

# **MAPPING TOOL FOR MATCHING ASSESSMENT TO GRADUATE QUALITIES AND TO COURSE OBJECTIVES**

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## **ABSTRACT**

Many universities have embraced e-learning with all the benefits that this new technology brings to education. However, most researchers focus on the development of course content and its presentation. Few researchers focus on the equally important question of assessment in the context of e-learning and how it relates to the stated objectives of the course or the graduate qualities assessment tasks are meant to develop.

The problem is compounded where assessment needs to remain the same across different deliveries (face-to-face, distance and online) of programs. In e-learning, especially when delivered to students in diverse international settings, assessment tasks need to be formulated within culturally appropriate parameters in order to maintain the validity and coherence of assessment across differing cultures. Our research has been developed to address this issue.

A growing number of universities (including the University of South Australia) are articulating a number of graduate qualities. Graduate qualities encapsulate the expectations of professional associations, employers and the community and they must be consistent with the requirements of a knowledge economy. Graduate qualities are designed to shape the teaching, learning and assessment that make up a program. They are especially relevant in the context of e-learning where instant feedback and cross-communication between lecturer and students and among students themselves is more difficult to implement effectively than in face-to-face learning.

The main focus of this paper is to explain our research and to show how we have been mapping assessment tasks in relation to course objectives and graduate qualities. We have found that mapping assessment to the stated objectives of a course whether it is delivered in traditional face-to-face or online modes is a non-trivial task and often not even attempted by lecturers in any systematic fashion. A further mapping to the graduate qualities that assessment must develop is even more difficult without a systematic approach aided by an effective mapping tool. We have developed a mapping tool based in part on Bloom's Taxonomy and tested it using courses that are taught in face-to-face and online modes in Australia, Malaysia and Hong Kong. The mapping tool is of particular relevance to science or technology based courses.

## **KEYWORDS**

e-learning, assessment, graduate qualities, knowledge economy, mapping tools.

## **INTRODUCTION**

Employers want graduates who have specialist professional knowledge in a particular discipline or professional area, and who can also contribute immediately to their workplace. Employers therefore are not just interested in what graduates know, but also in how they will continue to learn and to apply their knowledge in new ways. Professional associations expect graduates to reflect well on their professions, to be competent and ethical, and to contribute to the development of their profession. The wider community also has expectations of a graduate. The community is a collection of large and small networks of people that reflect social, cultural, family, educational and political values. All these groups have an interest in the ways university education may influence a graduate's perspectives and the contribution they will make to the community.

To address these expectations and to maintain a uniform standard of graduate across diverse geographical and cultural contexts, the University of South Australia has selected seven qualities. The graduate qualities provide a useful framework for describing the knowledge, skills, abilities and personal qualities that a student will develop or consolidate during their degree program. A graduate of the University of South Australia:

1. Operates effectively with and upon a body of knowledge of sufficient depth to begin professional practice;
2. Is prepared for lifelong learning in pursuit of personal development and excellence in professional practice;
3. Is an effective problem solver capable of applying logical, critical and creative thinking to a range of problems;
4. Can work autonomously and collaboratively as a professional;
5. Is committed to ethical action and social responsibility as a professional and citizen;
6. Communicates effectively in professional practice and as a member of the community;
7. Demonstrates international perspectives as a professional and as a citizen.

Graduate qualities generally outlast the knowledge and contexts in which they were originally acquired as they provide a framework for ongoing learning of new knowledge. They are central to preparing graduates for employment in a global knowledge economy and in supporting the global trend in tertiary education to e-learning. Graduate Qualities address the development of education and learning in accordance with knowledge economy needs, especially in an e-learning context and they provide a valuable measure of quality in education. Graduate qualities also provide a form of benchmarking against which other higher education institutions and professional bodies involved in alliances with the e-learning delivery point can judge the value of student learning taking place.

Course developers are required to assign an indicative unit weighting to each of the seven graduate qualities to quantify the relative emphasis placed within their course on each graduate quality as shown in Table 1.

Table1. Graduate qualities and indicative unit weightings

<b>Graduate Quality</b>	<b>1</b> Body of Knowledge	<b>2</b> Lifelong learning	<b>3</b> Effective problem solving	<b>4</b> Work alone and in teams	<b>5</b> Ethical action	<b>6</b> Communicate effectively	<b>7</b> International perspective
<b>Indicative Unit weighting</b>	2.0	0.5	1.0	0.5	0.0	0.25	0.25

The indicative unit weightings are decimal numbers and, in any given course they must add up to 4.5. A cumulative addition of the indicative unit weighting assigned to a specific graduate quality across all of the courses in a degree program gives an indication of the extent to which that graduate qualities is developed within a degree program. Program Directors can use these figures to determine the best mix of courses within a program or, to require changes to the emphasis placed on certain graduate qualities within all courses or within selected courses.

Graduate qualities should also be reflected in the course objectives. Course objectives are a definitive statement of course outcomes and should show how graduate qualities will be developed within the course and, which graduate qualities have been assumed.

In 2004 we undertook a comprehensive research project to investigate the critical role of assessment tasks in developing graduate qualities. We selected a three year degree program (the Bachelor of Computer and Information Science) that is delivered across a diversity of geographical and cultural contexts. Our research examined how assessment practices within the program relate to graduate

qualities and course objectives, and whether the diversity of delivery has any impact on the design of assessment tasks and their requirements.

A course developer has one reliable tool for developing the graduate qualities in students: the assessment tasks. If an assessment task is designed to develop both discipline specific knowledge and graduate qualities, clearly it will demand that students engage with discipline specific knowledge in such a way that the graduate qualities are further developed.

Cross cultural factors in assessment practices need to be identified in order to gain a better understanding of the main issues inherent in developing a program that can be delivered internationally and in a variety of different modes. The aim is to ultimately increase the validity and coherence of assessment across differing geographic and cultural contexts. The program we chose to investigate is delivered in both face-to-face and e-learning modes, locally and in Hong Kong, India and Malaysia.

The ultimate aim of this project was to develop a comparative mapping methodology that would lead to:

- An information base that assists course developers in understanding how their students' learning can be addressed towards the university's graduate qualities through their assessment tasks;
- A wider understanding of assessment design in both face-to-face and e-learning modes, and how that can be formulated to remain the same across differing geographic and cultural contexts but within culturally appropriate parameters in order to address all students' learning needs;
- The provision of a model from which other programs in an international context might be designed to support graduate qualities and their linkages to assessment and learning.

## **THE METHODOLOGY**

### **Approaches to the task**

The diverse make up of the project team has meant that we first needed to understand as a group, the different factors to be taken into account when approaching a mapping exercise such as this. We began by holding a series of meetings which were in effect, discussion groups. The discussions initially allowed us to develop shared understandings about the many meanings of issues to be researched. These included graduate qualities and how they related to assessment, how the assessment tasks could be viewed in relation to course objectives, and how the assignment tasks might provide information about the types of assumptions course developers make about a student's prior knowledge.

Once these shared understanding began to emerge, the team undertook a number of mapping exercises to investigate the practicalities of mapping against varying sets of parameters. We agreed to start by analysing the assessment tasks for one course (Object Oriented System Development) which is taught in Hong Kong, Malaysia, India and locally. A detailed description of the processes we undertook to eventually produce our final mapping tool is provided in the next section of this paper.

The process of developing the final mapping tool used an iterative enhancement approach. Our early mapping tools proved to be either too simplistic: did not give enough information to warrant analysis, or too complex: provided more information than could be usefully analysed and read in a meaningful and holistic manner across all courses within a program. One important aspect of these preliminary mapping exercises in relation to graduate qualities was our discovery of the many different ways that graduate quality indicators can be interpreted when relating them to assignment tasks. Each team member viewed the task from a different point of view, some relating to their own teaching, others in how they interpreted the requirements of the task, or the final outcomes required, or the process that students would undertake to get to the outcome.

The differing interpretations among project team members gave us an indication of how students might similarly have issues of interpretation when faced with assignment requirements. As a consequence we decided that an additional model of ‘measurement’ was needed to address our understanding of the relationship between assessment tasks and course objectives. At this stage we turned to one of the later interpretations of Bloom’s Taxonomy (Writing Objectives, 2004).

### Bloom’s Taxonomy

Bloom’s taxonomy proposes three domains of learning development: cognitive which emphasises intellectual outcomes, affective which deals with the emotional facets of learning, and psycho-motor which addresses the physical aspects. There are other systems or hierarchies that have been devised in the educational and training world: the most common being devised by Marzano and Ebel (Anderson and Krathwohl, 2001) but Bloom’s taxonomy is the best known and most widely used classification of cognitive learning objectives.

Learning is organised as a series of levels or sub-domains, and it is suggested that one cannot effectively address higher learning levels until those below them have been covered. It is thus effectively serial in structure. The model includes six levels of thinking: knowledge, comprehension, application, analysis, synthesis and evaluation. Each sequential level not only assumes a deeper understanding of the content, but includes the previous levels as subsets of the new level. The concept can be represented as pyramidal in nature, incorporating the notion of lower and progressively higher order thinking and use of knowledge (Writing objectives, 2004).

A criticism of Bloom’s taxonomy is that all the higher level skills assessment tasks can be regarded as having hidden agendas or process tasks that are not explicit in a question or task (Ebel and Frisbie, 1991). However, after fifty years, Bloom’s taxonomy remains a widely used tool with which to recognise the level at which students are being assessed by identifying the specific requirements of assessment tasks. Importantly, the concept is also relatively easy to understand and apply at most levels and in most disciplines of teaching and learning.

Each sub-domain can also be assessed separately by the use of keywords, tasks or concepts as shown graphically in Bloom’s construction wheel (see Figure 1). By matching keywords from the middle ring we can map course objectives. Keywords from the outer ring allow us to map the sub-tasks (reports, diagrams, code, etc) within the assessment tasks.

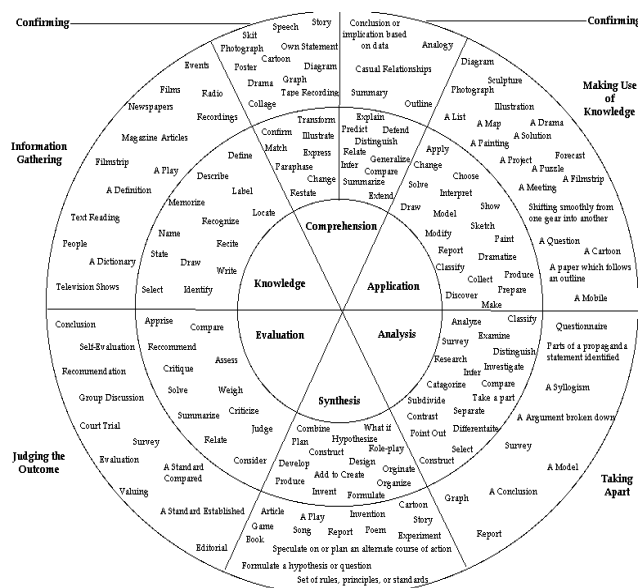


Figure 1. Bloom’s Construction Wheel

### **Setting up the mapping**

The strategy of using Bloom's cognitive domain and dividing this across a number of sub-domains, offered us a way of further extrapolating whether the stated course objectives aligned with assessment tasks. In the literature, a number of practitioners have shown how an adaptation of the taxonomy into either a rating scale or as a grading assistance, can relieve some of the complexities of setting criteria (Box, 2004; Oliver et al, 2004; Scott, 2003). Other authors have shown that Bloom's taxonomy offers a way of describing and delineating learning outcomes when writing objectives into course statements and assessment tasks across a number of disciplines (Coats, 2002; Writing Objectives, 2004).

The keywords and types of questions asked within each sub-domain of Bloom's cognitive domain relating to learning presented us with a tool that could be embedded within the mapping exercise. Consequently, the sub-domains were set down within the mapping of assessment tasks against course objectives as well as within stated graduate quality expectations. Once we all agreed as to how this taxonomy was to be applied, the data base could be constructed from the course statements that list both course objectives and graduate quality expectations.

### **Undertaking the mapping**

The task of mapping and feeding information into the database, as well as setting up the information in an accessible and readable manner was undertaken by a project officer who reported back with the mapping object as it developed. In order to obtain a less subjective view of the set tasks and their various allocated qualities, the team hired an external project officer who was familiar with Bloom's taxonomy as well as teaching and learning within the computing field. The mapping object was constructed by:

- Organising data from course statements and assessment tasks for each of those courses into numerical items;
- Organising data acquisition into a format that could allocate terms from both the Bloom's taxonomy sub-domains and from the stated course objectives;
- All the variables were then put into a spreadsheet and the most significant results were graphed.

The dimension relating to delivery in diverse contexts was then added to the mapping exercise. The assessment tasks was examined initially by the project officer to ascertain what cultural and knowledge assumptions were being made about students in terms of expectations of ability to undertake a task. This was then put into the database as part of the mapping object. It quickly became apparent that determining these assumptions required specialist knowledge and a further in-depth analysis of four courses was undertaken to determine what underlying cultural and knowledge assumptions might be made by course developers about their students.

## **DEVELOPING A MAPPING TOOL**

Our initial mapping exercise used a simple mapping table that mapped assessment tasks directly to graduate qualities. Each member of the team was asked to analyse each assessment task used in one selected course and complete this table. A ranking of high, medium, low or nil to each of the seven graduate qualities based on their perception of the extent to which each graduate quality was addressed in the assessment task. A comparison of the tables produced by members of the team revealed significant variation but there was sufficient correlation in the rankings to encourage us to trial this mapping exercise in Malaysia using three Malaysian staff members who had taught many of our IT courses.

A comparison of grade distribution results collected in 2002 and 2003 for all courses taught both locally and in Malaysia (using the same course content, resources and assessment tasks) showed a very consistent pattern. The pass rates for the same courses were very similar but the percentage of students in Malaysia who achieved a Credit, a Distinction or a High Distinction grade was much lower. We

hoped that this mapping exercise would reveal cross cultural factors that could account for the differences in the grade distributions.

Although the Malaysian lecturers ranked Graduate Quality 6 ‘Communicates Effectively’ and Graduate Quality 7 ‘International Perspectives’ higher, on average, than our team did, the results were not conclusive and could not explain the grade distributions. We concluded that a directly mapping of assessment tasks to graduate qualities using a simple mapping table was inadequate.

### The Mapping Tool

The differing interpretations (as to which graduate qualities were addressed) among project team members suggested that an additional model of ‘measurement’ was needed. We undertook a more detailed analysis of the selected course by applying Bloom’s taxonomy firstly to the course objectives and then to the assessment tasks. A direct comparison could then be made to determine the degree of correlation between the assessment tasks and the course objectives. We then extended the process by linking assessment tasks and course objectives to graduate qualities. The process used in the mapping exercise is represented by a flowchart (see Figure 2). It has two starting points; assessment tasks and course objectives and two end points; Graduate Qualities mapping and Bloom mapping. A new mapping tool based on the flowchart was drawn up and is shown in Table 2. We trialled this method using the assessment tasks in one selected course and decided that the method should be applied to all 21 computing-related courses taught within the program.

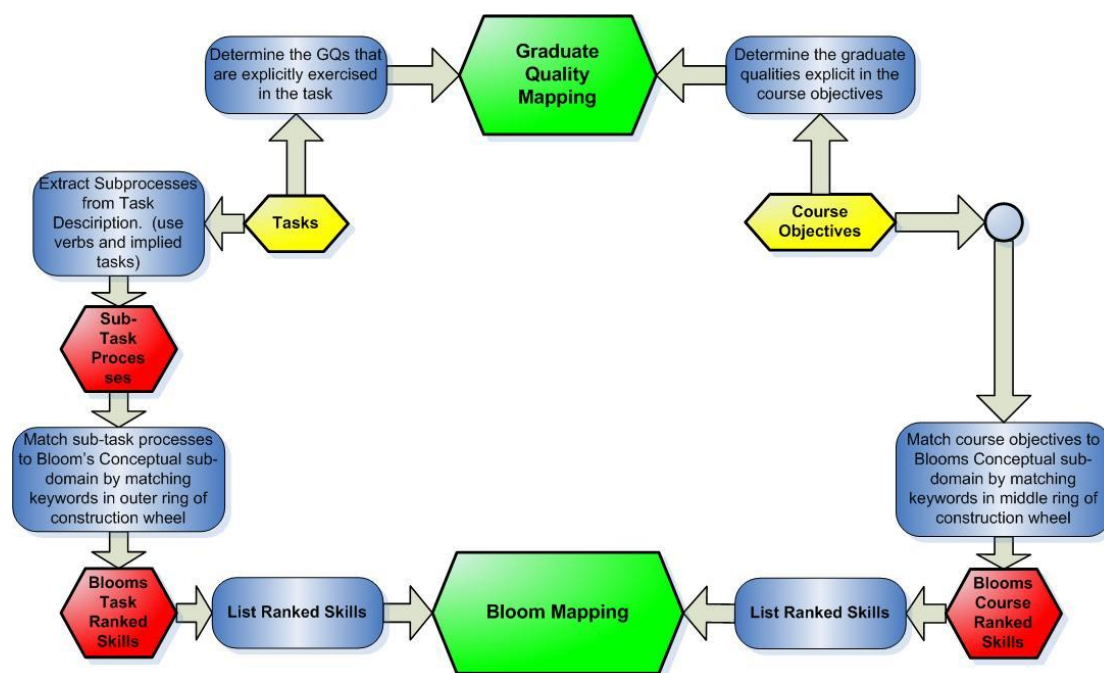


Figure 2. The initial mapping process flowchart

The task of mapping and feeding information into the database, as well as setting up the information in an accessible and readable manner was undertaken by the project officer who reported back with the mapping object as it developed. The mapping object allowed us to directly compare assessment tasks to stated course objectives in terms of Bloom’s cognitive sub-domain. In addition, both the assessment tasks and the stated course objectives were mapped to graduate qualities by determining which graduate qualities were addressed in the course objectives and also in the assessment tasks. This mapping exercise, in the case of graduate qualities, was more subjective but it provided valuable data that allowed us to estimate the degree to which each graduate quality was addressed in each course.

Table 2. The Mapping Tool (Object)

Course	Major task	Bloom's cognitive sub-domains in:		Relationship of assessment to Course Objectives	Graduate Qualities in:	
		Course objectives	Assessment		Course objectives	Assessment
COMP 1011	Assignments					
	Exam					
EET 1010	Workshops					
	Practicals					
	Tests					
	Exam					
COMM1050	Assignments					
	Tests					
COMP 1009	Practicals					
	Assignments					
	Exam					

### Adding Cultural and Knowledge Assumptions and the Final Mapping Tool

The process represented by the flowchart shown in Figure 2 did not address the issue of mapping the cultural and knowledge assumptions underlying the assessment tasks. We modified this flowchart by adding another input: students (meaning their abilities) and another output: assumption mapping. The final flowchart (see Figure 3) showed how the mapping process can relate these three inputs together. We modified the mapping object shown in Table 2 by adding an additional column for assumptions.

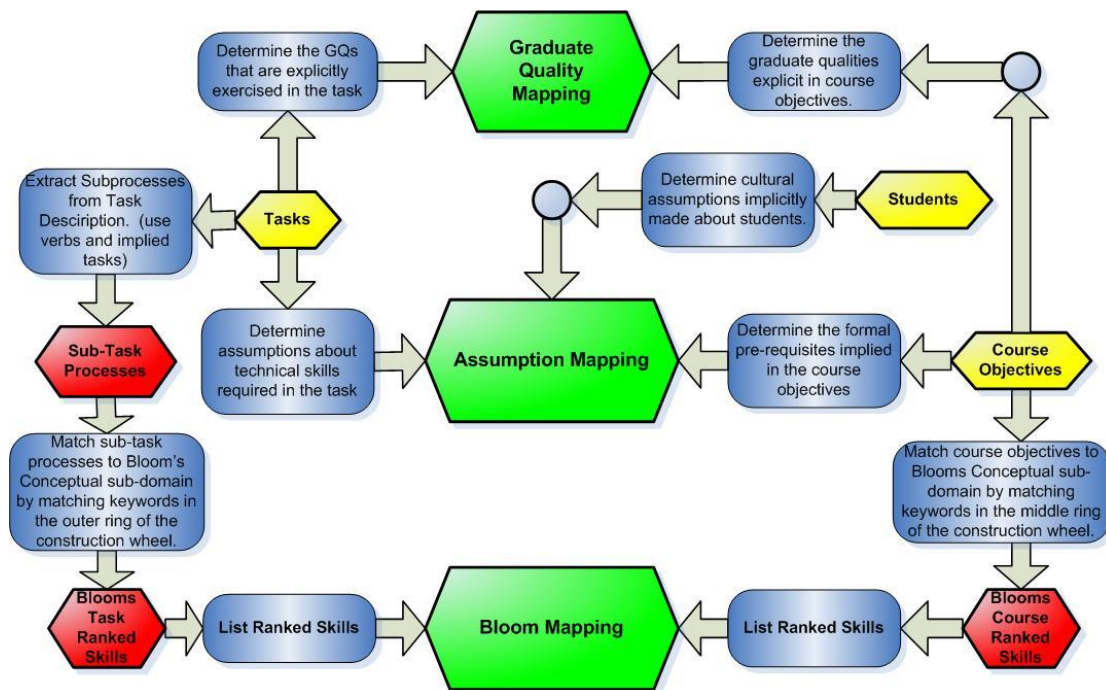


Figure 3. The final mapping process flowchart

Although it is common practice to gauge the quality of assessment design by checking the correlation of assessment to course objectives (Anderson and Krathwohl, 2001), the introduction of graduate qualities

made it necessary to assess other learning outcomes such as communication skills and international awareness that are outside the cognitive domain of Bloom’s taxonomy (Anderson et al., 1994). The team decided to select four different courses and analyse all assessment tasks for these courses to determine what cultural and knowledge assumptions were made by course developers and how they related to graduate qualities outside Bloom’s cognitive domain. This exercise provided us with enough data to draw relevant conclusions about the type of assumptions course developers often made.

In the process of developing a final mapping tool it was noted that the process was somewhat subjective but we believe that the final mapping tool is sufficiently refined to be useful to course developers. Whilst this mapping tool is rather simple it is an illustration of how a “course evaluation” software package can be developed in the next phase of this project. By asking the appropriate questions the software will guide the user in evaluating a course.

## THE FINDINGS

The mapping exercise has resulted in a mapping tool that provides a detailed information base about current assessment practices and a relatively objective view of those practices in relationship to course objectives and graduate qualities. We do acknowledge that the nature of the mapping may result in dissenting arguments around the allocation of indicative unit weightings to each graduate quality and the relationships of graduate qualities to assessment tasks or course objectives.

As a project team, we have achieved a wider understanding of assessment design and its relationship to student learning needs in general. The project has also provided an opportunity for us to question more closely what may be the appropriateness of tasks that are allocated to students across their diverse cultural environments and diverse knowledge bases.

### On Graduate Qualities and Course Objectives

The results of the investigation of 21 courses (see Figure 4 and Figure 5) indicate that, in terms of graduate qualities, there are many apparent discrepancies between what the course objectives state and what the assessment tasks ask the students to do.

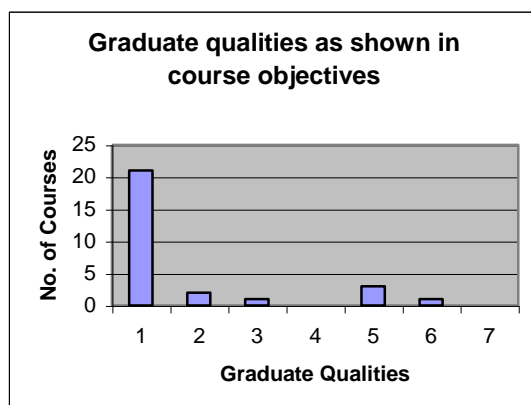


Figure 4.

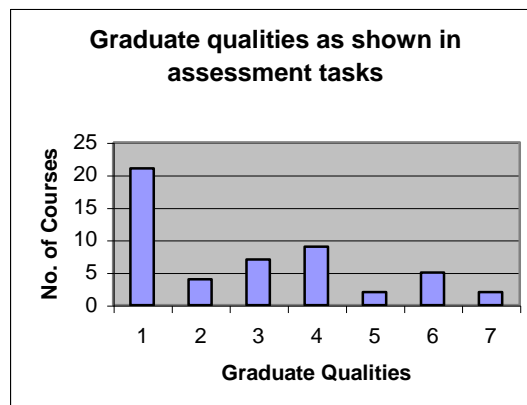


Figure 5.

Only four of the 21 courses explicitly address more than one graduate quality. In most of the courses, course objectives focus exclusively on Graduate Quality 1 ‘Body of Knowledge’ which would indicate that course developers wrote the course objectives to reflect the course content only. In the case of assessment tasks, nine of the 21 courses explicitly address only Graduate Quality 1 although a number of courses address 5 out of 7 graduate qualities.

An examination of the allocation of graduate qualities using indicative unit weightings (see Figure 6) made by course developers in their course statements indicates a higher correlation with the course



assessment tasks rather than the course objectives. However, the mapping exercise revealed that in some courses there is little or no correlation between the three categories (assessment tasks, course objectives and graduate qualities) under consideration.

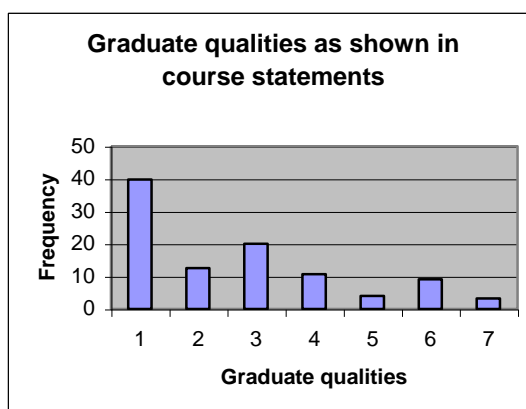


Figure 6.

The majority of assessment tasks basically require students to understand and apply the content taught. If we use Bloom’s cognitive domain as a guide, these tasks assume that students have been guided or have learned to take their first level knowledge acquisition through the comprehension level to the third level of application. This third level assumes that students have developed sound problem solving skills – one of the graduate qualities. The mapping exercise showed that students were not being incrementally developed throughout the courses so as to tackle these various cognitive skills in any linear formation.

A further critical analysis of the assessment tasks in four courses found that, in all cases the assessment tasks assumed that students already possessed a number of graduate qualities. In several other cases we determined that the assessment tasks actually tested whether students already possessed these graduate qualities.

Of all the graduate qualities, it is Graduate Quality 4 ‘Ethical Action and Social Considerations’ and Graduate Quality 7 ‘International Perspectives’ that are least likely to be built into course objectives or assessment tasks. Ethical action in higher education implies the need to address all stakeholders’ concerns. International perspectives similarly address the current demands of a global focus, encompassing relevant cultural factors. These graduate qualities are closely related and indicate the extent to which graduates are prepared for a modern, global knowledge economy and the degree to which we emphasise the internationalisation of teaching and learning.

Course developers traditionally design courses, assessments and delivery modes based on local (Australian) business and IT environment and, the local teaching and learning environment so that our graduates can be more competitive in the local job market. If these courses are re-used in different cultural and geographic contexts the vocabulary, readily accessible software, business and IT practices and legal structures may not be applicable (Gillani, 2003). To accommodate these challenges the university has introduced graduate qualities. However, our research indicates that, in many cases, courses have not been designed on the basis of graduate qualities. Many course developers try to add or integrate some aspects of graduate qualities into traditional course design.

### **On cultural and knowledge assumptions about students**

The team were not able to ask students in diverse settings about the assignment tasks, and the mapping does not clearly indicate whether the cross-cultural factor of delivery has an impact on ability to tackle assessments. At the same time, the mapping does highlight issues of assumed knowledge that may impact more negatively on students overseas than those with Australian schooling or background.

Although there is no indication that assessment tasks are culturally insensitive, some assessment tasks make significant cultural and knowledge assumptions. In particular, many assessment tasks require highly developed language skills that are likely to be beyond even those students with high IELTS scores in English.

In some cases the material for assessment demands a learning style that may not have been developed by the students from different cultural backgrounds. To accommodate diversity in cultural and educational background demands a paradigm shift in instructional design towards student-centred design (Gallani, 2003) but global education systems differ markedly in the extent to which they develop student-centred learning. In e-learning, a rapidly developing trend in global tertiary education, student-centred learning is vital and must be developed rather than assumed.

Various assessment tasks require intensive collaborative work, as well as a highly developed self-directed study style. In courses that included group projects, assumptions were often made that the students could organise effective collaborative teams. In some cultures students are reluctant to be part of groups. In other cultures, consensus is all important and students will try to avoid conflict through argument or debate. Group dynamics will often be different and may negate the course developer's rationale for using group projects. Self-directed study that requires a critical analysis of course content or recommended texts presents a fundamental difficulty for students from an educational culture that emphasises rote-learning and acceptance of authority.

A number of courses require students to make investigations into areas that may not be understood or available. In many cases assumption were made about the ready availability of detailed information about certain industrial or commercial enterprises or access to these enterprises. One assessment task we examined required students to design a software system for a car rental company. While car rental is common in Australia and it is a reasonable assumption that most Australian university students have a driving license, in Hong Kong these assumptions are not valid. Very few students in Hong Kong possess a driving license and fewer have any understanding of car rental procedures.

In terms of knowledge assumptions, we have found that there is some difficulty in clearly defining where an assessment task is part of the process of learning, and where the assessment task is testing what students have already learned. In an e-learning environment such assumptions may present considerable difficulties for students without the support available in a traditional face-to-face teaching environment.

## **CONCLUSIONS**

Our research suggests that developing a method of summing up a program's graduate qualities using the indicative unit weightings for courses can be achieved if we can develop an understanding of graduate quality pre-requisites among course developers. We believe that this can be achieved through the use of course objectives that are written to explicitly state how graduate qualities will be developed and, which graduate qualities will be reinforced and are therefore assumed. Course objectives must also show a direct relationship to the course developer's allocation of graduate qualities. We also propose the development for assessment marking schemes that give due emphasis to process as well as to outcomes produced by students. These marking schemes must support the e-learning environment by making the processes that are designed to develop graduate qualities transparent to both students and teaching staff.

Our research suggests that the best method of determining international implications is through a thorough analysis of assumptions made by course developers. As this analysis requires knowledge of the course content it is an exercise best done by nominated course moderators with specialist knowledge. The task of determining the degree to which such assumptions are valid will remain intractable until a suitable method for measuring cumulative graduate qualities (such as the one we propose based on course objectives) is implemented.

Computer and information science courses provide a sound basis for the introduction of Graduate Qualities other than 'Body of Knowledge' and 'Problem Solving' which tend to be heavily emphasised in most science and technology based courses while other qualities are often ignored. However the knowledge economy requires the systematic development of many other qualities that students will need in the real world. The development of this mapping tool provides a valuable means of measuring Graduate Qualities and educational objectives across a wide range of science-based disciplines. The mapping tool also offers a methodology to standardize and implement learning and measurement in e-learning mode.

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