

TEACHING CAD: THE CHALLENGES OF ONLINE DELIVERY TO DISTANCE LEARNING STUDENTS

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ABSTRACT

Nowadays, online learning is becoming more and more popular, and is often combined with part-time work. Therefore, there is a growing need in Construction Higher Education to offer a degree by distance. Computer-aided Design (CAD) is an essential tool for digital design, communication and documentation. For many years, CAD has been taught in undergraduate programs such as Architecture, Construction Management and Engineering to prepare students for industry. Since 2007, The University of Newcastle has offered a Bachelor of Construction Management in a problem based – mixed mode (face-to-face and online). Distance learning requires students to be motivated, self-disciplined and to manage their time. Generally, online students require additional support as they need to adjust their approaches to learning. However, teaching CAD online is more challenging than teaching other subjects. On-campus students attend face-to-face tutorials and interact with their tutor who is able to interactively and visually demonstrate aspects of the CAD graphical user interface, while distance learning students rely on the communication with the lecturer as well as the available teaching materials. This paper discusses the concept and teaching methods of the course ARBE1103 Communication in the Built Environment 2 which is offered to multiple disciplines in mixed-mode delivery.

Keywords: Blackboard, Computer-aided Design (CAD), Distance Learning, Online Learning

INTRODUCTION

There is no doubt about how popular online learning has become during the past years. Many students work part-time or fulltime to finance their studies. Open universities have been created which advertise courses on television, and more and more universities have decided to offer online courses. Felix Salmon (2012) suggests a future in which the world's best universities offer courses online for free. He refers to Sebastian Thrun, a computer scientist at Google and also former Professor at Stanford University, who decided in 2011 to deliver his Introduction to Artificial Intelligence class online and for free to no less than 160,000 students. Interestingly, the best results were achieved by online and non-Stanford students and only 30 of the 200 Stanford students continued to attend classes face-to-face as the others preferred the intimate atmosphere of learning online. The new online concept has proven to be extremely successful and Thrun decided to leave Stanford to found his own online university Udacity which allows 500,000 students into one course (for free). This provides a great opportunity for students around the world. So how do universities cope in teaching (large) classes online?

Some universities offer courses in blended-delivery to improve the students' learning that may respond to the needs of the current 'net' generation. Barnes et al. (2007) states that students prefer to use digital learning resources rather than paper. Daryl Gene Pieta (2009) has conducted "A Study on Blended Instruction in Computer-Aided Drafting for Secondary Education" to investigate if integrating educational online technology within a face-to-face classroom enhances students' learning experiences. He found an increase in student motivation and confidence (81%) when using the E-School course management system (Moodle) as well as when using AutoCAD (35%), the software which was taught during the test. At universities, many on-campus students use all of the resources provided and – in accordance with Pieta – benefit most in a blended-delivery teaching environment. But how do distance learners cope with online delivery? There are many publications about online learning, but little about the delivery of tutorial-based courses.

From 2007, The University of Newcastle has offered the Bachelor of Construction Management in mixed mode delivery (face-to-face and online) to part-time and full-time students. The content of Communication courses, which are offered in this degree, covers drawing conventions and techniques, and required academics delivering this course to address the challenges of teaching a tutorial-based course (CAD) online. This paper investigates these challenges and evaluates the teaching methods used with a large mixed-cohort university class (ARBE1103 Communication in the Built Environment 2).

LITERATURE REVIEW

Literature about teaching CAD online at a tertiary level is sparse in relevant databases (CuminCAD, JSTOR, Google Scholar). The results of these searches highlighted publications that dealt mainly with new CAD features or technologies. Trade literature as well as video tutorials touting different CAD packages are available, but do not address the holistic manner in which CAD is delivered in a problem-based learning environment at university. The review below draws on those sources the researchers found to be relevant as well as the experiences they have gained over the years.

Online teaching and learning

Online learning requires students to be highly motivated and self-disciplined and may not be the easiest way of learning for everyone. It is evident that online students require more support on non-course related matters than on-campus students: to (1) understand the delivery approach, learning environment and use of technology (Wozniak et al. 2007), and (2) to clarify administrative or university policy issues as well as (3) to master their work-study-family balance (Gajendran et al. 2011, Kanuka and Jugdev 2006). Bergmann and Raleigh (1998) describe this as a constant demand for attention and see this as a result of students' overall lack of understanding about their role as a distance learner.

Learning environment

Social interaction between students and the choice of communication tools they use is essential for delivering a course successfully online. Therefore, the learning environment needs to offer a sense of community so that students can learn to interact with each other in a productive way (Bender and Vredevoogd, 2006). Also, guidelines are suggested for the use of the main communication tool (for example a discussion board as used in ARBE1103) as well as the observation of the students' interaction. In addition to communication tools such as emails, a well-organised online learning platform is also needed to upload learning resources. Universities often use virtual learning environments such as Blackboard, CyberExtension, eCollege or Instructure even though they do not deliver courses online. Most of them offer not only content management tools but also learning units, discussion boards and assessment tools. Also, virtual worlds and web 2.0 environments (Ning, Blog, chat rooms, Twitter) are used for teaching as a space for innovation and students' collaboration (Dillembourg 2000).

The role of a tutor

Several studies have confirmed the importance of the tutor role as being central to students having 'an effective and enjoyable learning experience' (Rideout, 1999). The role has been described as that of stimulating students' thinking and cognitive processes. Stinson and Milter (1996) suggest that a tutor needs to build relationships with students, listens actively and facilitates their learning. Schmidt and Moust (1995) found that a combination of content expertise and personal qualities (including a commitment to students' learning and an ability to communicate in understandable language) improves students' learning. According to Schmidt et al. (1993), students guided by content-experts spent more time on self-directed study and achieved better scores than students guided by non-expert tutors. Overall, students prefer tutors who actively guide a process. All these studies support the significance of a tutor's role, especially during the first years of students' studies.

Courses offered online

Many well-respected universities such as Harvard, Yale, Stanford and MIT have decided to offer some of their courses online and many others have followed this trend. Courses are available via iTunes University (including 13 Australian universities of which eight teach Building) and Open universities. In December 2011, MIT announced that it would make courses freely available online. MITx uses an open-source learning platform to enhance the educational experience of its on-campus students and expects to host millions of learners around the world (MIT news 2011).

Some online courses are available, for instance, to teach computer literacy skills or CAD. CAD training is extremely complex and traditionally has a steep learning curve. The completion rate for such industry-based online training is very low, often less than 50 % (Prensky, 2001). Interactive training guides offered by vendors explain the use of palettes and commands that may be sufficient for experienced CAD users, but they do not explain from first principles how to set up a project (something that is essential for beginners). Online tutorials without further support are insufficient for university students as the importance of a

tutor's role has shown. Also, the continuous change in technology requires students to develop confidence in using any CAD program (not only the one they learnt) to communicate with their peers (Nielsen et al. 2010). In conclusion, there are two different types of CAD online courses: the ones that teach the software only and others that aim to deliver an overall understanding (for example a university course).

CASE STUDY

The course ARBE1103 aims to prepare students for industry by developing their general understanding and practical skills in digital media for design, communication and documentation including basic CAD modelling and the presentation of a selected project. There are three assignments: online quizzes (10%) which monitor students' overall progress as well as continuous, individual projects (40% and 50%). The students are provided with plans which are not to scale and asked to create a CAD model and orthodox drawings. Lectures and tutorials are used to deliver content and to assist students to use the software and to guide them through the problem-based project-tasks.

Student numbers and background

The course ARBE1103 is delivered to a mixed cohort of undergraduate on-campus and distance learning students from different backgrounds. Most are from the Construction Management degree (approximately 60 %) and the Architecture degree (around 30 %). The other 10 % are from disciplines such as Engineering, Education, Design and Cross-Institutional students who can select the course as an elective. Nearly 50 % of all Construction Management students study by distance (or 20 % of all students enrolled to the course are distance learners). The number of students increased over the years (2007: 183, 2010: 293) with the number of distance learners doubling during the same period (2007: 26, 2010: 64). Reasons for the dip in 2011 enrolments (259) are unknown at this stage. However, commencing students for semester 1 2012 for ARBE1100 Communication in the Built Environment 1 indicate that there will be a significant increase in students taking ARBE1103 in semester 2 2012 (currently 366 students of which 115 are distance learners).

Student engagement

Engaging students from different backgrounds can be difficult as course content has to be adjusted according to their needs. Additional support in the form of information sessions and handouts must to be provided. At a university, teaching CAD is usually tutorial-based and delivers the overall knowledge about how to use a CAD program and other software (including ArchiCAD and Photoshop) to communicate a project. The lecturer supervises the distance learners who can download one hour-tutorial recordings each week (which are produced outside the classroom) as well as written instructions. In previous years, only short demonstrations were recorded. Generally, it is recommended that the lecturer teaches a tutorial class him/herself to understand (and address in the recording) the issues students experience during the class. Additional recordings (video and audio) assist to explain and

solve problems (for example, demonstrating a CAD operation about how to create an unusual window shape), and mini-exercises prepare the students for their assignments.

Also, lecturers need to engage constantly with students and monitor relevant discussion boards. Students feel positive when lecturers respond regularly and quickly. However, students should be encouraged to continue with other parts of their work when they experience a problem. Another change in the teaching strategy of ARBE1103 is that on-campus students can also access all the resources uploaded for distance learners. This results in more student engagement on the discussion boards. Regular emails provide a reminder of upcoming submissions to assist students with their time management and foster social engagement (especially for distance students) as learners tend to respond or to post questions on the discussion board after receiving an email.

(Self-) Evaluation

In 2010, online quizzes were developed as a further assignment (1 A and B) of ARBE1103 to monitor students' progress in general and to motivate their learning. Especially distance learning students need more engagement to keep going, and tests or self-evaluation are good tools to make them work. Also, reflective journals became a part of the two project-based assignments (2 and 3). The students are required to document their weekly progress and the difficulties they experience while working on individual projects which encourages them to discuss problems (and that way to collaborate virtually) on the discussion board online.

Assessment criteria and instructions need to be clear to assist the student's learning processes. Also, providing feedback to students is essential so they can improve their work. In ARBE1103, the project-based assignments are a continuous, individual project. The students have to rework what has been criticised in their initial attempt (assignment 2) which then contributes with 40 % to the mark of assignment 3. Feedback needs to be detailed enough so that students understand their mistakes and / or what has been done well. Students appreciate general feedback during the lectures but they also value individual feedback in written form about each assessment criterion. They also want to see project examples to understand what is expected from them. Surveys conducted at The University of Newcastle have shown that students like courses in which lecturers provide positive feedback (for example as a post online).

The course and teaching strategies of ARBE1103 have been evaluated by students, tutors, colleagues as well as the National and State Visiting Panel (the accreditation committee of the Architecture degree) to ensure the quality of content and delivery. Our 2011 Student Feedback on Courses (SFC) survey achieved a response-rate of 18 % (n= 46) and confirmed overall satisfaction with the course with a mean of 3.98. The evaluation is based on 14 questions which were rated on a 5-point-Likert scale. The highest values have shown that the course challenged the students, extended their learning (challenge: 4.30) and developed their skills (outcomes: 4.23). The students were happy that teaching staff were available to help with their learning (4.13) and that they received helpful feedback (4.15). Furthermore, students confirmed that they were clearly informed about learning objectives (expectations: 4.09) and appreciated the quality of resources and assessment (both 4.00).

DISCUSSION AND CONCLUSIONS

Challenges: Many universities have noticed the need for more flexible degrees and offer courses online. However, in Australia so far only The Central Queensland University (CQU) and The University of Newcastle offer undergraduate building degrees online. Why is it so challenging to teach online (especially CAD)? Most students have not worked with complex user interfaces before, and they struggle with the installation process or re-installation when software issues occur. However, it is not only the software that causes difficulties. There are university policies, students' attitudes and the problem-based learning environment that contribute to these challenges: at The University of Newcastle university policies, for example, require staff to provide feedback to students within three weeks after an assignment submission, Construction Management students need to be convinced of the importance of learning CAD for their future role, and a problem-based learning environment demands comprehensive solutions to real-scenario problems – it is not only learning the software but acquiring overall knowledge about how to become an effective member of the building industry community by using CAD. The biggest challenge of ARBE1103 is that the course is delivered to a large (around 300 students) mixed-cohort with limited university budget. Delivering such a class online requires excellent management, efficient communication methods and extra meetings / handouts outside the regular timetable to give all students a chance to manage their tasks.

Teaching methods: At universities the traditional mode of delivery is lecture and tutorial-based and blended-delivery therefore needs to ensure the replacement of tutorial classes for distance learning students. Teaching CAD is reliant on the interactions between tutor and student(s) and requires step-by-step instructions which navigate learners through complex user-interfaces. This can become very difficult for a lecturer who supervises 60 or more distance learners on his/her own. Often the number increases as many on-campus students decide to learn online rather than to attend classes. Also, the Communication course is usually delivered in year one to students who need to develop their three-dimensional understanding and who often have no previous experience with CAD and building. Therefore, a mini-project exercise is recommended before students start with their assignments. Asperl (2005) suggests that students choose the degree of difficulty they work to, and to use realistic projects. In ARBE1103, the students have to select one of five real projects to remodel them. The projects vary in difficulty and size (number of levels) which motivates the students as they can select the task according to their own level of skills.

Conclusions: CAD is not easy to learn as it requires not only computer skills but mental capacity, spatial vision and physical coordination (Garcia et al., 2007). Teaching CAD online to a large class is extremely time-consuming, but it provides students with convenient and flexible ways of studying for their degrees. Particular difficulties of teaching online include students' motivation as well as the additional time required resulting from increased student contact and individualised instructions. Joseph Cavanaugh's (2005) study has shown that the time spent per student online increases by over six times the workload than by teaching in-class. A significant reduction of student communication would have a negative effect. The difference between online-courses offered on the internet and a university course also need consideration: internet-courses offer no flexibility in delivering the content while the university course aims to teach the course successfully to students' needs. Online tutorials

offered by CAD vendors provide limited instruction only and are not sufficient as replacement of university tutorial classes. Additional exercises and interaction are required to assist student's learning.

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