

Mapping curricula: ensuring work-ready graduates by mapping course learning outcomes and higher order thinking skills

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Abstract—Curtin University of Technology is in the process of completing comprehensive course reviews of all its courses by 2010. A key factor in reviewing courses is extensive internal and external stakeholder feedback to ensure that graduates have achieved Curtin’s graduate attributes and thereby appropriate employability skills. In this project, comprehensive course review consists of two distinct processes: the first is the curriculum mapping of the course to ensure alignment within units and across the entire course; the second is assistance for course teams to implement reviewed curricula (with particular focus on improving classroom practice). This paper focuses on the details of the curriculum mapping process devised for this project and which has recently been cited as best practice in a national report. Curtin adopted an outcomes focused framework in 2003. All units and courses have learning outcomes which are derived from Curtin’s graduate attributes. In the mapping process described here, all unit learning outcomes are coded and mapped to show the spread of unit learning outcomes and how they ensure student achievement of the course learning outcomes which focus on work readiness of graduates. In addition, all unit learning outcomes within a course are assigned a star rating based on Bloom’s taxonomy of educational objectives: this star rating allows course teams to see the spread of higher order thinking skills, and where they are developed within a course. Using this process, teaching staff code their own learning outcomes, and ensure that assessment aligns directly with unit learning outcomes. This paper also includes discussion of issues and challenges such as teaching staff involvement and “buy in”, problems associated with version control of course information, and the role of teaching and learning staff in assisting teams to review courses.

Keywords—course review; curriculum mapping; aligned assessment

I. INTRODUCTION

Many changes in Australian higher education over the past two decades have been part of world-wide trends in the management and delivery of higher education. These trends have included increased demands for accountability. Community stakeholders are demanding more from university graduates: community leaders have indicated that now, more than ever, graduate employees need broader skill sets than just discipline knowledge. The Employability Skills Framework (Department of Education Science and Training, 2002), developed by the Australian Chamber of Commerce and Industry and the Business Council of Australia, named eight employability skills (communication, teamwork, problem solving, self-management, planning and organising, technology, life-long learning, and initiative and enterprise) as well as personal attributes that are broadly consistent across all industry sectors. The vocational education and training sector (VET) has taken a system-wide approach and embedded these eight employability skills in all nationally recognised qualifications (Precision Consultancy, 2007). In contrast, higher education has essentially focused on employability skills through graduate attributes, with no systemic framework for embedding the eight named employability skills. It is generally the case that universities address employability skills through their graduates’ attributes; employability skills are usually a subset of a university’s graduate attributes which reflect broader aspirational, social,

ethical or humanitarian characteristics (Precision Consultancy, 2007). Embedding and assessing learning outcomes derived directly from institutional graduate attributes, as has been done across the VET sector, is highly desirable to ensure aligned curricula (Biggs, 2003a); however, the practicalities of doing so are far from simple and require a shift in educational thinking. Unfortunately, at many universities, graduate attributes remain at the level of intended or desired outcomes for students (Bath et al., 2004, Sumsion and Goodfellow, 2004, Precision Consultancy, 2007, Barrie, 2004).

Curtin University, through the process described in this paper, ensures that its nine graduate attributes are the direct source for all course learning outcomes so as to produce work-ready graduates (Curtin University of Technology, 2005). Curtin's attributes ensure that graduates know their discipline, have key employability skills (critical thinking, information, communication, technology, lifelong learning and professional skills), an international perspective and intercultural understandings. The premise for Curtin's pedagogical philosophy is that 'the aim of teaching is to make student learning possible' (Ramsden, 1992) and that student achievement of intellectually challenging and work-ready learning outcomes is the appropriate goal of university learning. At Curtin, learning outcomes are defined as what students know, understand and can do as a result of learning experiences (Hubball and Burt, 2004); they must be achievable, demonstrable and measurable. Curtin's Curriculum 2010 (C2010) project is a university-wide initiative to ensure all course curricula are current, aligned and pedagogically sound by 2010 (Curtin University of Technology, 2007). This is operationalised through comprehensive course reviews of all majors and courses. At the heart of this renewal is a five phase process of curriculum mapping focused on ensuring course learning outcomes (derived from the graduate attributes) are embedded and assessed in the units which comprise the course. The aim of the curriculum mapping is to ensure that the student's collective experience of course units ensures they are work ready upon course completion. This paper describes the centrally mediated, collegial approach to the C2010 curriculum mapping process in detail, then concludes with a discussion on its advantages and challenges so far.

II. THE FIVE PHASES OF CURRICULUM MAPPING

The C2010 curriculum map is a tool to ensure that the course has clear and understandable course learning outcomes; every unit in the course contributes to the students' achievement of those course learning outcomes (there is no overlap or needless repetition, and there are no 'gaping holes' in the course); every unit in the course contributes to the develop of appropriate higher order thinking skills, and each has a syllabus, clear and concise learning outcomes, a tuition pattern (for example, workshops and tutorials) devised to assist students to achieve the outcomes; and manageable assessment tasks which directly measure the students' achievement of the learning outcomes. This curriculum mapping tool is based on the concept of the aligned curriculum: clear learning outcomes are supported by carefully chosen learning experiences, and tested by directly linked assessment tasks (Biggs, 2003b, Ramsden, 2003, Huba and Freed, 2000, James et al., 2002, Race, 2005). Figure 1 shows an overview of the five phases of the Stage 1 curriculum mapping process. A full explanation follows. To get maximum "buy in" by teaching staff, this process is designed so that the bulk of administrative work is undertaken by the C2010 team, and teaching staff join the process to decide curriculum changes and how they might be implemented. The main liaison occurs between the C2010 team (this usually means a lead curriculum developer, an assistant curriculum developer, and administrative support) and the course team (that is, the course coordinator and all those staff who coordinate units within the course).

Figure 1 An overview of the C2010 curriculum mapping process

Phase	Interaction between C2010 team and teaching staff	C2010 activity
PHASE 1 Initial request and needs analysis	Course is nominated for review by the Course Coordinator (CC); a Needs Analysis is compiled to determine how the course might change and why (based on course structure, and course trends using internal and external feedback such as <i>eVALUate</i> , CEQ, feedback from employers and industry partners). The Needs Analysis document is used for discussion with CC (and course team if appropriate)—general directions are set. CC informs course team and Head of School that course has been referred to C2010. [This phase typically requires a one hour meeting with the CC.]	On advice from CC, C2010 gathers data and compiles the Needs Analysis.
PHASE 2 Map the existing course	CC sends to C2010 the current course learning outcomes based on Curtin's graduate attributes (if those course learning outcomes exist); the most recent versions of unit outlines for all core units (including service taught units) and selected optional units. CC arranges times for course team meetings (for Phase 3). [This phase typically requires no meetings.]	C2010 uses these materials to create a map of the existing course in preparation for Phase 3.
PHASE 3 Course team considers map of existing course and renews unit information	The course team uses the Needs Analysis and the map of existing course to <ul style="list-style-type: none"> • consider how the course might change • consider how the unit learning outcomes currently relate to the course learning outcomes and prompt higher order thinking skills • revise unit information (alignment of the syllabus, the unit learning outcomes, the assessment tasks and the learning experiences) [This is typically a two hour meeting with the course team.] Outside this meeting, the CC and Head of School engage in dialogue with service teaching providers to negotiate refined learning outcomes and address quality issues.	C2010 uses revised unit information from this meeting to create a map of the renewed course in preparation for Phase 4.
PHASE 4 Consensus on renewed course	The course team uses the map of the renewed course to <ul style="list-style-type: none"> • decide how the course will change to address issues and challenges identified through internal and external feedback • refine revised unit information so that the course learning outcomes are achievable and the level of higher order thinking skills is appropriate • ensure that all unit experiences are designed to engage students to learn effectively. [This is typically a three hour meeting with the course team, but this may take longer depending on the amount of change to be negotiated.]	C2010 makes all refinements to map of the renewed course.
PHASE 5 Course changes approved	CC liaises with C2010 to <ul style="list-style-type: none"> • ensure appropriate migration of existing students, and relations with external providers • prepare for implementation. 	C2010 prepares documentation and facilitates the approval process.

Phase 1 Initial request and needs analysis

To begin the process, the Course Coordinator (CC) requests that Comprehensive Course Review begins for a particular course, or suite of courses and majors (the latter is often the case where several courses have very similar structures and units). C2010 compiles a detailed Needs Analysis—this includes the course structure and its relationships to other courses; the course's reach and delivery; the course review data (student profile, student performance, retention, success, CEQ, GDS, *eVALUate* Course Summary Report); and external stakeholder feedback (including past graduates, employers and industry and professional bodies). After an initial discussion with the CC (and course team and other stakeholders such as Head of School and Dean of Teaching and Learning), a summary is made of the key issues to be addressed in the review. Following initial discussions, the CC's tasks are to provide C2010 with digital copies of the course learning outcomes and unit outlines for all core units (including ser-

vice taught units) and selected optional units, and to begin to organise staff meetings with the course team to undertake Phase 3 of this process (typically, these are one to two hour meetings).

Phase 2 Map the existing course

In Phase 2, the focus of activity is within the C2010 team: C2010 staff use the materials sent by the CC to create a map of the course in its current form. There are three key aspects of this first version of the curriculum map: the alignment of course learning outcomes with Curtin's graduate attributes (and accreditation competencies if appropriate); the unit information; and the mapping of learning outcomes. The first step is to set the overarching outcomes for the course and align these to the graduate attributes. This is undertaken using a table (part of which appears below, figure2) and includes the mapping of external accreditation competencies if appropriate.

Figure 2 Aligning course learning outcomes with the graduate attributes and accreditation competencies

Curtin's graduate attributes	Brief description	External professional competencies (if appropriate)	COURSE LEARNING OUTCOMES A graduate of this course can:
1. Apply discipline knowledge, principles and concepts	Apply discipline knowledge, understand its theoretical underpinnings, and ways of thinking; Extend the boundaries of knowledge through research.		
2. Think critically, creatively and reflectively	Apply logical and rational processes to analyse the components of an issue; Think creatively to generate innovative solutions.		
3. Access, evaluate and synthesise information	Decide what information is needed and where it might be found using appropriate technologies; Make valid judgements and synthesise information from a range of sources.		

The compilation of these course learning outcomes is an iterative process undertaken with the whole course team, so that all staff agree on and contribute towards the achievement of course, rather than just unit outcomes. The second key piece of information in the curriculum map is the unit information (in the current course). C2010 uses recent unit outlines to present four key details as follows: the syllabus, the unit learning outcomes (and which two course learning outcomes they support, and the level of thinking skill involved), the assessment tasks (their weightings, and the unit learning outcomes they assess), and the learning experiences (brief description of the types of learning experiences designed to facilitate student achievement of the unit outcomes).

Figure 3 Unit information as a key component of a curriculum map

Credit value and Syllabus from Student One	Unit learning outcomes Successful students in this unit can:	CLO	CLO	Level of thinking	Assessments Students demonstrate achievement of outcomes by	%	ULOs assessed	Learning experiences
XXX 100 (25) Introduction to the nature and sources of law. This unit provides an overview of the structure and institutions of government with a focus on the legislative and judicial process. Key aspects of constitutional, administrative, civil and criminal law as they relate to business are examined.	1. Comprehend and apply the basic legal rules and principles arising in the Australian legal and political system	1	2	**	1. Detailed information here	25%	2,4	A description of the types of learning experiences designed to engage learners.
	2. Analyse and apply a selection of legal rules and principles that govern Australian society and impact on the conduct of business	1	2	***	2. Detailed information here	25%	1,3,4	
	3. Write clear, concise and coherent	1	4	*****	3. Detailed information here	50%	1,2,3,4	

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	accounts relating to the political and legal systems of Australia						
	4. Employ problem solving skills and decision making techniques in regard to the political and legal system of Australia	1	3	*****			

Key: CLO = Course learning outcome(s) to which this unit learning outcome most closely relates
Level of thinking = Star rating using Bloom's taxonomy
ULO's assessed = The unit learning outcomes assessed in each assessment task

This map includes a star rating (by the C2010 team in the first instance) of each unit learning outcomes—this system is based on Bloom’s taxonomy of educational outcomes, where one star indicates the lowest level, and six stars indicate higher order thinking skills as shown in the following figure. The system is designed to prompt teaching staff to consider the level of thinking they are promoting in students, and also to be able to see at a glance, the collective level of experience across a course.

The third key piece of information in the curriculum map is the alignment of unit learning outcomes with the course learning outcomes. Figure 4 illustrates how the information is presented and indicates how each course learning outcome is achieved through various unit learning outcomes, at what point in time in the course, and at what level of thinking (using the star system above). This example shows the alignment of unit learning outcomes with course learning outcome number three (Information skills).

Figure 4 Mapping unit learning outcomes component of a curriculum map

Course Learning Outcome (CLO) 3 Access, evaluate and synthesise information				
Decide what information is needed and where it might be found using appropriate technologies; Make valid judgements and synthesise information from a range of sources.				
CLO	Unit	Unit learning outcome	Year Sem	Level of thinking
3	Unit 1	1. Prepare a basic strategic plan for a business	1.1	*****
3	Unit 2	4. Employ problem solving skills and decision making techniques in regard to the political and legal system of Australia and a selection of legal rules and principles that govern Australian society and impact on the conduct of business	1.1	*****
3	Unit 13	3. Apply the economic way of thinking to analyse real world events	2.1	***
3	Unit 14	4. Analyse and evaluate economic issues using economic theory	2.1	****
3	Unit 15	2. Write clear, concise and coherent arguments relating to management theory and practice.	2.1	*****
3	Unit 16	3. Recommend marketing strategies in 'real world' situations	2.1	*****
3	Unit 21	3. Access, evaluate and synthesise information with particular emphasis on the evaluation of international case studies and scholarly journal articles	3.1	*****
3	Unit 24	1. Demonstrate their critical thinking and information processing skills;	3.2	***

Key: CLO = Course learning outcome(s) to which this unit learning outcome most closely relates
Level of thinking = Star rating using Bloom's taxonomy
Year Sem = Year and semester in which this unit is normally completed.

Phase 3 Course team considers the map of the existing course and revises unit information

In Phase 3, C2010 staff meet with the CC and the course team and using the map explained above, completes the following: create, confirm or revise the course learning outcomes; see an overview of the

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course in its current state (using key unit information: the syllabus, unit learning outcomes, assessment tasks and tuition pattern); and consider how, in the current course, the unit learning outcomes relate to the course learning outcomes and prompt appropriate higher order thinking skills. The Needs Analysis including feedback from current students, past graduates, employers and industry informs the changes to the curriculum, the design of assessment and the learning experiences to ensure they are authentic, and sequentially develop graduate attributes. After reflection, each unit coordinator is asked to revise the unit information as follows:

1. update the syllabus if required
2. the unit learning outcomes—create up to five succinct statements conveying what the successful student in this unit can do. Each outcome begins with a strong action verb prompting appropriate higher order thinking. The Unit Coordinator indicates which one or two course learning outcomes each relates to, and what level of thinking skill is expected (using Bloom's taxonomy).
3. the assessment tasks—the Unit Coordinator gives brief detail of each task, and indicates its overall weighting, and the unit learning outcomes it tests.
4. the learning experiences—the Unit Coordinator indicates how students will be engaged to achieve the outcomes in this unit, and the optimal tuition pattern of student interaction. This opportunity is taken to utilise a community engagement model of learning to foster opportunities for developing work-readiness through application of knowledge and skills.

Phase 4 Consensus on the renewed course

C2010 uses the revised unit information (collected in Phase 3) to map the renewed course and the revised map is the focus of Phase 4. The course team uses the new map to ensure there is appropriate spread of unit learning outcomes in relation to each course outcomes, and that there is horizontal and vertical integration—that is, that

- within each unit, the syllabus and the learning outcomes align, that assessments test achievement of the learning outcomes (nothing more and nothing less), and that learning experiences are designed to engage students to achieve the learning outcomes;
- within each semester, there is sufficient spread and variety of assessment tasks and learning experiences, and no overlap of learning outcomes
- across all semesters, learning outcomes are developmental and require increasingly sophisticated thinking skills, and there is sufficient spread and variety of assessment tasks and learning experiences at appropriate levels
- the collective experiences ensure that graduates are work ready on completion of the course.

Finally, the course team revisits the Needs Analysis document to ensure that best aspects of the course have been maintained or enhanced, and areas needing development have been improved. Before the new curriculum is approved, it is essential that the course team ensures that all the feedback collected as part of the Needs Analysis is addressed—this includes particular attention to feedback from current students (such as eVALUate results), recent graduates (such as CEQ data and other feedback obtained through the Alumni office), employers of recent graduates and regional and external teaching partners. When all the refinements have been made and agreed by the team, the CC (in due consultation with Head of School and providers of service taught units) authorises C2010 to prepare documentation to complete the course change approval process.

Phase 5 Course changes approved

C2010 uses the map of the renewed course (and the map of the existing course) to assess the level of change and to prepare the documentation for authorisation by the CC and Head of School prior to being formally approved within the University. C2010 monitors progress and informs the CC and Head of School when changes have been approved. They also liaise to ensure that existing students are either migrated to the new course or guaranteed completion of the course in its current state.

III. DISCUSSION: THE ADVANTAGES AND CHALLENGES OF THIS MAPPING PROCESS

This paper describes a process with clear benefits as well as unsolved issues. The process described above is somewhat skeletal—in reality, working with busy academic staff to review curriculum is complex, time-consuming and often unpredictable. One of the clearest complexities is around course structures, and managing changes to units and the flow-on affect across multiple courses, and then across many administrative areas. For example, if a course changes radically, how does this affect existing international student offers? What affects are there on timetabling, and even the costs of offering courses in a department? With up to a hundred courses and majors in review at any given time, the impact on systems can be large. Nevertheless, from the view of the academic staff member, the process as described here has generally been very positively received. There are probably some fundamental reasons for this: the strategy of ensuring all the administrative and documentation work is done by C2010 has been warmly welcomed by teaching staff who value the level of funding for this initiative as an indication that the quality of teaching and learning experiences is worthy of such funding. More than this though, the process as described here brings to the attention of teaching staff that units of study (which up until now have been their primary focus) are part of a collective course experience, that the achievement of course learning outcomes and the employability skills which they encompass is the goal if graduates are to be work-ready, and that external stakeholders—particularly graduates and employers—do have perspectives on how well-prepared graduates are for the workplace. The inclusion of feedback from these external stakeholders helps to emphasise in the curriculum mapping process that, at the end of the day, the aim of teaching is to make learning possible, and the learning focus is on producing work-ready graduates who can make a reflective contribution to society as a whole.

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