Delivering an engineering course across multiple campuses and online

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STRUCTURED ABSTRACT

CONTEXT

CQUniversity began offering the first year of the undergraduate engineering course at three regional campus locations in 1992. Laboratory facilities for first-year units were modest and, at that time, the mode of teaching was all face-to-face. By the late 1990's, the university had begun to invest in technology that allowed robust video-conference connections between campuses. Due to continued advances in technology, the undergraduate engineering offering at CQUniversity has now expanded to include full courses on four regional campuses with a fifth campus soon to offer all four years. Individual campus class sizes vary from around 40 students for first-year units to as few as 1 student for some upper-level discipline units. To support students on all regional campuses, the minimum full-time staffing includes at least one academic for each Civil, Electrical and Mechanical Engineering disciplines, together with an Administration Officer and Laboratory Supervisor/Instructor.

PURPOSE

By delivering across multiple campuses as well as online, CQUniversity gives students the opportunity to access learning support for their engineering studies regardless of their location or whether they are in full-time employment. This paper relates the technological and educational strategies used to deliver an undergraduate engineering course effectively and efficiently across multiple campuses as well as online.

APPROACH

Effective, equitable and efficient learning and teaching over multiple sites requires a toolbox of technologies and delivery strategies. Depending on the curriculum and the geographic distribution of the students, academics can select the most appropriate technology and delivery strategies.

RESULTS

A toolbox of technologies and delivery strategies designed to facilitate effective and efficient delivery across multiple campuses and online has been developed at CQUniversity. The available systems include: the use of dedicated videoconference teaching rooms in a number of different formats suitable for lectures or workshops which can be centrally recorded; web-based videoconference software that can be either used on a desktop or be connected to the videoconference teaching rooms; and an online learning management system where recorded lectures/tutorials are automatically uploaded. These systems have evolved and been integrated over time in order to meet the needs of students and staff distributed across a large geographical footprint.

CONCLUSIONS

Ensuring a good learning experience for small student cohorts distributed over multiple campus locations requires academics to have a range of delivery strategies available to them. The technologies and strategies now utilised by CQUniversity provide students the opportunity to access high-quality support and learning resources regardless of their location.

KEYWORDS

Cross-campus, technology, delivery strategies

Introduction

CQUniversity began offering the first year of the undergraduate engineering course at three regional campus locations in 1992. Laboratory facilities for first-year units were modest and, at that time, the mode of teaching was all face-to-face. By the late 1990's, the university had begun to invest in technology that allowed robust video-conference connection between campuses. Using the new Interactive System-wide Learning (ISL) interactive video broadcast system, an academic can synchronously deliver lectures to multiple campuses while providing a medium for effective engagement with all their students. Due to continued advances in technology, the undergraduate engineering offering at CQUniversity has now expanded to include the full course on four regional campuses with a fifth campus soon to offer all four years. Individual campus class sizes vary from around 40 students for first-year units to as few as one student for some upper-level discipline units.

Many CQUniversity students are the first person in their family to go to university. This presents a challenging situation as their support network is often inexperienced with higher education. Therefore, deploying video-conferencing technology for teaching geographically dispersed students does not eliminate the students' need for local support. At the minimum, each campus employs one academic in Civil, Electrical and Mechanical Engineering, one Administration Officer and one Laboratory Supervisor/Instructor. Casual staff are also employed in similar numbers for tutorials, marking and other duties. This staffing can adequately support a local intake of 25 or fewer students each year.

By using video-conferencing technologies to deliver across multiple campuses, as well as online and by also having geographically dispersed staff, CQUniversity gives students the opportunity to access learning support for their engineering studies regardless of their location or whether they are in full-time employment.

Current multi-campus delivery practices in Higher Education

It is widely reported and instinctively known by instructors that student success is highly correlated to class attendance (Lukkarinen et. al, 2016, Kirby et. al, 2003, Purcell, 2007, Silvestri, 2003). Hence in planning the multi-campus delivery strategy, consideration was given to provide students opportunities to attend classes and interact with local academics face-to-face. However, with the advent of education technology, learner engagement practices in higher education have become diverse and complex. Francis et. al. (2013) showed that increased participation in blended learning activities also improves student success, while Beer et. al (2010) showed that increased Moodle access is correlated with better educational outcomes. Kahu (2013), defines learner engagement as a "psycho-social process, influenced by institutional and personal factors, and embedded within a wider social context". Hence, in designing a new delivery strategy, it is imperative to look beyond face-to-face class attendance and access to learning resources. Delivery strategies should also consider supports for all learning avenues as well as individual circumstances and learning dispositions (Skinner et. al. 2009, Reschly & Christenson, 2012).

Congdon et. al. (2009) describes the experience of delivering the first year of Doctor of Pharmacy course in the University of Maryland in Baltimore and several satellite campuses. Their approach includes a combination of synchronous delivery through videoconferencing tools and asynchronous delivery through recorded video lectures. Using this delivery strategy, students' academic performance was generally equivalent between campuses, despite the differences in students' learning behaviour at each campus (Congdon et. al. 2009). Kidd et. al., 2006, reports that a similar approach was used in delivering a clinical pharmacokinetics course at Shenandoah University. While all students recorded high satisfaction, the students in distance classrooms rated the course higher than the on-campus students (Kidd et. al., 2006). It can be deduced from the above evidence that a combination of well organised synchronous and asynchronous delivery strategy can be used to effectively deliver the CQUniversity undergraduate engineering course across multiple campuses.

CQUniversity delivery options

Each CQUniversity campus has a range of teaching room and technologies each designed to cater for a variety of delivery strategies and class sizes.

Interactive System-wide Learning

ISL lecture theatres, with a seating capacity of between 30 – 100 are a central component of the multi-campus delivery strategy. A typical ISL theatre includes; large format display for content (projector or

large LCD TV), a second LCD TV for video conference, high definition video cameras with pan and zoom for audience and presenter, microphones for students activated through a button on the seat or remotes, lectern with PC, microphone, document camera and ability to plug in your own device controlled by a touch panel system. All ISL theatres support unattended video conferencing operation, where the sessions start and close automatically and the camera pans to the presenter at the start. All sessions are recorded and automatically uploaded to the Echo360 Active Learning Platform (ALP) (Echo360, 2018) and then linked to the Learning Management System (LMS) page for the unit. Figures 1 and 2 shows the typical configuration of an ISL lecture theatre.

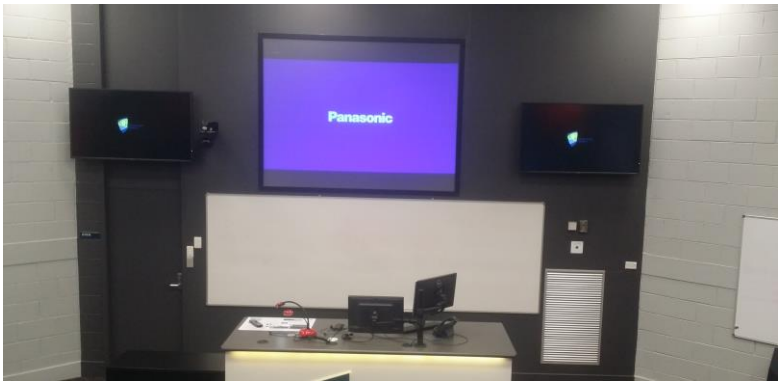

Figure 1: Front view of a typical ISL lecture theatre

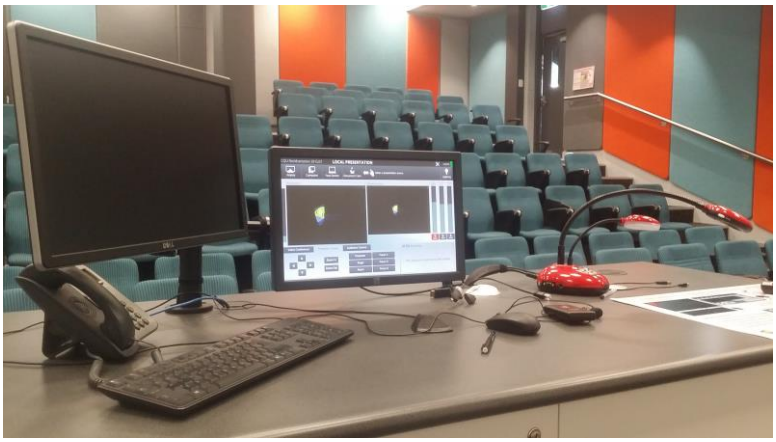

Figure 2: Lectern of a typical ISL lecture theatre

Collaborative Interactive System-wide Learning

These are smaller flat floor ISL spaces (typical capacity of 36 seats) that promote collaborative learning. Collaborative ISL rooms typically contain 6 tables with a large LCD TVs mounted on one side of the table. Each table can be shared by up to 6 students and is fitted with a PC, camera and microphone. Software installed on the PC allows the student group to share their work among the team and with the facilitator. The facilitator can then display the work to other campuses using the ISL facility. Collaborative ISL spaces also have the front of room screens, cameras and microphones that allow them to be used as general ISL theatres. Figures 2 and 3 shows the typical configuration of a collaborative ISL space.

Figure 3: Front view of a typical collaborative ISL space

Figure 4: Group work table of a typical collaborative ISL space

Self-serve video space

These are typically standard office spaces configured to provide videoconferencing as well as video production services. They contain video and audio equipment compatible with the ISL system and staff can deliver ISL lectures from these spaces. These spaces can also be used for classes where there are small student numbers. In addition to the ISL equipment, these spaces are provided with software and hardware to record videos. A typical configuration of a self-serve video space is shown in Figure 5.

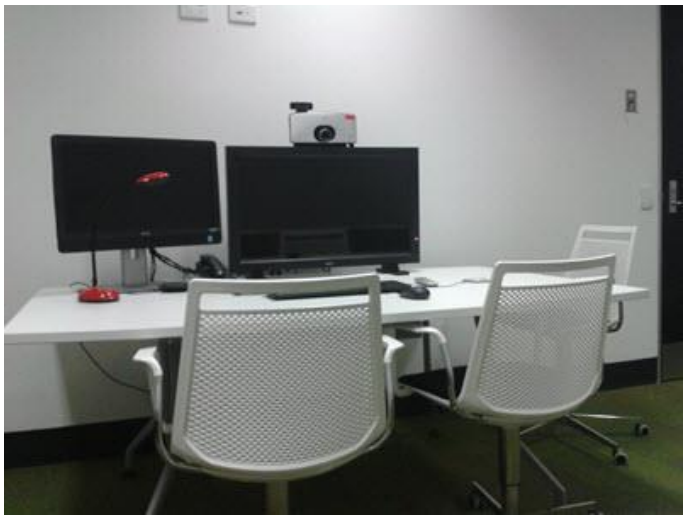

Figure 5: Self-serve video space

Zoom videoconferencing tool

Zoom is a video conferencing software developed by Zoom Video communications (Zoom, 2018). This software provides seamless and reliable video communication for up to 100 users. Despite the high quality video and audio features, bandwidth requirements of Zoom is less compared to other comparable products in the market making it an attractive solution for students access the lectures and tutorials from a multitude of location in regional Queensland. Furthermore, it provides “click to join” feature, removing the need for user accounts and login before access. Zoom is compatible with a multitude of operating systems including; iOS, Android, Blackberry, Windows, and Mac. Most undergraduate engineering ISL lectures are simulcast on Zoom allowing the students to access them from anywhere. Furthermore, Zoom is used to conduct online tutorials for distance students, where tablet computers are used as whiteboards with the screen sharing option of Zoom. CQUniversity Learning Management sites also have a feature to embed Zoom sessions, making it possible for the students to quickly join scheduled sessions. Students attending these tutorials have commented positively about the interactive nature as well as the quality of video and audio. Recordings of Zoom sessions can also be uploaded to the unit learning management website.

The CQUniversity engineering delivery strategy

Many first-year engineering students are transitioning to university study from high school. In this first experience of tertiary education, students require structured support from academics who are based locally. This enables students to build a rapport locally and seek assistance if they encounter difficulties with their studies.

As students progress through the course, they develop skills and knowledge that increases their learning independence. Indeed, by the time students reach the end of their study, they are expected to have “responsibility and accountability for their own learning” (Australian Qualifications Framework Council 2013). The delivery framework outlined in Table 1 is designed to encourage increasing learning independence as the students move from the first year through to their final year of study.

At CQUniversity, students are also able to enrol in a co-operative engineering course (co-op) where they undertake two six-month work placements during the course. The first of these placements is scheduled at the end of the second year of study. The co-op course is generally seen as an attractive option for on-campus students who are largely school-leavers. This results in most on-campus students being on placement for six months in the first half of their third year of study. During placements, students following the recommended study plan complete one unit in online mode. For many of them, this is their first experience of online study. This experience results in students becoming independent in their approach to study and more likely to effectively engage with the range of multi-campus teaching practices.

The CQUniversity delivery toolbox

As can be seen in Table 1 that first-year on-campus students have lectures, tutorials and laboratories with local staff present. As the first year of the course is common to all disciplines, these classes have reasonable numbers of students (between 15 and 50) on all campuses. Lectures for these classes are delivered using the larger ISL facilities which are also connected using the Zoom technology to facilitate students studying online to also connect synchronously. These lectures are also recorded and uploaded to the unit learning management websites so that students can view them asynchronously. On-campus tutorials and workshops are delivered in conventional classrooms and collaborative spaces. Online students are offered tutorials via Zoom, generally after hours, to accommodate students in full-time work. On-campus students undertake laboratories in conventional facilities on each campus. Online students generally come to campus for intensive residential schools to complete hands-on activities. However, online students are also invited to complete the practical work during the term with on-campus students if they reside close to one of the engineering campuses and can fit in with the on-campus schedule.

By the second year, student cohorts have split into discipline-specific streams for most of their units. Lectures for these classes are delivered using the ISL technology. Some classes have face-to-face tutorials and workshops, but many have delivered by ISL or Zoom. These classes vary in size across campuses from less than 5 students to around 20. Generally, these classes are held in mid-size ISL or

Zoom rooms but may also be scheduled into self-serve video spaces when numbers are small. Practical activities are all carried out in local laboratory facilities.

In the later years of the course, students often gradually morph into a combination of on-campus and online learning as they take up opportunities to work part-time in industry. However, because they have started their studies on-campus, they will generally come to campus to make use of the local facilities and seek the assistance of local academic staff if they are having any difficulty. They continue to complete practical work on-campus, working with peers they have formed relationships with in the early stages of their course.

Online students have a different experience from their first year of study. However, the lines separating on-campus from online are continuing to blur as online students can now participate in real-time lectures and tutorials via Zoom if they wish. They also now have the opportunity to attend local practicals throughout the term with on-campus students if they live sufficiently close to a campus rather than having to attend intensive residential schools.

Table 1: Delivery strategy

Student cohort	Delivery strategy
First year on-campus Multi-discipline	All lectures are delivered by the unit coordinator or lecturer to all campuses using the Interactive System-wide Learning (ISL) system with teaching staff present in all campuses for possible face-to-face interactions All tutorials and workshops are delivered face-to-face by local academics All laboratories are delivered on campus by local Laboratory Supervisors/Instructors
Second year on-campus Mostly discipline-specific	All lectures are delivered using ISL A mix of face-to-face and ISL workshop and tutorials All laboratories are delivered on campus by local Laboratory Supervisors/Instructors
Third and fourth year on-campus Discipline-specific	All lectures and tutorials are delivered using ISL Some face-to-face support for double-weighted Project Based Learning (PBL) workshops and computer laboratories All laboratories are delivered on campus by local Laboratory Supervisors/Instructors
Online students All year levels	Tutorials/workshops using Zoom video conferencing software, usually conducted after hours All laboratories completed in residential schools on-campus Students living close to one of the Engineering campuses are encouraged to attend the classes and laboratories on their campus

At all levels of undergraduate study, students frequently seek local support from lecturers which they have established a rapport with, in addition to directly contacting Unit Coordinators who may be located on another campus. This often takes the form of one-to-one meetings or meetings with small study groups in the academic's office. To ensure students receive the correct advice pertaining to their units of study, local academics can easily connect via Zoom with the Unit Coordinator from their PC and create a blended environment of face-to-face and videoconferencing. It is vital that this local support is offered to ensure students are comfortable seeking assistance, can maintain a strong relationship with their institution and have the best chance to successfully complete their course.

The effectiveness of this delivery strategy has been evaluated using the weighted average of the overall student satisfaction and the pass rate of all undergraduate engineering units offered in each campus. Student satisfaction was measured using the Likert scale unit evaluation surveys completed by the students at the end of each term. Average student satisfaction in all units for the five campuses and online mode for term 1 2018 were; 4.0, 4.0, 3.9, 3.7, 3.6 and 4.0, which results in a weighted average satisfaction of 3.9. This is comparable with the average student satisfaction of 4.0 for the school, where most of the other courses are delivered in only one or two campuses or online. The small difference in average satisfaction scores generally demonstrates an equitable learning experiences across the campuses.

Conclusion

The aim of the CQUniversity multi-campus delivery strategy is to provide a quality and equitable learning experience for small student cohorts distributed over multiple geographical locations, in an efficient manner. As a majority of the CQUniversity engineering students are high school leavers unfamiliar with the higher education environment, students in the first year are provided with face-to-face support for lecturers, tutorials, workshops and laboratory sessions on all campuses. As the students progress through the course, they develop a better understanding of the learning environment as well as the skills required to become an independent learner. Delivery strategy in the upper years includes a combination of face-to-face classes, ISL lectures and tutorials, and Zoom sessions designed to encourage independent learning while providing all students with access to staff and resources regardless of their campus location.

The experience at CQUniversity is that a one-size-fits-all strategy for delivering across multiple campuses is not the optimal solution for a complex course such as engineering. Different levels of student experience, different cohort sizes and different unit content all require individual approaches so providing academics with a toolbox of technologies and delivery strategies gives them the flexibility to choose the approach that works best for their unit. High student satisfaction across different campuses confirm that the multi campus delivery strategy is meeting the learning expectations of the students and the similarity of the satisfaction among campuses suggests the delivery method is equitable.

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