a variety of legal and contractual issues arising from the practice of construction management. The simulation exercise required students to role-play various parties on construction projects, including client, consultant, main contractor and sub-contractor organisations. As part of the role-play, students had to issue tenders to engage the services of other student groups. After tendering, the groups had to negotiate contract terms with other parties to bind them into their project teams. Once contracts were agreed, these bonds were tested with a major project variation, followed by the introduction of a dispute scenario and finally the introduction of a requirement to comply with some environmental legislation. In the first run of the exercise, 32 groups eventually coalesced into eight project teams, each with one client, one consultant, one main contractor and one sub-contractor. In the second run of the exercise, the slightly smaller class involved 28 groups and then seven project teams. The large class sizes allowed both single and two-stage systems of tendering to be implemented by the students. In addition, the large number of project teams allowed different procurement pathways (such as traditional contracting, design and build, management contracting and construction management) to be followed. Finally, the large number of groups allowed a wide variety of contract forms from the construction sector to be explored by students.

Feedback from students engaged in the first simulation exercise was positive and prompted a more detailed audit of student experiences to be conducted. This audit aimed to reveal lessons that would be useful in enhancing the simulation exercise and utilised two main sources of student feedback: a module review form that was completed anonymously by students and an assessed assignment that required students to reflect on their learning and experience of the module.
The approach

Student feedback was analysed using a Pareto technique which involved ranking individual issues based on the frequency of their occurrence. The ranked issues were then categorised into three bands, those with strong consensus (>5.0% of sample), moderate consensus (2.5-5.0%) and weak consensus (<2.5%). A ranked and categorised shortlist of issues was then created, with a cut-off point set to the point at which the cumulative frequency of shortlisted issues reached 80% of all of the feedback received.

The shortlist of issues derived from the analysis of student feedback after the first run of the exercise in 2010 was mapped onto the theoretical framework for enhancing student engagement. The mapping exercise enabled a score to be determined for each action point, representing how well each point was being addressed, based on the feedback from students. The mapping exercise helped to focus the attention of all of the project participants (IAP, SCL and SAGSET) on the action points achieving the lowest scores. Modifications to the simulation exercise were then made prior to its second run in 2011 and the same audit format was used to gauge the impact of the changes.

Assessment

The bulk of the data used for the audit of student experiences was in the form of qualitative statements provided by students. The first data set was derived from a standard module questionnaire. The second was acquired from the conclusions of a reflective essay which formed part of the final summative assessment on the module. (N.B. It is acknowledged that the use of this data will introduce some bias to the results, as students knew the essay would be marked and thus their comments tended to be less critical than in the anonymous module survey questionnaire.)

In both data sets the statements and narratives were analysed in two stages:

1. Coding in relation to the three aims of the project:
   i. Comments relating to the large class size
   ii. Comments specific to the teaching of construction law
   iii. Comments relating to the use of an innovative teaching method

2. Mapping of comments against the five student engagement proposals and the 20 action points derived from the Zepke and Leach framework.

Evaluation

The audit of the first run of the simulation exercise analysing 619 data items resulted in a shortlist of 21 issues raised by the students (three with strong consensus, eight with moderate consensus and ten with low consensus). After mapping against the action points, the average score for the action points was 4.4 (the scores ranged from 0 to 11). In relation to the proposals for improving student engagement the student audit shows that, from the perspective of creating a student-centred learning approach to aid motivation and agency, the module has scored quite well, with both proposals achieving a high average. From the transactional engagement perspective the results were less consistent, with two out of the three proposals scoring high averages but the third scoring very low overall.

The first proposal, enhancing student self-belief, scored very highly in the comments reviewed as part of the audit. In particular, the module seemed to be most effective in helping students to develop a positive perception of their level of competence. There was also a strong indication that students saw the challenges of the module as learning opportunities. Less clear was whether students believed they had the resources to complete the tasks set, and this is an area for future development.

The second proposal, to enable students to work autonomously, scored below average in the survey of student feedback. The only action point in this area to score above average was “helping
students identify with ideas”. “Promoting secure relations with others” scored slightly below average and “creating a sense of social belonging” within the group exercises was not evident at all.

The third proposal, *to recognise that teachers are central to engagement*, scored very low. This may be understandable, as the actions in this proposal are largely staff-focused and teaching staff were not part of the survey. However, the feedback was useful in identifying areas where students had noted the level of engagement by staff and from this it can be seen that the level of preparedness was appreciated by students. There was a reasonable level of acknowledgement that staff had been sensitive to student needs and had worked to establish an inviting learning environment. Less well recognised was teaching staff being approachable, creating challenging tasks and discussing academic progress with the students. The points concerning demanding high standards and engaging with IT were barely mentioned.

The fourth proposal, *to create learning that is active and collaborative*, scored well overall. Two action points, namely “highlighting the benefits of collaborative learning” and “development of interpersonal skills”, were well recognised by students. Less well recognised was the encouragement of a learning community.

The fifth proposal, *to create learning experiences that are challenging and enriching*, also scored well overall, but the contrast with the point in the third proposal in relation to creating challenging tasks suggests that the focus of attention here was more on enrichment than challenge. Students were very aware of the emphasis on analysis, synthesis and evaluation, as well as reflecting on ideas, knowledge and experience of themselves and others. Issuing of detailed, swift and focused feedback was not well recognised and is an area for improvement.

From the mapping exercise, it was possible to develop a prioritised list of action points. These were clustered into four groups and provided the basis for discussion between the university, the SCL and SAGSET over the period June-September 2011. As a result of discussions held, a number of changes were made to the simulation exercise and the way in which the module was delivered, specifically:

- **Priority 1 actions**: An additional member of staff (an ex-SCL member) was recruited to deliver weekly lectures, thus freeing up the module tutor to be more available to students when they were engaging in simulation activities. Tasks were streamlined around a single project scenario with project material provided by a local contractor. The simulation was augmented with a requirement to engage with web-based project sub-sites in which each group had to evidence work undertaken on a weekly basis.

- **Priority 2 actions**: The websites were intended as a vehicle to provide swift and regular feedback to groups and a place where groups could discuss learning derived from the exercise and the lectures. Students could also raise issues via the websites that the tutor could access and act upon. The websites were seen as key to creating a greater sense of social belonging and helping students to identify resources needed to complete the tasks at hand.

- **Priority 3 actions**: By streamlining the project scenarios and enrolling the assistance of a legal expert to deliver lecture material, the idea was to encourage students to focus their attention on collective learning. The SCL helped by reviewing course material prior to the start of the module to ensure that topics covered were relevant and realistic. The use of the websites was intended to cement working relationships with others by making working processes and task allocation much more transparent.

- **Priority 4 actions**: The reflective report was enhanced to help encourage collaborative learning and evaluation of lessons learned, both individually and with others. The report required students to consider interpersonal skills, challenges and opportunities presented by the simulation and to identify with ideas generated to solve problems at both individual and group levels. Students were also required to assess how their competence had grown as a result of completing the simulation exercise.
The module was re-run between October and December 2011 and then evaluated for a second time using the same technique described above. For the purpose of the evaluation in this report, only the combined feedback is presented.

In the second audit 682 data items were analysed, resulting in 20 shortlisted issues (four with strong consensus, 12 with moderate consensus and four with weak consensus). After mapping against the action points, the overall average score for the action points had risen from 4.4 to 5.3 and the scores had a similar range (from 1 to 12). Averages across all individual proposals had increased, with the most significant improvement achieved in the third proposal (recognise that teachers are central to engagement). Of the twenty action points, 14 had improved scores, four remained level and two received a lower score. The first proposal, to enhance student self-belief, scored very highly again, with an increased average (up from 7.33 to 8.33). The first action point dropped one point (down from 9 to 8), but still scored well. Most significant in this proposal was the score for fostering a belief in students that they had the resources to complete the task, which rose from 2 to 5.

The third proposal, to recognise that teachers are central to engagement, again scored the lowest overall, but did show some improvement in comparison to the first audit (average up from 1.50 to 2.75). Two action points in this section did well in the second audit. First was the action point to create challenging tasks, which achieved the largest point increase in the whole table (the score increased from 1 to 5). The second point was the action to demand high standards (the score increased from 0 to 2). The other notable score was the point relating to engaging with IT which did not score in the first audit but did in the second.

The second, fourth and fifth proposals all improved overall, but did not achieve significantly different scores in comparison to the first audit.

Discussion, summary

Of the responses with strong consensus in the second audit, two were positive comments and two were negative. The positive feedback related to the way in which the modified exercise helped to develop professional skills and raise awareness of how clear contracts need to be in order to avoid disputes arising. The first point is consistent with the original version of the module, but the second was made much more strongly after the amendments were made. The negative feedback related to the need to make the brief and marking scheme clearer and to the challenges posed by the changes made to encourage IT usage. To some extent, these two issues were interrelated, as efforts were made following the first audit to make the brief and marking scheme clearer, but the enhanced IT requirements added a new level of complexity that undermined the efforts to clarify the brief. That said, there was evidence that students thought the idea of engaging with IT was good and so it is worth expending further effort to resolve the IT problems encountered.

Of the 12 comments with moderate consensus, 11 were positive and only one was negative. The negative comment was only just above the moderate consensus category threshold and, interestingly, was one that was hardly mentioned in the first audit. This related to difficulty in getting to grips with law as a subject. It would appear that engaging a legal specialist to deliver the lectures had the effect of raising concerns within the student cohort about their ability to understand legal issues. However, the worry about understanding legal issues was offset by a larger group that found that ‘the lectures were enjoyable, helpful and well structured’.

Overall, changes made to the module elicited more comments relating to law, but these revealed a deeper respect for the subject than was evident in the first iteration of the simulation exercise. The most significant of the positive comments in the moderate consensus category, in comparison to the first audit, was the increase in the number of students who considered that the new module ‘was effective in representing real life challenges’. This improvement seems to have resulted from changes made to the project scenario. In the first run of the exercise, each group had a different project scenario. In the second run, all groups worked on the same project but approached it in seven different ways. This sharpened focus for the project scenario enabled students to become
more aware of the complexity of construction contracts and how small changes to projects can have a significant impact on the different parties involved.

Fewer students in the second audit reported that the simulation exercise ‘was an interesting and effective way of learning’. That said, the new module was viewed as effective in helping students gain a deeper insight into the construction industry and in relating theory to real life and more students did report that the exercise ‘was a nice alternative [to the more common] teaching methods’.

More students in the second audit felt that the simulation exercise was helpful in illustrating the challenges of working in large teams, but other comments relating to large group working were not significantly different to the first version of the module, revealing on-going concern about working in large groups. An attempt was made to address this during the course of the second run of the simulation exercise. Action was taken to modify the way in which module marks were allocated, enabling the marks from the individual reflective report to override any lower mark derived from combining group and individual assessment marks. This action was commented on both positively and negatively in the student feedback, but was well received in general.

Further development

During the conducting of the audits, the framework to improve student engagement was revealed as a useful tool to formulate a plan for action, but difficulties were apparent in translating student feedback in a way that mapped easily onto the framework. To ease this translation, future audits will utilise a questionnaire with questions directly related to the 20 points on the framework. The questionnaire will be issued alongside module feedback questionnaires, as close to the end of the module as possible. The essays were more effective than the questionnaires in providing a deep view of the learning derived from the module, due to being submitted after the completion of the simulation exercise, but the fact that they form part of the summative assessment does tend to make them less critical. Overall, the collective use of module feedback forms, reflective essays and a bespoke questionnaire are all useful elements of an audit system that aims to enhance opportunities derived from innovations like the one outlined in this case study report.

References


7

Further reading/bibliography

This work is licensed under a Creative Commons Attribution-NoDerivs 3.0 Unported License

Publication Date: 21/05/2012