Mixed-mode delivery of construction management degree programs

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Abstract

The profile of students reading for construction management degrees is changing. In Australia, a buoyant construction industry is currently fuelling high student expectations. Job opportunities for students (as part-time employees) and for graduates are attractive. Students embarking on their studies come from a wide variety of backgrounds with a profile that is significantly different from the early 1990’s when the Bachelor of Construction Management (Building) program started at Newcastle University (Australia). This degree was conceived to meet the needs of the local building industry. It embraced problem-based learning as its main tenet and was developed to be delivered to on-campus as well as to distance learners. Reviews by the Australian Institute of Building and the Australian Institute of Quantity Surveying as well as the University have highlighted the need to respond to market requirements and student expectations. Over the past two and a half years the degree has been redeveloped to embrace mixed-mode delivery of courses to on-campus as well as to distance learning students. This paper describes how the degree has evolved and the manner in which e-learning has been harnessed to deliver an innovative problem-based learning curriculum in mixed-mode.

Keywords: e-learning, problem based learning, distance learning, mixed-mode learning, blended delivery.

1. Background

The opportunities for would-be construction managers are considerable. A recent KPMG survey (2007) notes that the demand for construction is expected to increase significantly over the next five years. The report observes that the “single overwhelming conclusion that can be drawn from our study is that the shortage of qualified contractors is without doubt the biggest
challenge to new construction projects in the future. Furthermore, with market demand expected to increase significantly over the next five years, this issue looks set to intensify as the pool of qualified contractors able to bid for projects is reduced and the wider shortage of skilled labour contractors impacts the ability of teams to deliver on projects.” The findings of this survey are significant as they address the global market for construction. Closer to home, a recent survey conducted by the Master Builders Australia (2007) acknowledges marked differences between states and sectors but goes on to note that in “the non-residential sector conditions are strong and are expected to continue to improve. In contrast, current conditions in the residential sector are reported as poor. However, in a significant finding after negative results in previous surveys, builders now expect residential activity to improve over the next six months.”

There are clearly good job opportunities in the construction industry, and these are reflected by buoyant recruitment to tertiary level construction programs. Students embarking on their studies at the University of Newcastle come from a wide variety of backgrounds. Many are of mature age and already have a construction background. Few are female. Many are highly computer literate and expect to engage with their studies using computer systems. This profile is significantly different from the early 1990’s when the Bachelor of Construction Management (Building) program started at Newcastle University (Australia). Then the degree was conceived to meet the needs of the local building industry, and focused largely on domestic and commercial opportunities in the region. It embraced problem-based learning as its main tenet and was developed to be delivered to on-campus as well as to distance learners.

In addition to the changed profile of our current intake of students, an increasing number of them bring with them financial necessities of having to work to support their tuition. This latter point is emphasized by Mills and Ashford’s (2004) in their investigation into part-time employment of construction management students. They highlight a trend of increasing levels of student engagement in the workplace. More recently an Australian Vice Chancellors’ Committee report (2007) entitled “A summary of findings from a national survey of students in public universities” confirmed that increasing financial stress was undermining students’ abilities to study effectively.

These financial pressures cannot be ignored. A response that the National Tertiary Education Union Newcastle branch president Bert Groen recently suggested (McKenny, 2007) might be occurring is where academics ask students to choose between their work and their studies. This is clearly an unsatisfactory approach, and is obviously not to be advocated. Students require flexible alternatives that respond not only to their pecuniary realities, but to different ways of learning that many of them engage in.

Hodgson, Sher and Mak (2007) note that the profile and expectations of construction students is changing. Not only are many of these students acculturated to the use of information technology, they are saturated with it. Lecturers need to recognise that the skills students enter University with are evolving and that many prefer to use digital materials rather than paper.
2. Current developments in the BCM program

Our Bachelor of Construction Management program is delivered by staff in the School of Architecture and Built Environment. The School comprises three disciplines viz., construction management and quantity surveying, architecture and industrial design. Degree programs at our University are subject to scrutiny from accrediting bodies as well as from the University itself. In 2004, our construction management degree (Bachelor of Construction Management [BCM]) was reviewed as part of our own internal quality assurance procedures, and by the Australian Institute of Building and the Australian Institute of Quantity Surveying. Several recommendations were made and we have responded in various ways. In the context of these recommendations the BCM program was re-conceptualised to address the changing needs of our stakeholders. Figure 1 shows the context within which the program was re-conceptualised.

![Figure 1: Context within which the BCM program is embedded](image_url)

The re-conceptualised BCM program has responded to the review recommendations and the general trends in the Australian higher education sector (mentioned above). The re-conceptualisation was aimed to:

- Cater for the changing demands/needs of students
• Increase efficiency of the program delivery
• Re-conceptualise the teaching philosophy to enhance student learning and to conform to stakeholder requirements
• Enhance the quality assurance processes

This paper discusses how the new BCM program has addressed these issues through the following strategies:

• We use of Information Technology to facilitate flexible learning and improve efficiency. We now offer our BCM program in mixed-mode. This allows our students to study on-campus or as distance-learners, and provides them with the flexibility to decide at what pace to progress their studies.

• We have improved teaching efficiency and quality by combing the delivery of BCM and Architecture courses that were previously taught separately.

• We have approached PBL integration differently and introduced electives.

• We have developed a robust map of graduate skills and knowledge that links to all stakeholders’ requirements.

3. Use of IT to facilitate flexible learning

Our program employs range of IT and online tools to create flexible and effective learning environments for students. We use the Blackboard learning management system, Lectopia online lecture system, Audio recording systems, online tutorials and tele-tutorials to facilitate student learning.

3.1 Blackboard

Staff have been using Blackboard for several years, and have developed expertise in most aspects of on-line pedagogy. Blackboard provides the equivalence of an on-campus classroom experience to on-line (distance learning) students. For example, all courses on our BCM program provide students with access to electronic course outlines, course materials (lecture notes, lecture recordings, reading materials), and relevant websites.

In addition, specific assistance is available from our Library to help students locate relevant materials. Our University’s Teaching and Learning unit have developed targeted electronic materials to support our construction students in working in groups and in writing technical and other reports. Members of staff are skilled in engaging on and off-campus students in groupwork and in electronic discussions (Sher and Williams, 2007).
3.2 Lectopia

The University of Newcastle has invested significant funds in information technology infrastructure to service on-line delivery of teaching and learning materials. A major component is Lectopia, a system which gives students access to recorded lectures via the Internet. Lectopia allows lecturers to record their lectures from specific venues (there are currently 31 Lectopia-enabled lecture theatres in our institution). Staff simply present their lectures to on-campus students and what they say and display (from their computer or visualiser) is recorded in a digital format. Once a lecture has finished it is automatically processed and is ready for students to access via Blackboard within a short space of time (usually a couple of hours). Lectopia also provides podcasts of classroom lectures, which students subscribe to for automatic download of classroom lectures.

3.3 Audio recorded lectures

In addition to Lectopia, staff audio record their lectures (and some tutorials). These recordings are then made available to students via Blackboard in mp3 format. This approach is designed to service students without broadband access, as well as those who wish to use their iPod’s to listen to lectures (whilst travelling to and from work, or at other convenient times).

3.4 Tele-tutorials

Notwithstanding the abovementioned array of (largely) asynchronous electronic teaching and learning aids, it is sometimes convenient for staff to communicate synchronously with students. In such instances, tele-tutorials are conducted.

3.5 On-line quantity surveying measurement tutorials.

A significant challenge for those teaching measurement is (and always has been) to ensure students have sufficient knowledge and understanding of construction technology to enable them to measure buildings. Measurement is a process which requires a technical knowledge and understanding of building or civil engineering technology. However, at the time students are required to learn how to measure, many of them do not yet have the requisite technical knowledge and understanding. Measurement requires students to follow a prescriptive set of rules provided by published standard methods of measurement (SMM). These publications do not explain the taking-off process and are designed to provide experienced surveyors with rules for measuring in a standardized manner. From a lecturer’s perspective the challenge lies in teaching SMM based measurement processes to students who have just enough knowledge of construction technology to comprehend the measurement rules. We have collaborated with the Department of Civil and Building Engineering at Loughborough University (UK) to develop several on-line quantity surveying measurement tutorials that assist on and off-campus students to understand these processes (Hodgson, Sher and Mak, 2007).
3.6 3D models

As previously mentioned, many novice quantity surveying students are not familiar with how to read and interpret construction drawings. A discussion of whether or not these students need to be able to prepare technical drawings before they can fully understand them is outside the scope of this paper. However, many software packages are currently available to help students overcome the limitations of 2D drawings. We have trialled 3D models developed using Google SketchUp (2007) and have been encouraged by the ease with which these have been created, and by the verbal feedback students have provided. We are currently developing 3D construction drawings in addition to traditional 2D drawings to facilitate students’ understanding of the manner in which buildings are constructed.

4. Program rationalisation and re-conceptualisation of our the teaching philosophy

The changes to the BCM degree are significant, and extensive resources and effort have been directed to developing and delivering what is effectively a new curriculum. Delivery of the redeveloped courses to on-campus BCM students commenced at the start of 2006. The new program structure is illustrated in Figure 2. This approach allows efficient utilisation of cross discipline skills for student learning.

4.1 Problem-based learning

The BCM program is based on a Problem Based (PBL) curriculum. Traditionally, in universities, PBL is expressed in terms of the content that is taught and the sequencing of this content, embodied in courses. It is argued that a PBL curriculum consists of the:

- application of concepts and theories to practice/real world situations,
- concepts and theories that inform practice of the discipline
- processes of the discipline
- processes of learning

The problem-based learning (PBL) approach adopted in the BCM degree builds on an established body of knowledge, at the heart of which is the intention to improve the effectiveness and relevance of student learning (Brubacher, 1977, Boud and Feletti, 1991). Students should be ‘empowered learners’ who have the capacity for autonomous learning and an inner drive towards continuous and lifelong learning (Candy, Crebert and O’Leary, 1994). The motivation must be initiated by an assessment process that places the student’s development at its heart (Newble and Entwistle, 1986). Since its inception, the BCM program has incorporated PBL as one of its central tenets. Continuing this approach, the redeveloped program retains PBL as an integral part of students’ learning experiences. Integrated PBL
courses are included in all years of study, and provide opportunities for students to assimilate and exercise newly acquired knowledge, understanding, and skills by engaging in a variety of different exercises.

<table>
<thead>
<tr>
<th>SEMESTER 1 — 1ST YEAR [1000 LEVEL]</th>
<th>SEMESTER 2 — 1ST YEAR [1000 LEVEL]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Integrated Project 1</td>
<td>Construction Law and Legislation</td>
</tr>
<tr>
<td>Communication in the Built Environment 1</td>
<td>Building Condition Reports and Surveying</td>
</tr>
<tr>
<td>Construction Technology 1</td>
<td>Communication in the Built Environment 2</td>
</tr>
<tr>
<td>Construction Ecology 1</td>
<td>History &amp; Theory in the Built Environment 1</td>
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<tbody>
<tr>
<td>Open elective</td>
<td>Construction Technology 2</td>
</tr>
<tr>
<td>Construction Integrated Project 2</td>
<td>Health and Safety in the Built Environment</td>
</tr>
<tr>
<td>Measurement of Building Works</td>
<td>Estimating and Tendering</td>
</tr>
<tr>
<td>Economics in the Built Environment</td>
<td>Construction Procurement</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEMESTER 1 — 3RD YEAR [3000 LEVEL]</th>
<th>SEMESTER 2 — 3RD YEAR [3000 LEVEL]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Ecology 2</td>
<td>Research In The Built Environment 1</td>
</tr>
<tr>
<td>Construction Technology 3</td>
<td>Open elective</td>
</tr>
<tr>
<td>Construction Business Management</td>
<td>Construction Integrated Project 3</td>
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<tr>
<td>Construction Project Planning</td>
<td>Construction Integrated Project 4</td>
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<tr>
<th>SEMESTER 1 — 4TH YEAR [4000 LEVEL]</th>
<th>SEMESTER 2 — 4TH YEAR [4000 LEVEL]</th>
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</thead>
<tbody>
<tr>
<td>Construction Technology 4</td>
<td>Construction Integrated Project 5</td>
</tr>
<tr>
<td>Construction Ecology 3</td>
<td></td>
</tr>
<tr>
<td>Research In The Built Environment 2</td>
<td>Construction Integrated Project 6</td>
</tr>
</tbody>
</table>

**KEY**
- Courses taught to BCM & Architecture
- Courses taught to BCM students
- Integrated Projects taught to BCM students

*Figure 2: Structure of redeveloped BCM program*

The question of choice for the implementation of a PBL curriculum is based on the characteristic of PBL to facilitate a fully integrated curriculum. This is defined in the goals of PBL programs, and includes an ability to (a) develop high professional competency (b) reason critically and creatively (c) make reasoned decisions in unfamiliar situations (d) adapt to and participate in change (e) appreciate another person's point of view (f) make self evaluations,
identify own strengths and weaknesses and undertake appropriate remediation (g) work productively as a team member

The mixed mode delivery re-conceptualised the PBL integration. The 30 units subjects (courses) that allowed cross subject integration in the old program were discontinued. Now subjects (courses) are delivered as specific knowledge delivery courses and integrated project courses. Knowledge and skill delivery courses employ PBL to allow inter-subject integration, i.e. integrating concepts with in a subject domain (Micro integration). Integrated Projects employ PBL to allow intra-subject integration of knowledge and skills of students (Macro Integration). Moreover, targeted reflection has been introduced to promote reflective practice.

4.2 Reflective practice

Central to PBL is the idea that students develop as reflective practitioners, requiring them to develop the ability to "think-in-action", to develop an awareness of "knowing how they think", which progressively translates into managing their own thinking, increasing their problem-solving skills, ultimately developing as a life-long learner (Fonteyn, 1998). This practice is mirrored by the staff in the BCM program who actively develop new and innovative ways to foster and gauge the students’ developments as reflective practitioners (e.g. Brewer, Jefferies, Gajendran and Williams (2007); Brewer, Gajendran, MacKee and Williams (2004) and Brewer, Gajendran, MacKee and Williams (2003)). These have variously included reflective journals, the combination of reflection and self-assessment in reflective self-assessment tools, and most recently the inclusion of student reflection within assessable items as reflective footnotes. The efficacy of each of these innovations has been evaluated using multiple perspectives.

5. Quality Assurance: continuous improvements

5.1 Aligning and mapping student learning

The PBL curriculum is aligned with the development of students’ graduate attributes. The proficiencies of graduates then become the basis for the development of course objectives. The University of Newcastle identifies three broad domains of graduate attributes as important outcomes of a university undergraduate degree: professionalism, community responsiveness and scholarship. The domains of attributes are generic to all undergraduate programs and reflect the University’s scholarly values in relation to teaching and research, the employability of graduates and partnerships with the community. They define the abilities of each graduate that transcend disciplinary outcomes. The program specific attributes within the domains are developed in various disciplinary and interdisciplinary contexts. The BCM program has developed 12 program specific graduate skills. These skills and the corresponding university attributes are listed in Table 1. Each course identifies which specific attribute is targeted in that course, and all of these attributes are delivered across the program.
### Table 1: Construction Management Program Skills Mapped against University Graduate Skills

<table>
<thead>
<tr>
<th>Professional Graduate Skill</th>
<th>University Graduate Skill Profile</th>
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<tbody>
<tr>
<td>1. Use knowledge of the construction industry, the environment and social processes that inform and contribute to construction practice, to optimise decision-making and evaluation of construction practices and processes.</td>
<td>Professionalism¹</td>
</tr>
<tr>
<td>2. Be able to develop, implement and evaluate strategies that result in and/or contribute to successful construction and construction related projects.</td>
<td>Professionalism</td>
</tr>
<tr>
<td>3. Be able to communicate effectively with stakeholders and members of construction teams to facilitate project delivery</td>
<td>Professionalism</td>
</tr>
<tr>
<td>4. Demonstrate leadership as appropriate, to manage construction and construction related projects and/or processes</td>
<td>Professionalism, Community responsiveness³</td>
</tr>
<tr>
<td>5. Be able to work effectively both independently and collaboratively in interdisciplinary and multi professional environments and teams to facilitate clients centred construction project outcomes</td>
<td>Professionalism</td>
</tr>
<tr>
<td>6. Function ethically, and within legal parameters, and conduct themselves in a professional manner.</td>
<td>Professionalism, Community responsiveness</td>
</tr>
<tr>
<td>7. Perform the range of industry skills required by professional bodies, appropriate to their employer and context</td>
<td>Professionalism, Community responsiveness</td>
</tr>
<tr>
<td>8. Be able to conduct and critically evaluate construction industry research and demonstrate an understanding of its contribution to the development of construction industry knowledge and practice.</td>
<td>Scholarship</td>
</tr>
<tr>
<td>9. Demonstrate professional and personal behaviour consistent with a commitment to lifelong learning, accountability in practice and the promotion and development of construction industry professions.</td>
<td>Community responsiveness, Scholarship</td>
</tr>
<tr>
<td>10. Demonstrate creativity, lateral thinking and/or promotion of entrepreneurship and innovation within the context of work processes and procedures.</td>
<td>Professionalism, Scholarship</td>
</tr>
<tr>
<td>11. Demonstrate understanding of social, cultural, global, environmental, ethical and business opportunities in the construction industry, and an understanding of the need for and principles of sustainable development</td>
<td>Community responsiveness</td>
</tr>
<tr>
<td>12. Demonstrate a capacity to inform themselves, their clients and the community of the social and environmental consequences of the actions and projects in which they are involved and the capacity to apply their skills and knowledge in the interest of their employers and clients without compromising the welfare, health and safety of their community</td>
<td>Scholarship, Community responsiveness</td>
</tr>
</tbody>
</table>

### 5.2 Student evaluation

The Discipline of Building engages in a constant process of improvement in the BCM program. This is only possible because it undertakes frequent evaluation of courses, teaching, and the
program itself, using techniques that provide multiple perspectives. These include student evaluations of each course, every time it is offered, using a standard University survey instrument, the results of which are recorded, reported and publicly published on our University website. Graduates of the program are also surveyed prior to exit, and again some time after they have graduated to elicit feedback on their overall experiences. The results are then fed back into the Discipline as an input into the continuous improvement process. Focus groups are also conducted with the students in each year of the program to augment the Student Evaluation of Course surveys, providing fine detail on the issues. Finally, many individual staff members conduct student evaluations of their own teaching, using centrally administered, anonymous survey questionnaires customised to investigate their particular style of teaching and assessment. The combination of all of these evaluative techniques invariably results in a program that continuously evolves and improves in order to meet the needs of the students.

6. Concluding comments

Like other disciplines, construction management and quantity surveying education needs to adapt to widespread changes. For example, measurement and other office and site practices have been revolutionised by computer technology, and industry practices have evolved in response to changed contractual conditions. These changes have necessitated revisions to traditional CM & quantity surveying curricula. The problem based learning CM degree program that has been successfully implemented at the University of Newcastle has been revised over the past three years. It is now delivered in mixed-mode, providing on and off-campus students with innovative and flexible education. This structure is continually evolving, and it is inevitable that the curriculum currently being delivered at our institution will be different to that of the future.

Endnotes

1 Professionalism: An attitude or stance towards work and activity: Graduates of the university, through well-founded knowledge and skills within their fields of study will be enabled to act professionally with honesty and integrity. They will be enabled to act effectively and ethically in decision-making and problem-solving and work both autonomously and collaboratively. They will have the ability to respond effectively to change and to seek continuous improvement in practice.

2 Scholarship: An attitude or stance towards knowledge and learning: Graduates of the university will have a scholarly attitude towards knowledge and learning, having a commitment to the expansion of knowledge and a respect for intellectual integrity and the ethics of scholarship. As scholars they will be enabled to apply logical, critical and creative thinking to the advancement of knowledge and understanding through a capacity for rational enquiry and self-directed learning. They will be able to communicate their knowledge effectively.

3 Community responsiveness: An attitude or stance towards society: Graduates will be enabled to play effective and responsible roles as members of local, national and global communities. They will have a capacity for perspective forming and an appreciation of the philosophical and social contexts of their
disciplines. They will have the capacity to engage in constructive public discourse to sustain communities.

References


