Self and Peer Assessment: A Necessary Ingredient in Developing and Tracking Students' Graduate Attributes.

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***Abstract**: Recently there has been a shift to focus on assessing students' learning outcomes in terms of graduate attributes which they should develop and demonstrate during the course of their degree. A number of universities have tried to address these issues for example by using software tools such as ReView to track attribute development or by producing both academic and professional skill development transcripts. However, many attributes such as teamwork and the ability to give and receive feedback are typically practised in collaborative peer exercises. Furthermore these exercises are often conducted outside of regular class sessions, hence thorough assessment of these attributes should include input from both individual students and their peers. Hence we propose that any method of developing and tracking student's graduate attributes should include self and peer assessment.*

Introduction

Professionals, in addition to being technically competent, require skills of collaboration, communication and the ability to work in teams (Lang et al, 1999; Scott & Yates, 2002). There is a reported competency gap between the level of these skills required by employers and the level developed by students during their undergraduate courses (Meier et al, 2000; Martin et al, 2005). As a way of focusing curriculum development and addressing this gap there has been an increase in assessing students' learning outcomes in terms of specific graduate attributes which they should develop and demonstrate during the course of their degree (Barrie, 2004). Some of these attributes are discipline specific, others are generic to all professions. Generic attributes include teamwork skills, being able to think critically, reflectively and independently and being able to critically appraise your own work and the work of others.

Similarly attributes are also generally required by professional organisations to obtain degree program accreditation or for their members to obtain professional accreditation. For example Engineers Australia Accreditation Policy (Engineers Australia 2004) lists attributes divided into three Units of Competency:

- Unit 1: Knowledge Base
- Unit 2: Engineering Ability
- Unit 3: Professional Attributes

A number of faculties within universities including the University of Technology, Sydney and Queensland University of Technology, are attempting to track both students' academic and professional attribute development by using software tools such as ReView (Thompson, 2007). However, since many attributes may need to be at least partially assessed by students' peers (eg teamwork) or are practised in collaborative exercises, any method of developing and tracking graduate attributes should include results from self and peer assessment.

In this paper we examine the potential of using self and peer assessment as a tool to assist in the development, assessment, tracking and the provision of feedback on students' graduate attribute development throughout a degree program. Furthermore we examine whether student engagement with these processes is improved by linking attribute development to the categories required for professional accreditation. We also investigate the potential of these methods to influence curriculum development by challenging academics to produce assessment tasks that develop and demonstrate desired attributes.

Background

It is often difficult to fairly assess the contribution of individual students to a team project since most of the work may occur outside of scheduled lecture or tutorial times. Self and peer assessment is often used as a means of delegating assessment of an individual's contribution to a team task to the team members themselves (Johnston & Miles, 2004). In addition to providing fairer assessment, self and peer assessment is reported as assisting students to develop important professional skills including reflection and critical thinking (Mello, 1993; Somervell, 1993). Willey and Freeman (2006) report using self and peer assessment to produce formative learning-oriented feedback to complete the learning cycle and encourage ongoing skill development, while Boud and Falchikov (2007) discuss its use for developing students' skills for lifelong learning. Willey and Gardner (2008a) report using self and peer assessment to integrate graduate attribute development with discipline content delivery. They discuss using metrics to partially allow students' attribute development to be assessed and tracked throughout a subject or a whole degree program.

Graduate attributes are often thought of as discrete skills, while some could be described as skills, most are really the development of attitudes and dispositions. This attribute development is an ongoing and highly contextual process. Graduate attributes in some sense could be considered as the maturity or ability to apply previous knowledge to new contexts to achieve new learning and knowledge (Hagar & Holland, 2006). To effectively develop graduate attributes in students throughout their degree program subjects need to be designed to provide opportunities for these attributes to be continually developed and assessed in various contexts.

Self and peer assessment provides opportunities to practise, develop, assess and provide feedback on these attributes and develop students' judgement (Boud & Falchikov, 2007). Incorporating self and peer assessment, especially in large classes, may result in an impractical administrative burden without the assistance of online tools. However the success of such tools in improving students' learning and attribute development depends critically on how academics implement them within their subjects (Freeman & McKenzie, 2002). In this paper we discuss investigating the effectiveness of using self and peer assessment facilitated using an online tool SPARK^{PLUS} (Willey & Gardner, 2008b) to develop, assess and track students' graduate attributes, increase student engagement by incorporating professional attribute categories and positively influence curriculum development.

SPARK^{PLUS}

SPARK^{PLUS} assists students to make their self and peer assessments by requiring them to rate each other over multiple criteria (Figure 1). The program has the capacity to not only assess a student's contributions to a team project, but also allows students to self and peer assess individual work and improve their judgment through benchmarking exercises (Willey & Gardner 2008b, Willey & Gardner, 2009).

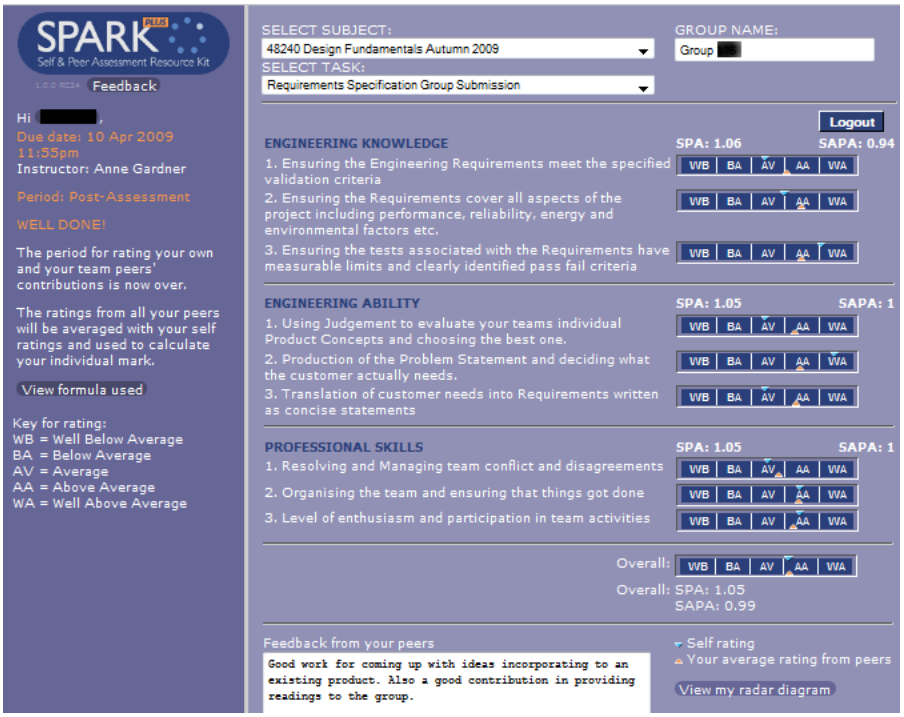
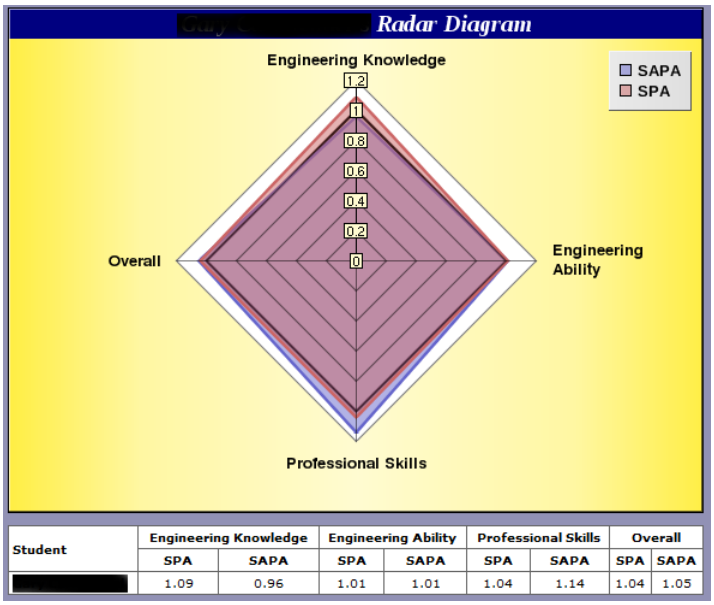


Figure 1: A student's SPARKPLUS results screen for a task where students were required to self and peer assess contributions to a team task. Note: to improve readability some criteria were omitted from the above screenshot.



Student	Engineering Knowledge		Engineering Ability		Professional Skills		Overall	
	SPA	SAPA	SPA	SAPA	SPA	SAPA	SPA	SAPA
[redacted]	1.09	0.96	1.01	1.01	1.04	1.14	1.04	1.05

Figure 2: SPARK^{PLUS} Student Radar Diagram reporting attribute categories with results table.

SPARK^{PLUS} can produce three assessment factors:

The Self and Peer Assessment (SPA) factor is a weighting factor determined by both the self and peer rating of a student's contribution. It is typically used to change a team mark for an assessment task into an individual mark.

The Self Assessment to Peer Assessment (SAPA) factor. This is the ratio of a student's own rating of themselves compared to the average rating of their contribution by their peers. The SAPA factor has strong feedback value for development of critical reflection and evaluation

skills eg, a SAPA factor greater than 1 means that a student has rated their own performance higher than the average rating they received from their peers and vice versa.

The third factor is a mark, the calculation of which depends on the type of task that has been selected.

Being a criteria-based tool SPARK^{PLUS} allows academics the flexibility to create criteria specifically targeted to allow any task, including development of attributes, to be assessed. In addition, using common categories (like the three engineering categories previously described) throughout a degree program, to which academics link their chosen criteria, allows the results to be recorded, for example in an e-portfolio, providing a means for both academics and students to monitor and track a student's attribute development as they progress through their degree.

Method

In Spring (2nd) Semester 2008 SPARK^{PLUS} was used to facilitate four different self and peer assessment tasks within the subject Design Fundamentals. Design Fundamentals is a second year subject taken by all engineering students at the University of Technology, Sydney (UTS). Students are required to work in teams to complete a number of peer learning exercises and produce, report on and present a prototype product. Self and peer assessment is used to assess, assign marks and provide feedback on attributes with which students must engage to achieve the subject learning outcomes. Table 1 provides a brief outline of the subject including its main aims, group work tasks and how self and peer assessment is used. The assessment metrics produced by SPARK^{PLUS} were shared between all group members in structured feedback sessions several times a semester. Students were guided on how to both reflect on their own performance and learning, and to give constructive feedback to their team peers. The process focuses on improving students' judgement and moving them to be more expert in their ability to engage with subject learning outcomes. The aim of using regular formative feedback is to assist students to identify their individual strengths and weaknesses and through reflection address any competency gaps in their development.

Individual self and peer assessment criteria were linked to each of the three categories from Engineers Australia, allowing the results to be recorded in an e-portfolio (for example using the radar diagrams shown in Figure 2), providing a means for both academics and students to monitor a student's attribute development as they progress through their degree.

A post-subject survey comprising a mixture of free response and 4 point Likert format questions was conducted to assess:

- the potential of self and peer assessment processes to develop and monitor students' attribute development.
- whether students' engagement with these processes and motivation is improved by linking attribute development to the categories required for professional accreditation.

In addition the two coordinators kept reflective notes throughout the semester and regularly met with the instructing academics (two coordinators and 10 tutors) to reflect on each self and peer assessment exercise including their potential to influence curriculum development.

Table 1: Outline of the subject Design Fundamentals including a description of how self and peer assessment was used.

Design Fundamentals	
Subject aim	• Develop students' understanding of the engineering design process • Develop students' skills to build a small engineering project from initial concept to prototype production. • Build on students' skill and graduate attribute development begun in the first year of their degree • Promote the development of professional skills including teamwork, critical evaluation, feedback, communication skills and academic honesty.
Cohort size	Approx 300 (45 repeating students did different tutorial assessments)
Tutorial size	32
Small group size	4
Groupwork tasks	• Develop individual project concept, participate in Peer Learning Assessment and Reflection Exercise facilitated using self and peer assessment • Individually complete benchmarking (assessment ability / professional judgement) exercise, participate in Peer Learning Assessment and Reflection Exercise facilitated using self and peer assessment • Team delivery and management of multistage engineering project, prototype production, 2 written reports and oral presentation. Self and peer assessment used to provide feedback on team contributions and moderate marks.
Why self and peer assessment is used.	• Provide constructive feedback to students on their professional skill development and how they are contributing to their teams • Provide students with the opportunity to learn from this feedback to improve subsequent performance. • Develop professional attributes including critical evaluation and judgement • Determine individual assignment marks by appropriate adjustment of group marks • Discourage free-riding
Support provided	• Tutor facilitated feedback sessions • Structured feedback process • Appeal mechanism

Results

In accordance with our ethics approval, participation in the post-subject survey was voluntary. Of the eligible cohort of 255, 89 students (35%) volunteered to complete this online survey.

The survey results relevant to this paper are presented below in Figures 3a and 3b. The 'Strongly Agree' and 'Agree' responses were combined to give an aggregate result, as were the 'Strongly Disagree' and 'Disagree' responses. The percentage of any unanswered questions are generally not shown but can be calculated by subtracting the provided results from 100%.

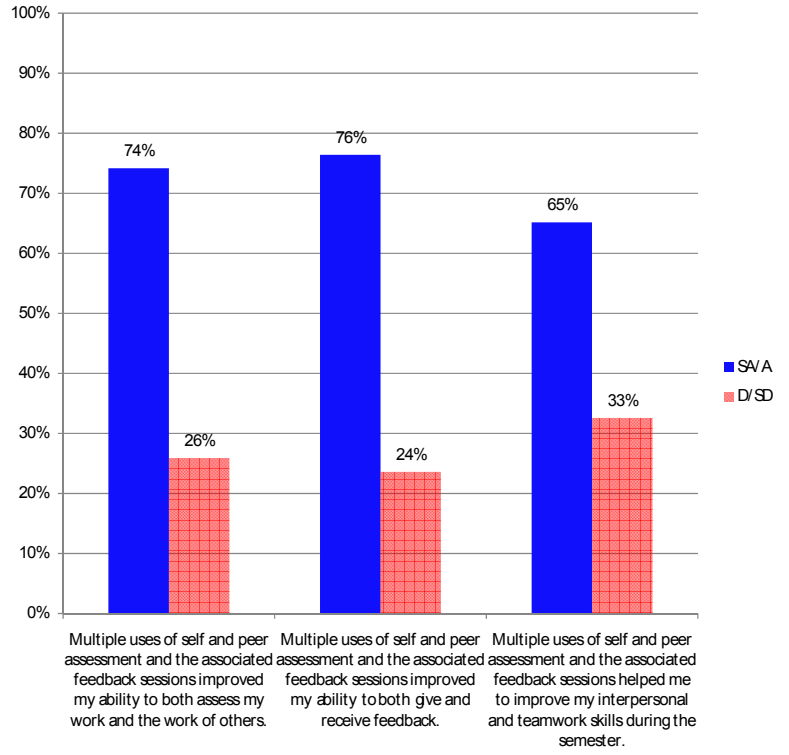


Figure 3a: Post Subject Survey results related to this paper

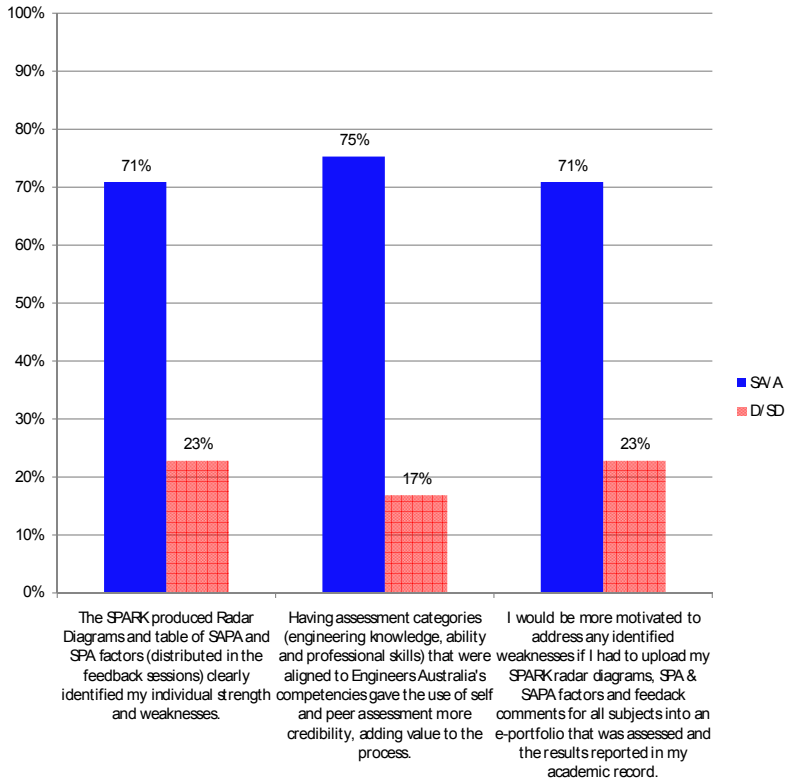


Figure 3b: Post Subject Survey results related to this paper

Discussion

In response to how the multiple uses of self and peer assessment and the associated feedback sessions had helped respondents to achieve the required attribute outcomes:

- 74% agreed that it improved their ability to both assess their work and the work of others.
- 76% agreed it improved their ability to both give and receive feedback
- 65% agreed it improved their interpersonal and teamwork skills

These results clearly show that self and peer assessment is effective in helping students to develop aspects of the generic attributes of reflection, critical evaluation, ability to give feedback and interpersonal and teamwork skills. Furthermore, depending on the assessment design often only a student's peers are in a position to evaluate how well a student has developed these skills. Even when assessment tasks are designed to allow an academic to make informed judgements, in large classes this requires considerable time and effort often imposing an intolerable burden. By using self and peer assessment students are not only developing their critical evaluation / judgement by assessing each other's work and collaborating in peer learning but with careful design may be provided with frequent opportunities to practise and develop a whole range of generic and discipline specific attributes. Additionally, the results in Figure 3b demonstrate the potential for self and peer assessment to monitor this attribute development with 71% of respondents agreeing that the Radar Diagrams and factors clearly identified their individual strength and weaknesses.

In addition, all academics in the trial reported being able to use these features to identify at a glance students/groups that were having problems achieving the attribute learning outcomes. This facilitated academics to move into more of a coaching role to support students in addressing gaps in their development and learning.

The results also show that students responded positively to the opportunity to track their development against specific attribute categories. In particular, 75% of respondents agreed that using self and peer assessment categories aligned to the competencies required for Professional Engineering accreditation added value to the process. Our eventual aim is to provide students with two transcripts on graduation, one identifying their academic achievement and the second their professional attribute/skill development. Respondents (71% in Figure 3b) reported that this form of reporting would increase their motivation to address their weaknesses as they were identified.

In general for innovations to be successful students must see them as being both useful and adding value to their education. When this attribute tracking trial was introduced, to increase student engagement we discussed with students how they could use the results and their e-portfolios to demonstrate their competence to prospective employers. Scott and Yates (2002) reported that successful engineering graduates rated the ability to contribute positively to team-based projects as the most important of 49 possible reasons for their success. Technical expertise, while acknowledged as necessary and receiving the greatest amount of teaching time during their degree was rated a comparatively low 29th. Like the successful graduate, employers are also aware that a student's generic attribute skill level is a good indicator of how successful and valuable they will be as an employee. Despite this, the development of these attributes are not typically recorded in academic transcripts and as previously stated in some cases can only be fairly assessed by student peers. The inclusion of self and peer assessment to track student's development within different attribute categories is one method of providing evidence of this development.

We also found the process of requiring academics to allocate their assessment criteria to different attribute categories had strong potential to influence curriculum development. Academics were challenged to reflect on the design of their assessment tasks to produce assessments that actually develop and demonstrate desired attributes. This was evident when academics first implemented the self and peer assessment processes reported in this paper. After initially trying to allocate their existing assessment criteria to the different attribute

categories they discovered that many criteria needed to be rewritten to more accurately reflect the desired learning outcomes. This realisation led to the innovative redesign of tasks to assess and hence better achieve these learning outcomes. In particular, academics were challenged to design assessment tasks that had components that contributed to the relevant attribute categories for their subject. Assessment tasks have now been designed to more thoroughly test a student's application or ability to combine and apply requisite knowledge rather than just testing this knowledge itself.

While these results from a single trial need to be interpreted with some caution, they do support our argument that self and peer assessment should be included in any comprehensive method to assess, monitor, track and provide feedback on students' graduate attribute development.

Note: While we acknowledge that the assessments provided by students may not always accurately reflect the actual level of a student's attribute development, as they are the result of subjective assessments by peers, it does provide a useful guide and indeed mirrors the professional situation where an individual's contribution and performance is judged by their peers. In addition, if multiple peers are used (eg groups of size 4 to 8) in the evaluation process any bias from a single member of the evaluation group tends to be averaged out.

Conclusion / Recommendations

In this paper we report evidence that supports the inclusion of self and peer assessment processes into any method to assess, monitor, track and provide feedback on graduate attribute development. The results demonstrate the potential of self and peer assessment processes to develop and monitor students' attribute development. Furthermore we found that student engagement with these processes was enhanced by linking student's development to the attribute categories required for accreditation in their profession. We also found that this type of implementation had strong potential to influence curriculum development by challenging academics to design assessment tasks that had components contributing to the required attribute categories for their subject.

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