Interactive learning modules in geotechnical engineering

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ABSTRACT: Recent developments in e-learning authoring software, such as Articulate Presenter and Adobe Captivate, have greatly simplified the task of developing engaging and pedagogically effective interactive learning modules (ILMs). ILMs offer a number of benefits over traditional forms of instruction, such as increased student engagement and improved student experience by providing an appropriate learning context and an active learning environment. This is particularly relevant for the current student cohort of Generation Y learners who often prefer active learning environments. This paper explores the advantages and limitations of ILMs, presents examples of them in the civil and geotechnical engineering contexts and, based on the results of student surveys, examines their efficacy.

1 INTRODUCTION

Over the last decade or so online learning (also known as web-based learning) has become increasingly popular, with the vast majority of higher education institutions worldwide offering it in some form or other – from modules within courses (i.e. subjects), to complete courses, and entire programs (i.e. degrees). A relatively recent and important development in online learning is the use of online multimedia Flash presentations or interactive learning modules (ILMs). E-learning authoring software, such as Articulate Presenter (Articulate Global 2011a) and Adobe Captivate (Adobe Systems Inc. 2012a), has recently been developed which enables subject matter experts to generate e-learning objects relatively rapidly and easily from standard Microsoft PowerPoint files on their desktop. These software packages also allow for audio- and video-narrated content to be packaged with interactive and feedback mechanisms, such as Adobe Flash (Adobe Systems Inc. 2012b) interactions and quizzes (Carrington and Green 2007). This is particularly desirable given the relatively universal nature of Flash files, and provides a quick and efficient means of creating, delivering and managing educational material online.

ILMs provide a structured and active learning environment whereby students can learn by exploring and navigating through the content and can be assessed during the learning process, typically through the use of quizzes, which may be used for diagnostic, formative or summative assessment. Furthermore, students have the ability to revise material until it is understood, which is particularly useful for students whose first language is not the one used for instruction, as students can review the material as often as needed.

In addition, Maier (2008a, 2011) suggests that ILMs have several additional benefits for both students and teachers. With respect to the former:

- increased student engagement – the current group of students, usually referred to as Generation Y learners, often have significantly different expectations to previous student cohorts. They expect value for money and that higher education providers will accommodate pressures outside of study, such as paid employment and meeting family responsibilities, through the flexible delivery of teaching, services and advice (Bradley et al. 2008). Furthermore, several commentators suggest that they learn by doing rather than reading and listening to lectures, are adept with new technology, multi-task, expect more immediacy, have shorter attention spans and diminishing literacy skills (McNeely 2005, Roberts 2005, Windham 2005, Rogers 2007). E-learning and ILMs have been shown to enhance engagement and satisfaction of Generation Y learners, as will be discussed further below;
- improved learning outcomes;
- time flexibility – students can learn in their own time and at their own pace rather than needing to conform to a predetermined timetable; and
- location independence – students need not be on-campus to view the material. They might be at home, another campus, overseas or in a park.

With respect to teachers, Maier (2008a, 2011) suggests that ILMs also have several benefits:

- Reduced contact time – once the ILMs have been developed, less scheduled contact time is required to deliver the content included in the ILMs. Instead, the extremely valuable, face-to-face sessions can be held in other ways (Maier 2008a, b), an example of which
is discussed below in the context of just in-time teaching. It is worth noting that the time required to develop the ILMs themselves is not insignificant. The author has found that a one-hour lecture, in the form of a mature PowerPoint file, takes around 4 to 8 hours to convert to an ILM. Depending on the features included, the development will take longer;
• Less preparation time – again, once the ILMs have been developed, the face-to-face sessions require reduced preparation time;
• Fewer student queries – as the content is available online and the material can be reviewed according to the students’ needs, Maier (2011) reports that queries have noticeably reduced;
• Teach at multiple campuses – again, as the content is available online, the material can be accessed at the host campus, as well as other campuses, including ones overseas;
• Tutor training – ILMs can be very helpful when training instructors, as the teacher can direct the tutors to the online content and the tutors can learn the material in the same way as the students. As a result, there is no need to arrange individual training sessions for the tutors;
• Provision of assumed knowledge – students who have not taken a particular prerequisite course and therefore lack the appropriate knowledge, can also be directed to the ILMs; and
• Course handover – when the course is transferred to a different teacher or coordinator, the ILMs greatly simplify this task.

One of the key features of ILMs is that engaging and pedagogically relevant assessment tasks and quizzes can be readily incorporated into the Flash presentations via products such as Articulate Quizmaker (Articulate Global 2011b), Adobe Captivate and Raptivity (Harbinger Knowledge Products 2012). Raptivity allows educators to create learning interactions such as games, simulations, brainteasers, interactive diagrams, virtual worlds relatively rapidly and simply. These interactions can then be embedded directly into online courses to improve learner engagement, similar to quizzes from Articulate Quizmaker and Adobe Captivity. It is useful to note that the software products described above are SCORM – (Sharable Content Object Reference Model – a collection of standards and specifications for web-based e-learning) and AICC – (Aviation Industry Computer-based training Committee) compliant, implying that they are compatible with most learning management systems (LMSs), such as Blackboard (Blackboard Inc. 2012) and Moodle (Moodle.org 2012), and the results of online assessments can be incorporated into the LMSs’ grade books.

2 APPLICATIONS OF ILMs IN CIVIL ENGINEERING

Maier (2008b) has used Articulate Presenter and Quizmaker extensively in his Environmental and Water Engineering courses, an example of which is shown in Figure 1. It can be seen that students are actively able to navigate the module using the left-hand navigation bar and the pause/play/fast-forward/rewind controls at the bottom of the screen. In addition, students can actively learn by selecting various parts of each slide to expose additional information and resources such as photographs, illustrations, videos, sound bites and attachments including Word Documents, Excel spreadsheets, pdfs and so on.

Maier (2008b) has also promoted the use of ILMs to add real-world context to his courses by including case studies from guest lecturers from industry. The approach adopted by Maier is he requests the guest lecturer to prepare a 5 minute PowerPoint presentation on an agreed case study relevant to his course and also asks the guest lecturer to record narration of the PowerPoint presentation. The PowerPoint and associated audio file(s) are then emailed to Maier, who then transfers and synchronises them using the Articulate Presenter software. An example of such an ILM incorporating an industry case study is shown in Figure 2. In this way, Maier has been able to assemble a relatively large catalogue of relevant and engaging short, guest lecture presentations, which can be reused and which negates the need to organise and deliver face-to-face industry presentations each time the course is offered.
Maier (2008a) found that, of the 67 students surveyed, 88% thought that presentation of the course material in the form of ILMs was more enjoyable than using text-based resources and 84% felt that the ILMs were able to provide a more realistic context than the currently-available text-based resources. In addition, in response to the question “what the best aspects of using the online modules?” the following student responses were received: “The online modules were really good and enjoyable and made it easy to learn the subject”; “The information was much easier to absorb with use of the modules”; “Modules helped to understand lecture material”; “The online modules were easy to follow and kept me much more interested than simply reading notes”; “Interactive . . . videos in online modules made it easier to relate coursework to real life issues”; “It had more practicality than other courses and could be related to the real world”.

3 APPLICATIONS OF ILMs IN GEOTECHNICAL ENGINEERING

Recently, the author has used Articulate Presenter to develop pre-laboratory class learning modules, an example of which is shown in Figure 3. As class sizes have continued to increase, the laboratory component of the undergraduate geotechnical engineering program has presented difficulties as the result of limited equipment, technical and demonstrator resources, combined with class scheduling constraints. In order to address this, the author developed streamlined versions of the laboratory classes, whereby groups of students (typically 4 per group) participate in 45 minute focussed experiments. In order to enable these sessions to be as effective as possible, before each laboratory session, students are required to view the pre-lab ILMs, via the LMS. At the University of Adelaide, the LMS employs Blackboard and is known colloquially as MyUni. The ILMs incorporate audio narration and video footage of each of the experiments: sieve analysis, Atterberg limits, Proctor compaction, triaxial testing of clay, direct shear testing of sand, oedometer testing and seepage flow through a dam. Specific details of the laboratory experimental program are given in the companion paper (Jaksa et al. 2012).

As mentioned above, one of the most significant aspects of ILMs is that assessment can be embedded into them. These are important for a number of reasons. Firstly, sound e-learning design suggests that ILMs should include activities for students to do at regular intervals – generally no less frequent than 15 minutes apart. It is well understood, that students learn better by doing rather than passively listening. This is the nub of active learning (cf Felder & Silverman 1988, Prince 2004). Hence, e-learning designers are encouraged to include frequent activities and learning interactions such as quizzes, mini-games, simulations, brainteasers and interactive diagrams.

Secondly, if assessment is embedded within the ILM, the instructor has the ability to use the assessment results to inform his or her instruction. Maier (2008b) further advocates the use of ILMs in the context of just in-time teaching (JiTT). Briefly, JiTT is a relatively recent constructivist approach, which combines the best features of traditional face-to-face instruction with e-learning (Novak & Patterson 2000). Maier (2008b) uses ILMs as a replacement for his traditional lectures, where the content is delivered. Instead, students access the ILMs via the LMS and go through them in their own time. Maier subsequently uses the results of the ILM-embedded quizzes to inform him about the various areas of the material that students are having difficulty understanding. The following face-to-face class then focuses on these areas of difficulty by means of additional instruction, examples and discussion. Hence, the teaching is just in-time, focussed and relevant. Further treatment of JiTT is given by Novak & Patterson (2000) and Jaksa et al. (2009).

As mentioned above, Articulate Quizmaker facilitates the development of quizzes within ILMs and a variety of templates are provided to enhance student engagement. An example of a matching pairs quiz question, in the context of unified soil classification, is shown in Figure 4 and a multiple choice question in Figure 5.
The author uses them as an additional resource, not as a replacement for experienced educators or face-to-face classes. Whilst the ILMs present several significant opportunities, they should not be seen as a complete solution. Faculty may be daunted by the time commitment required to develop ILMs. Maier (2011) suggests that an effective approach is to develop the ILMs in stages. Firstly, one could audio record one’s traditional face-to-face lectures and then, prior to the subsequent offering of the course, synchronise the PowerPoint slides to the recorded audio. At a later and convenient time, additional photographs, video footage and illustrations could be added, followed by more polished narration. Finally, again at a later time, quizzes could be added. In this way, a slick ILM could be developed in a series of stages, over a period of years, rather than seeking to develop the entire package at the one time.

A survey conducted by the author in 2010 of 124 Level 2 geotechnical engineering students and 39 Level 3 students found that 84% and 85%, respectively, felt that the ILMs assisted in the preparation of the laboratory classes and 73% and 82%, respectively, felt that the ILMs enhanced their learning.

4 LIMITATIONS

Whilst the ILMs present several significant opportunities, they should not be seen as a complete solution. The author uses them as an additional resource, not as a replacement for experienced educators or face-to-face classes. Whilst Articulate Presenter simplifies the task of converting a PowerPoint presentation into a Flash online module, as mentioned previously, considerable time is nevertheless required to develop the ILMs. Faculty may be daunted by the time commitment required to develop ILMs. Maier (2011) suggests that an effective approach is to develop the ILMs in stages. Firstly, one could audio record one’s traditional face-to-face lectures and then, prior to the subsequent offering of the course, synchronise the PowerPoint slides to the recorded audio. At a later and convenient time, additional photographs, video footage and illustrations could be added, followed by more polished narration. Finally, again at a later time, quizzes could be added. In this way, a slick ILM could be developed in a series of stages, over a period of years, rather than seeking to develop the entire package at the one time.

A second issue with ILMs, and other e-learning technologies and deliverables for that matter, is their operational life. Computer software and operating systems are in a relatively constant state of flux. A current limitation of Flash-based, online deployments is that Adobe Flash is not supported by Apple mobile digital devices such as the iPad, iPod Touch and iPhone. In a recent response to this, Adobe have released a Flash to HTML5 convertor, currently named Wallaby (Adobe Systems Inc., 2012c), which may signal the eventual demise of Flash (Australian Personal Computer, 2011). Hence, an important question is “will the not insignificant time investment, of an educator in developing such resources, be wasted in a few years time when the operating system, software or deployment environment becomes obsolete?” However, this is a natural and inevitable part or ‘cost’ of technological progress.

Finally, ILMs offer no opportunity to answer automatically queries raised by students as they seek to learn and understand the material being studied. Hence, ILMs do not replace face-to-face sessions. Rather, they provide an opportunity to enhance them, through increased student engagement, and learning.

5 CONCLUSIONS

This paper has explored the use, benefits and limitations of interactive learning modules in geotechnical engineering. It has been shown that they have the potential to enhance student learning and engagement, particularly with the current cohort of students and this has been validated by student surveys. Commercial software, such as Articulate Studio, is readily available to assist subject matter experts in developing ILMs and, with such software, the task is relatively straightforward and time-efficient. The companion paper, Jaksa et al. (2012), presents a framework for improving geotechnical laboratory classes and ILMs feature prominently in the proposed approach.

REFERENCES


