Scientific Research

Teaching and Evaluating Graduate Attributes in Science Based Disciplines

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Graduate attributes, other than professional knowledge and skills, are now important outcomes for tertiary education. In science, anecdotal observations indicated minimal focus on: innovation; independent learning; communication; and societal involvement. Therefore, how graduate attributes were introduced, developed, taught and assessed into first and second year science units were investigated. Which graduate attributes were contextualized into learning objectives and activities together with how outcomes were measured and assessed were investigated. Results showed ~70% of teaching, development and assessment centred on disciplinary knowledge and most of the rest on professional skills. Oral presentations, portfolios, extended writing, and field trips comprised ~15% of assessment. Hence, a structured overview is needed to address the full scope of graduate attributes at the course level. There is an urgent need for the modern needs of tertiary education to be embraced by staff to ensure graduate attributes are attained commensurate with the expectations of the wider community.

Keywords: Graduate Attributes; Curriculum Development and Change; Science; Biology; Communication; Assessment

Introduction

Graduate attributes have been defined as "the qualities, skills and understandings a university community agrees its students will desirably develop during their time at the institution and, consequently, shape the contribution they are able to make to their profession and as a citizen" (Bowden, Hart, King, Trigwell, & Watts, 2000). Often graduate attributes focus on developing lifelong learners, and given the limited recall of knowledge of students and the rapid expansion of information, these skills are becoming more essential for professional and personal participation in society (Scoufis, 2000a, 2000b). As part of a quality control process, the Australian Government through its Tertiary Education Quality and Standards Agency (formerly AUQA) has not only regarded defining graduate attributes as an essential component of university courses, but also recognised the need to determine that the graduates have acquired these core outcomes and that by emphasizing graduate attributes, there is an improvement in the graduate standard (Baird, 2006). Over the past decade, this has led to the defining of generic graduate attributes at the institutional level and the implementation of these at the course level. Universities have responded to this demand by identifying generic attributes, listing them on their websites, and encouraging faculties to introduce and implement them into their academic programs (Barrie, 2005a).

When comparing descriptors of graduate attributes across many institutions and disciplines, they commonly include professional discipline based knowledge, practice, and commitment. The employers and tertiary educators have an expectation that graduates have obtained discipline knowledge, and in general, this has been a prime focus in university curricula (Bridgstock, 2009). However, the other graduate attributes are becoming more important to society as measures of successful tertiary education. This is indicated in Australian employer surveys across all disciplines (**Table 1**); where the most highly ranked attributes do not centre on professional knowledge. These data were almost identical to those from a survey of employers conducted by a local university, University of Western Sydney (**Table 2**). A surprising outcome for science disciplines was the employer expectation for "management ability" indicating that employers saw science graduates as potential leaders (**Table 2**).

At the Faculty level, implementation of graduate attributes has required translation of the generic form of graduate attributes into discipline relevant attributes, as well as a structure to ensure that these attributes are taught and examined. For externally accredited courses (e.g. teaching and nursing qualifications), the process is relatively straightforward because they are identified by external bodies, and accreditation relies on demonstration that the graduate attributes being taught and attained by the student or graduate. In non-accredited courses, such as science based courses, it generally relies on the faculty to determine the incorporation of graduate attributes into undergraduate programs (Bath, Smith, Stein, & Swann, 2004).

Recently a set of academic standards have been proposed for Australian science degrees which are not discipline specific and do include some professional practice and commitment (Jones,

Table 1.
Most important selection criteria when recruiting graduates, by industry, 2011.

Selection criteria	G/D/H	C/M/E	A/F	L/PS	M	C/T/U	All
Interpersonal and communication skills	1	1	1	1	1	1	1
Passion/knowledge of industry (etc)	3	2	6	2	1	2	2
Critical reasoning and analytical skills (etc)	2	5	3	3	3	3	3
Calibre of academic results	5	4	2	6	3	4	4
Work experience	6	3	4	4	3	5	5
Cultural alignment/values fit	7	5	5	4	6	8	6
Teamwork skills	4	7	7	7	6	7	7
Emotional intelligence	8	8	8	7	8	6	8
Leadership skills	9	9	9	10	8	10	9
Activities	10	10	10	9	10	9	10

Note: G/D/H = Government/Defence/Health, C/M/E = Construction/Mining/Engineering, A/F = Accounting/Finance, L/PS = Legal/Professional Services, M = Manufacturing, C/T/U = Communication/Technology/Utilities.)

Table 2.
Most important graduate attributes for employers-Extracted from http://www.uws.edu.au/strategy_and_quality/sg/surveys#11 2010 employer survey report UWS.

Area of Graduate Capability	Attribute	Rank
Personal abilities of graduates	• A commitment to ethical practice • Willing to face and learn from errors and listen openly to feedback • Being flexible and adaptable	1 2 3
Interpersonal abilities of graduates	• Willing to listen to different points of view before coming to a decision • Ability to empathize with and work productively with people from a wide range of backgrounds • Able to develop and use networks of colleagues to help solve key workplace problems	1 2 3
Intellectual abilities of graduates	• Able to set and justify priorities • Able to readjust a plan of action in the light of what happens as it is implemented • Able to see how apparently unconnected activities are linked and make up an overall picture	1 2 3
Specific skills and knowledge	• Able to communicate effectively • Able to organise work and manage time effectively • Able to use IT effectively to communicate & perform key work functions	1 2 3

Yates, & Kelder, 2011). Although this again defines the standards, the implementation of teaching and assessment of these standards has not been defined with the suggestion that the universities themselves determine how to interpret, teach and guarantee these standards. Although these ideally would be an integral part of the scaffolded learning of a well-structured degree in the 21st Century, in many cases, the reality appears to be different; the generic attributes are randomly taught, if at all. This is also reflected in the Tertiary Education Quality and Standards Agency audits where there is concern that claims of successful implementation of graduate attributes occurs because they exist in policy statements. The audits also had concern that there was also a need to inform the students of the graduate attributes and where they were being taught in a course. Ideally this would involve scaffolding with clear articulation of the progressive levels of achievement in the attribute to both students and staff. This contrasts with the result of a staff survey designed to determine the instructions given to students for writing science reports; the instructions, criteria and standards were the same irrespective of the undergraduate level (personal communication).

With all the rhetoric, it needs to be determined whether graduate attributes are truly being taught and acquired by graduates, or if this idea is in reality a non-sequitur. This paper focuses on a faculty of science in an Australian university, and within this faculty, although the corporate knowledge about the exact process for the implementation of the graduate attributes has been lost, it appears that it occurred about six years ago and was a top-down approach with superficial consultation with staff. The result has been that the non-discipline specific graduate attributes have been embedded as a co-curriculum strand alongside the discipline specific content. In general, the academics have been encouraged to self-determine if attributes are being taught in their specific units[1] and the accumulated mapping of this self-determination is used to satisfy the requirement that the graduate attributes have been obtained in a course. This paper addresses the current status of the implementation, teaching and assessment of graduate attributes in this faculty and considers staff perspectives on this important but often

[1]In this document a course comprises a structured group of units that upon successful completion qualify to be awarded a degree, and a unit is one of the topic/subject areas studied and assessed.

overlooked aspect of university education.

Background

University of Technology Sydney is a multi-campus university founded in 1988 which "aims to produce graduates with an appreciation of the practical, social and ethical dimensions of their chosen professions and with the skills and knowledge to operate effectively in culturally diverse workplaces within changing global and social contexts" (UTS web page). The university has ~36,000 students with 30% of domestic students having a language background other than English. Student progress and retention rates have been reported to be above the sector average (AUQA report, 2006).

In the Faculty of Science at the University of Technology Sydney, there has been a deliberate attempt to embed the institution agreed graduate attributes into the courses. The approach taken was a variation of a process referred to as constructive alignment (Treleaven & Voola, 2008). For the most part, it relied on individual staff members to ensure that graduate attributes were incorporated into the various programs. Staff were informed of the graduate attributes (**Table 3**) and asked to map the relevant graduate attributes against their particular unit content. Unit outlines given to students contained this mapping. The aim was to integrate course design to learning activities and student assessment.

This is a common approach to invoke graduate attributes, but it does not address the actuality of teaching and assessing graduate attributes through the application of appropriate standards (Green, Hammer, & Star, 2009). Hence, there is a no alignment between what universities advocate and what students experience and learn. In reality, constructive alignment is a mechanism of least resistance and does not address the issues discussed above. It is, however, a mechanism whereby the institution can collect data for checking boxes associated with quality assurance processes without any guarantee of standard or skill attainment.

Research Question

Anecdotal observations within the Faculty of Science supported the idea that, apart from professional discipline based knowledge and some practical skills, there was no systematic approach to map, scaffold, teach or assess graduate attributes at the course level, or even at a year level. Furthermore, there appeared to be no evaluation of how successfully graduates had acquired the graduate attributes, which was a principle of the Australian Universities Quality Agency, i.e. to assess performance against the Universities' disclosed objectives (Australian Universities Quality Agency, 2002). Therefore, the aim of this study was to systematically determine the degree to which graduate attributes were introduced, developed, taught and assessed into some of the first and second year science units in the Faculty of Science. The information obtained in this study was to form the basis for determining methodologies to improve the systematic implementation of graduate attributes within the Faculty.

Methods

Background

The Faculty of Science has five schools: Chemistry and Forensic Science (14 academic staff); The Environment (10 academic staff); Mathematical Sciences (22 academic staff); Medical and Molecular Biosciences (32 academic staff); Physics and Advanced Materials (13 academic staff). At various

Table 3.
Graduate attributes of the Faculty of Science, University of Technology Sydney.

1) Disciplinary knowledge and its appropriate application (A1)	An understanding of the nature, practice & application of the chosen science area of study.
2) An inquiry-oriented approach (A2)	An understanding of the scientific method of evidence based knowledge acquisition, deduction, inference and induction. Encompasses problem solving, critical thinking and analysis attributes, and the ability to discover new knowledge.
3) Professional skills and their appropriate application (A3)	The ability to acquire, develop, employ and integrate a range of technical, practical and professional skills, in appropriate and ethical ways within a professional context, autonomously and collaboratively and across a range of disciplinary and professional areas. This includes not only subject specific skills such as laboratory skills, computing skills or quantitative data handling skills, but also more generic skills such time management, personal organization, teamwork and negotiation.
4) Ability and motivation for continued intellectual development (A4)	The capacity to engage in reflection and learning beyond formal educational contexts, that is based on the ability to make effective judgments about one's own work and to undertake self directed, curiosity motivated, learning. The capacity to learn in, and from, new disciplines to enhance the application of scientific knowledge and skills in professional contexts.
5) Engagement with the needs of Society (A5)	An awareness of the role of science within a global culture and willingness to contribute to the shaping of community views on complex issues where the methods and findings of science are relevant. This includes an understanding of how science underpins society, the applications of science in different cultures and identifying and engaging with current and future challenges.
6) Communication skills (A6)	An understanding of, and ability with the different forms of communication - writing, reading, speaking, listening-including visual and graphical, within science and beyond and the ability to apply these appropriately and effectively for different audiences.
7) Initiative and innovative ability (A7)	An ability to think and work creatively, including the capacity for self-starting, and the ability to apply science skills to unfamiliar applications. It encompasses skills such as understanding risk management and risk taking, "thinking outside the box", questioning the norm to suggest new solutions for old problems.

times, usually at staff meetings and new staff induction, staff were informed of the Faculty of Science graduate attributes (**Table 3**), but were not informed how to implement them.

Data Collection

In an initial study, nine academics across these schools were interviewed on their perception, teaching and assessment of graduate attributes. The interviews centred on five main points: the importance of disciplinary knowledge; scaffolding of graduate attributes; the importance of communication; and implementation of graduate attributes. The responses were qualitatively assessed on the basis of the number of respondents that had similar responses or highlighted a particular aspect, and based on these findings; a questionnaire was developed as the main instrument for the larger study.

Interviews were conducted in isolation by a third year Communications student from the University of Technology Sydney. This separated the academic investigators from the process to eliminate perceived intimidation or bias. The science academics, representing all schools except School of Environment, volunteered their time to fill in the questionnaire. The questionnaire was used to evaluate how members of the faculty were involved in teaching and assessment of graduate attributes. The questionnaire was completed by all 34 academics (including those who participated in the initial study) who volunteered to participate. Each academic was the co-ordinator of a unit (subject), and represented different disciplines taught at first and second years of three year degree programmes. Though the units were from biology, mathematics and chemistry disciplinary areas, quantitative results were analysed with biology units compared with all three discipline areas combined because of the discipline interests of the authors. Student numbers in specific units ranged from 50 - 650.

The questionnaire focussed on how graduate attributes were contextualized into learning objectives and activities, how the outcomes were measured and assessed, and the proportion of activities and assessment devoted to specific graduate attributes. Both qualitative and semi-quantitative data were collected. The qualitative data arose from interview transcripts where academics were asked about their understanding of graduate attributes and how they supported their teaching. Semi-quantitative data covered: general background which included the unit and numbers of students taught, whether specific graduate attributes were identified in the unit outline and assessment processes; and beliefs or evidence about understanding of graduate

attributes as they apply to the unit and the degree. The quantitative questionnaires investigated the percentage of time spent on teaching or developing a particular graduate attribute in a unit, the percentage of time devoted to different teaching modalities and the percentage of the total assessment in a unit devoted to different assessment tools in teaching and developing particular graduate attributes. These data were also presented as a weighted score where the number of units was multiplied by the average percentage of time devoted to a particular attribute, e.g. if 5 units were in the 31% - 50% category of time spent on that attribute, then it would be $5 \times 40 = 200$ weighted units.

Results

The preliminary interviews indicated that faculty members had been made aware of graduate attributes. Staff recognized the importance of graduate attributes, particularly in the area of communication, and indicated the need to have them scaffold through the courses. However, for most members of faculty, their teaching focused on professional discipline based knowledge. Most graduate attributes were not specifically identified or highlighted to the students. In almost all cases, a written hand out (unit outline) at the beginning of semester was used to inform students of the graduate attributes to be addressed in the unit. These were not further emphasized or explained. This was exemplified in some representative interview comments listed below (**Table 4**). Other comments reflected a need for assistance in dealing with graduate attributes (**Table 4**).

From the interviews, it was clear that the bulk of focus was A1 (disciplinary knowledge), A2 (an inquiry oriented approach) and A3 (professional skills) and these were being taught. A2 and A3 relied heavily on practical classes for the teaching, and the actual skills learnt were decided at the unit level. There was no apparent consideration of necessary skills at the course level. There was no apparent mastery required for particular skills. A2 relied heavily upon students being given questions to answer (tutorials and assignments) and by the process of following a set of instructions in practical classes, although in some classes, students were made to design their own experiments. There was no structure at the course level to ensure that students had the opportunity to design their own experiments, and therefore only the students taking the particular units having this self experimental design were exposed to this attribute.

Of interest were some comments from different units that indicated that while there were recognitions of the attribute, formal teaching and structured assessment did not exist, but instead

Table 4.
Faculty members' comments on graduate attributes in initial study.

Focal point	Comments
Disciplinary knowledge	"acquisition of disciplinary knowledge would be the most important attribute taught in my unit"; "between 70% - 80% of the time is spent on teaching acquisition of disciplinary knowledge"; "acquisition of disciplinary knowledge should be scaffolded from first year"
Scaffolding of graduate attributes	"attributes should be scaffolded throughout the course"; "there should be scaffolding with knowledge and skills"
Highlighting graduate attributes to students	"they aren't specifically outlined"; "students are not informed or aware of graduate attributes"; "not a very high percentage of students are aware of graduate attributes"; "students should be able to develop professional skills by the end of their degree"
Importance of communication	"no mark dedicated to communication skills"; "believe it is critical to leave with communication skills"; "there is a need to develop communication skills required in the professional world".

there was a reliance on students to just obtain this attribute: Of concern were graduate attributes that apparently were not being addressed, or only being addressed by happenstance by individual students.

- For A5 (Engagement with the needs of Society) a typical response was:

  "Only if students decide to pick a topic that relates to the needs of society"

- For A7 (Initiative and innovative ability) there was an osmosis type of approach that relied on some hope that the students would acquire this attribute and a particular difficulty was finding a mechanism of assessment (including standards and criteria).

  "Students who are more competent in inquiring should be rewarded"
  "They gain initiative with the effort they put into their assessment. This attribute is subjective and therefore a mark cannot be placed on it. This attribute is developed and encouraged by the unit rather than assessed"
  "You can say they are "exposed" to such things, but you can't say they were good at it."

Graduate attribute A4 (ability and motivation for continued intellectual development) was not addressed at all, perhaps reflecting its impossible subjective and temporal nature.

Quantitative data were obtained around these observations using the administered questionnaire specifically collecting data on the University of Technology Sydney graduate attributes listed in **Table 3**. Analysis of the data showed trends predicted from anecdotal observations about the teaching and developing of graduate attributes. Irrespective of the specific science discipline, nearly all teaching and assessment activities, centred on discipline knowledge (**Figure 1**). This was particularly evident when the weighted score was used. The higher percentage spent in Biology for A3 (professional skills and their application; 11%) and the combined disciplines (8%) most likely reflected the large practical component in biological units. Although graduate attribute A6 (communication) appeared to be reasonably well addressed, when put in the context of a weighted score, it had only a minor role in the teaching programs. Most of the time dedicated to this attribute was not involved with teaching, but involved assigning the students communication tasks. Typical responses of staff included:

  "Students would demonstrate they have communication skills in specific assignments through the mark they receive";
 "Communication was assessed by short answer question in exams".

Examination of teaching modalities showed that the traditional teaching activities (lectures, tutorials, laboratory practical classes), which lend themselves to teaching discipline knowledge, still dominate in science (**Figure 2**). Indeed, for some units, lecture modality formed 90% - 100% of teaching time. Although specific group tasks were widely used, they accounted
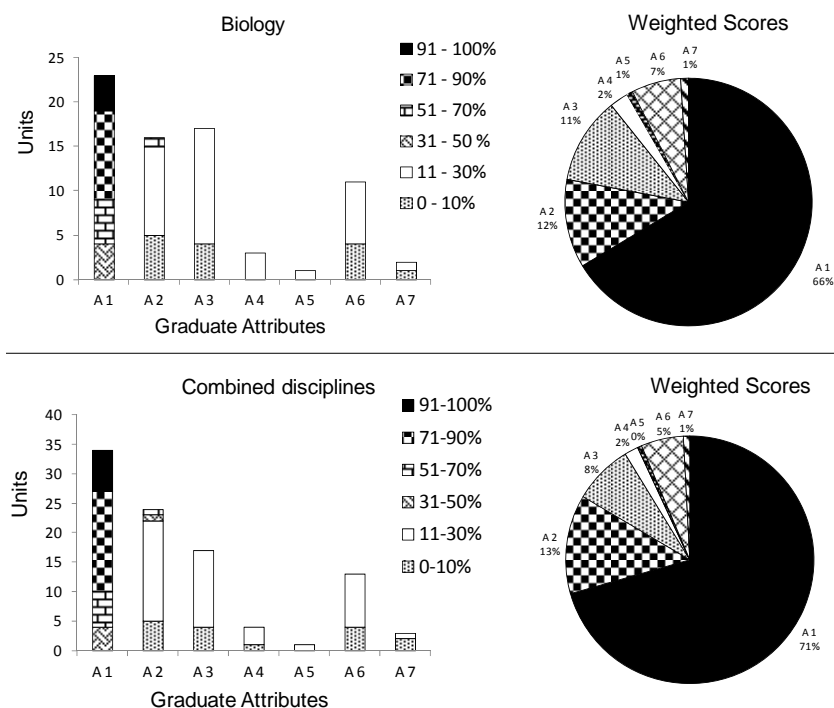
Figure 1.

Percentage of time spent on teaching or developing University of Technology, Faculty of Science graduate attributes. Column graphs indicate number of units reporting teaching and/or assessing each graduate attribute, with the percentage of time devoted to each attribute in each unit indicated. Pie graphs represent the percentage of time an attribute was taught/assessed in all units. The top graphs show results for biology units only whereas the bottom graphs show results for all disciplines (biology, mathematics and chemistry) where data were collected. Number of academics filling out the questionnaire was 34.
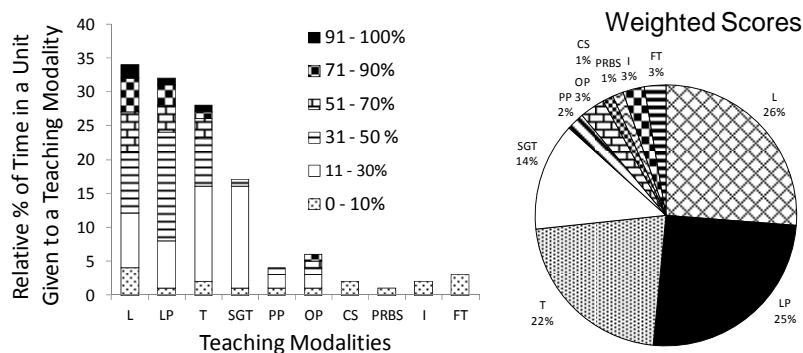
Figure 2.
Cumulative data for percentage of time and weighted scores for time spent on different teaching modalities. L-lectures; LP-laboratory practicals; T-tutorials; SGT-specific group tasks; PP-poster presentation; OP-oral presentation; CS-computer simulations; PRBS-peer review by students; I-internet; FT-field trips. Number of academics filling out the questionnaire was 34.

for only ~14% of the teaching time and were typically task orientated such as group essays, poster presentation, problem solving and practical reports. There were also claims that communication and group work was developed in practical sessions and discussions in tutorials. In no instance was there evidence that the skills of communication or group work were formally taught. The general expectation was that the students would learn by doing. Typical staff responses indicating this included:

"They learn this in tutorial classes by discussions, reading, speaking and listening";
"Communication skills are developed through scientific reports, presentations in this course"
"There is no mark dedicated to this attribute in assessments. Students develop these attributes by taking part in activities";
"There isn't an explicit mark for this attribute, but these assignments would help develop the graduate attribute".

In reality, how to work as a group was not taught and the assessment was focused on the outcome of the task and not on how the group functioned, nor on developing strategies to progress through group work difficulties. A surprise, given the computer age and the high computer literacy level and interest of most students, was that computer simulations were all but absent as a teaching modality.

The mode of assessment was also examined and again reflected professional knowledge being mainly tested. A variety of assessment tools were used within the Faculty of Science (**Figure 3**). However, as predicted by anecdotal observations, multiple choice questions (MCQs) and written exams (WE) constituted the greatest percentage of the total assessment mark for most units, and there was some emphasis in laboratory reports and assignments (**Figure 3**). Self-reflective journals, portfolios, and field trips, which may be mechanisms to assess some of the other graduate attributes, are either not used or very poorly represented. There is no doubt, based on typical staff responses that the traditional tools of assessment are used to minimize resources and turnaround times:

"In terms of communication, the problem is class sizes-maybe they do it in tutorial classes? The assessments are: quiz 20%; mid-semester exam 20%; final exam 60%";
"The problem is that there is a large cohort in first year

and it is hard to develop attributes";
"In terms of communication, you have to have some form of assessment, but the problem of measuring these skills is that there are too many students".

Of interest was that tasks involving written communication formed ~56% of the assessments (WE + A + LR + E), but there was no indication that writing/literacy skills were specifically taught.

Discussion

The Current Status of the Sector

Graduate attributes, though seemingly a new phenomenon, have been espoused by University proponents for decades. In 1862, in his opening address at Sydney University, Cardinal Wooley stated the importance of graduates attaining generic attributes imparted by the University (Barrie, 2004; Barrie 2005b). Recently the importance of developing graduate attributes to students has become a hot issue, as the universities are having an increasingly vocational role due to increased pressure from external stakeholders, including government and business (Green et al., 2009).

In order to fulfil this demand, universities have invoked policies and projects aimed at fulfilling this role. At the sector level there has been little consistency or transparency to describe methods of implementation and assessment. From the investigation of many university web sites, it appears that there is a tendency to describe proposals for embedding graduate attributes into courses, but no information on how this is being done or monitored. It is assumed that most courses have graduate attributes embedded into disciplinary knowledge and learning (Green et al., 2009). For example Sydney University put in place strategies designed to interweave graduate attributes into disciplinary knowledge rather than have them taught as parallel learning outcomes (Barrie, 2004) however there is little information available on the effectiveness of these strategies.

The Current Status of Academics and Their Teaching

There is clearly confusion among academics about their understanding of graduate attributes and desired outcomes highlighted by the varied responses by academics interviewed in this current study. The confusion centres on staff being able to
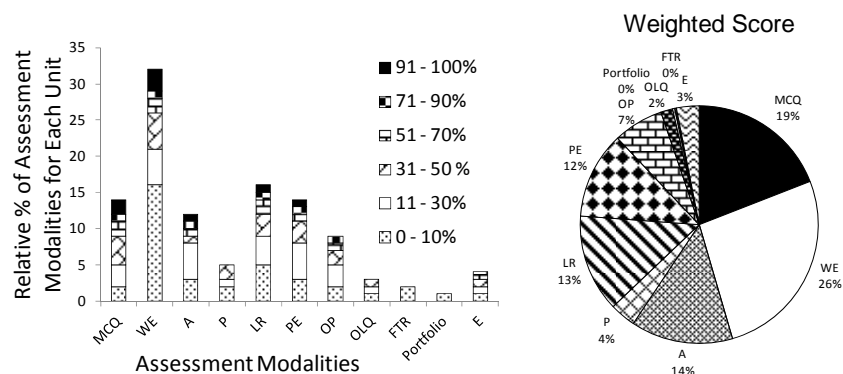
Figure 3.
Cumulative data and weighted score for percentage of the total assessment mark for each assessment tool. MCQ-Multiple Choice Questions; WE-written exam; A-assignment; P-poster; LR-laboratory report; PE-practical exam; OP-oral presentation; OLQ-on line quizzes; FTR-field trip reports; E-essay. Number of academics filling out the questionnaire was 34.

interpret and transpose generic graduate attribute statements written by the university into discipline relevant outcomes. Furthermore, there does not appear to be a link back to the needs of industry. For instance, it was interesting in this study that neither the members of faculty, nor the list of graduate attributes from the Faculty of Science recognized the need for "management" and "potential for leadership" as graduate attributes, despite this being an expectation from employer surveys. In addition there is no guide to the required standards.

Despite staff being aware of graduate attributes, quantitative data from this study indicated that 70% of all teaching, development and assessment centred on disciplinary knowledge and most of the rest centred on professional skills. This focus appears to be wide spread. For instance, at Griffith University (2012) an investigation of many courses (not just science) found professional knowledge and critical thinking were the main graduate attributes being addressed.

Matters raised by staff regarding the difficulties preventing them from addressing the broad range of graduate attributes included time limitations. Large class sizes limit teaching to disciplinary knowledge and time had to be taken to address the students' lack of basic literacy and numeracy. Another difficulty was being able to adequately assess graduate attributes other than disciplinary knowledge. In general, the comments in this regard centred on assessment being too subjective. It was also clear that faculty members did not understand the difference between teaching a graduate attribute and assigning a task involving a graduate attribute and thus claiming that it had been taught. For example, giving an oral presentation as an assessment task without initially informing and demonstrating how to prepare and deliver an oral presentation.

The Way Forward

This study highlights that there is a need for change and provides some tangible evidence that could be presented to the senior levels of Universities to gain support for this change. Essential for producing graduates with defined attributes is the need to identify those attributes that align with the needs of the employers. For example, if the employer surveys indicate a high priority for competency in group work, or for good time management, then these need to be identified as specific attributes rather than being buried under generic headings. For in-

stance, the attribute "Professional skills and their appropriate application" might be better subdivided into "Technical and practical skills", "Time management" and "Group work". Currently, in terms of compliance, the grouping of all these attributes under one heading means that a graduate attribute can be satisfied by only teaching one component of what is intended by the umbrella descriptor. For example, "Professional skills and their appropriate application" could be satisfied by only teaching practical skills but by default giving the impression that group work and time management had also been taught and assessed. In addition, it may be that some of the attributes such as "Engagement with needs of Society", and "Initiative and Innovation" would be more suitable to teach at a postgraduate level.

In moving forward, the content of student transcripts needs to be addressed to properly represent their abilities across the range of graduate attributes so that this can be communicated to employers. Currently transcripts reflect professional knowledge and little else. For instance, high achieving students well equipped with disciplinary knowledge, and disciplinary practical skills are easy to identify but there is little indication of their attainment of graduate attributes. On the other hand, we are not rewarding or valuing those graduates who, for example, are excellent communicators and thus may be the ones who promote wide spread change by convincing society to embrace new scientific developments. Generally, employers attempt to overcome the limited information in transcripts by using psychological profiling of potential employees. A mechanism for communicating these outcomes could be to provide additional documentation outlining attained graduate attributes or a portfolio that gives an assessment of the entire graduate attributes and level of competency.

There is an obvious need for academics to embrace change and begin to implement different strategies in graduate attribute development. The qualitative data in this study indicate that there are staff who want to embrace change and incorporate graduate attributes into courses. However, managing this process needs clear indications to the academic staff as to what is required. Rogan and Anderson (2011) stress that acceptance by academic staff is mandatory to change but requires staff to see value in the change from a personal and academic perspective. It is apparent from this study and the literature, there is a need for a champion to drive and manage the change, rather than

allow the change to be interpreted by individuals and taken in the directions of their whims. This would give academics permission to change teaching and assessment styles without fear that the removal of discipline content will question their adequacy as a teacher. Deliberate managed change directed at the course level would overcome this fear. For instance, this may involve convincing all faculty members involved with a course that some units will focus on specific graduate attributes with a reduction in disciplinary knowledge and that these units would be just as important as those focused on disciplinary knowledge. Within this same context, the increasing need to use more casual staff by Universities (Green et al., 2009), means that these tutors and demonstrators need to be informed of the importance of graduate attributes other than disciplinary knowledge and trained in their teaching and assessment.

Assessment was identified as a problem by all staff interviewed. Given that "from a students" point of view, assessment always defines the actual curriculum' (Ramsden, 2003), there is a need for resources to be set aside to develop teaching tools and valid assessment methods for attributes. Ideally, the assessment tools would show a direct link between teaching of graduate attributes, and determining that the learning outcomes have been achieved (real constructive alignment; Jolly, 2001). Some attributes lend themselves to subjective assessment and hence it may be more appropriate to use mastery as a mechanism for evaluation.

Conclusion

This project provides objective information about the teaching of graduate attributes and indicates the need to invoke change at the institutional level and across the sector. Ideally each discipline should be responsible for designing, implementing and assessing graduate attributes so as to produce marketable graduates. This study also indicates that for this to happen, graduate attributes have to be realistic in terms of their ability to be taught and assessed. They cannot be idealistic whims such as "demonstrates a willingness to be a 'lifelong learner'", which cannot be validated until the end of a graduate's working life. It also demonstrates an urgent need to refocus the purpose of tertiary education in the minds of academics. This will enable mechanisms to be developed that emphasise and ensure attainment of graduate attributes that are commensurate with the expectations of the university and the wider community.

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