Developing team skills with self and peer assessment: are benefits inversely related to team function?

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Abstract

Purpose - Self and peer assessment has proved effective in promoting the development of teamwork and other professional skills in undergraduate students. However, in previous research approximately 30% of students reported its use produced no perceived improvement in their teamwork experience. It was hypothesised that a significant number of these students were probably members of a team that would have functioned well without self and peer assessment and hence the process did not improve their teamwork experience. This paper reports the testing of this hypothesis.

Design/methodology/approach – This paper reviews some of the literature on self and peer assessment, outlines the online self and peer assessment tool SPARK^{PLUS}, and analyses the results of a post-subject survey of students in a large multi-disciplinary Engineering Design subject.

Findings –We found that students who were neutral as to whether self and peer assessment improved their teamwork experience cannot be assumed to be members of well functioning teams.

Research limitations/implications -

Practical implications –

Originality/value – To increase the benefits for all students we recommend that self and peer assessment focuses on collaborative peer learning not just assessment of team contributions. Furthermore we recommend that feedback sessions be focused on learning not just assessment outcomes and graduate attribute development should be recorded and tracked by linking development to categories required for professional accreditation.

Article type – Research Paper
Keywords - self and peer assessment, groupwork, professional skills, graduate attributes, SPARK, SPARK^{PLUS}.

1. Introduction

While the skills of self reflection, critical evaluation and an ability to work in teams are important for all professions, there is a reported competency gap between the level of teamwork skills required by employers and the level developed by students during their undergraduate courses (Martin et al, 2005; Meier et al, 2000). Self and peer assessment has proved effective in promoting the development of teamwork and other professional skills in undergraduate students (Somervell 1993, Boud & Falchikov 2007). However, in the author's previous research it was common for approximately 30% of participating students to be neutral when asked if self and peer assessment improved their teamwork experience (Willey and Freeman, 2006a pg 9 -10). It was hypothesised that a significant number of these students were probably members of well functioning teams that would have functioned well without self and peer assessment and hence the process did not improve their teamwork experience. In this paper we report testing the validity of this hypothesis and investigate whether students in well functioning teams benefit less from self and peer assessment processes.

2. Background

In addition to being technically competent, professional engineers require skills of collaboration, communication and the ability to work in teams (Lang et al, 1999; Sageev & Romanowski, 2001). Scott and Yates (2002) note 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. Not surprisingly, researchers report a competency gap between the level of teamwork skills required by employers and those developed by engineering students during their undergraduate courses (Martin et al, 2005; Meier et al, 2000; Natishan et al, 2000).

While team-based projects provide opportunities for team interaction they do not necessarily facilitate the development of teamwork skills (Natishan et al, 2000). Students need to understand team dynamics, how to resolve conflict and the importance of doing so. While this can be facilitated by instruction, it is insufficient on its own (Messer, 2001; Stonyer et al, 2001).

University courses ought to develop learning-oriented assessments (assessments specifically designed to encourage or enhance learning as opposed to simply testing that learning has occurred (Keppell 2006)) that not only encourage these skills to be developed but promote future development and learning after graduation (Boud & Falchikov, 2006). Thus if we are to successfully achieve teamwork and professional skill development as outcomes, we need a method of assessment and feedback that promotes these outcomes. Used thoughtfully self and peer assessment can potentially address all of these issues.

The use of self and peer assessment has been widely reported in the literature (Boud & Falchikov, 2007; Goldfinch, 1994; Goldfinch & Raeside, 1990; Falchikov & Goldfinch, 2000). In previous research Willey and Freeman (2006a, 2006b) reported their use of an online tool called SPARK (Freeman & McKenzie, 2002),

to facilitate confidential self and peer assessment and focus students' efforts on learning and practising the skills required for teamwork.

Rust et al (2005 pg 243) report 'that of the whole assessment process, the research literature is clear that feedback is arguably the most important part in its potential to affect future learning and student achievement'. However, feedback is often provided long after the assessable work has been completed at which time students may no longer be interested, instead being focused on the next assessment task. Hence for feedback to be productive and used for student reflection, it must be both timely and focused.

For several years the authors have used self and peer assessments, collected using the online tool SPARK, to not only promote the development of professional skills but to facilitate the provision of regular feedback in large engineering classes. In previous research they have found that the use of self and peer assessment improved students' group work experience, reduced the instances of free-riders ('free-riders' also known as 'passengers' are team members whose contribution is insufficient, inadequate and/or poor in comparison to their team peers) and encouraged students to improve their professional skill development (Willey & Freeman, 2006a, 2006b). Students reported that the use of self and peer assessment, together with criteria that specifically assessed teamwork processes, had encouraged team cooperation, commitment and increased engagement.
In addition, over a number of semesters in different contexts the authors have found it common for approximately 30% of students to respond as being neutral when asked if the use of self and peer assessment improved their group work experience (Willey & Freeman, 2006a). It was hypothesised that a significant number of these students were probably members of well functioning teams which would have functioned well without self and peer assessment and hence the process did not seem to improve their teamwork experience. In this paper we report testing the validity of this hypothesis and investigate whether students in well functioning teams benefit as much from self and peer assessment processes as those in teams with at least one poor team member.

3. The SPARK tool

SPARK assists participants in making their self and peer assessments by requiring them to rate each other over multiple criteria (Figure 1). We have found it effective to include explicit criteria for both discipline specific project tasks as well as demonstrated professional skills e.g. good team practices. Unlike other self and peer assessment packages, SPARK automatically produces two assessment factors. The first factor known as the SPA or Self and Peer Assessment factor is a weighting factor determined by both the self and peer rating of a student's contribution that can be used to change a team mark for an assessment task into an individual mark as shown below:

$$\text{Individual mark} = \text{team mark} * \text{Individual's SPA}$$

The second factor calculated is the SAPA or Self Assessment to Peer Assessment 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, providing students with feedback about how the rest of their team perceived their contribution. For example, a SAPA factor greater than 1

means that a student has rated their own performance higher than the average rating they receive from their peers and vice versa. While the SPA factor is typically used only for summative purposes, both factors can, and we believe should, be used for formative purposes as well.

"Take in Figure (1) Paper 2".

4. Design Fundamentals

Design Fundamentals is a compulsory core subject in the second year of the engineering degree at the University of Technology, Sydney. The subject's typical cohort is approximately 280 students from all engineering disciplines with tutorial classes being limited to a maximum of 32 students.

The subject's primary aims are to:

1. develop students' understanding of the engineering design process
2. provide students with the skills to develop a small engineering project from initial concept to the production of a prototype.
3. provide instruction and opportunities to practise to continue the development of students' professional skills including teamwork, critical evaluation, feedback and communication skills commenced in earlier subjects.

To promote the development of professional skills and encourage academic honesty, a process of self and peer assessment (collected using the online tool SPARK) is used three times during the semester, immediately after the submission of a project deliverable. The results of these assessments are used to:

1. provide constructive feedback to students on their discipline and / or teamwork skills and their contribution to their teams.
2. develop students' critical evaluation and feedback skills.
3. allow students to assess their ongoing skill development and identify their individual strengths and weaknesses.
4. provide students with an opportunity to learn from this feedback to improve subsequent performance.
5. determine individual assignment marks by appropriate adjustment to group marks.

Each self and peer assessment exercise involves students assessing their contribution and that of their group members to areas of the project specified by criteria. These criteria relate to both the discipline / technical requirements of the project and how students contributed using their team and professional skills.

Our intention is to use self and peer assessment processes to move students from being novices to become more expert in their professional skill development as they progress through the subject. To achieve this we have an intentional focus on using the results to facilitate the provision of feedback. Students are provided with both the SPA and SAPA factors for themselves and each of their group members. After allowing sufficient time for students to personally reflect on the assessments, each group is guided through a feedback process (Willey & Freeman, 2006 b).

Providing feedback multiple times during a semester affords students an opportunity to reflect and modify their group behaviour or approach to the remaining parts of the project. Hence they have an opportunity to practise and test

what they have learnt. Many groups who performed poorly in the first part of their project responded positively to this feedback, significantly improving their performance in the remaining stages of the project.

5. Method

In Autumn semester 2007 a post-subject survey was conducted to assess the effectiveness of the self and peer assessment processes used in the subject Design Fundamentals. While all non repeating students undertaking the subject were required to participate in the self and peer assessment exercises, only 95 students from an eligible cohort 220 agreed to complete the online questionnaire. The questions were mostly a mixture of free response and 5 point Likert format. While the survey was specifically prepared to explore students' views regarding the self and peer assessment processes used in the subject, we decided to re-analyse the data to compare the experience of students in teams with and without any poor team members.

The survey questions used in this analysis are shown in Table 1. First to test our hypothesis we investigated how many students who responded 'neutral' to the question "*Using self and peer assessment facilitated by SPARK improved my group work experience"* also indicated that their team had no poor team members.

Secondly, we compared the responses of students who reported that they did not have any poor team members to those that reported that they did, to investigate whether there is a link between the benefit students received from using self and peer assessment processes and how well their team functioned.

6. Results

Table 1 shows the respondents' answers to five of the post-subject survey questions. The top figures (bold) report the results for the entire responding cohort, while the centre (*italic*) and bottom figures (grey) report the results for respondents who reported they had at least one (65 respondents) and no (30 respondents) poor team members respectively.

Table 1: Results from the post-subject student survey Autumn 2007.

Question	Cohort Description	Agree	Neutral	Disagee
a) Compared to my previous experience with group work at University, the use of self and peer assessment facilitated by SPARK has made group work fairer.	All Respondents	**58%**	**26%**	**16%**
	At least one poor team member	*62%*	*25%*	*14%*
	No poor team members	**53%**	**27%**	**20%**
b) Multiple uses of self and peer assessment and the associated feedback sessions improved my ability to both assess my work and the work of others.	All Respondents	**67%**	**18%**	**15%**
	At least one poor team member	*66%*	*17%*	*17%*
	No poor team members	**70%**	**20%**	**10%**
c) Multiple uses of self and peer assessment and the associated feedback sessions improved my ability to both give and receive feedback.	All Respondents	**69%**	**17%**	**13%**
	At least one poor team member	*75%*	*9%*	*16%*
	No poor team members	**57%**	**37%**	**7%**
d) Multiple uses of self and peer assessment and the associated feedback sessions enabled me to respond to the feedback to improve my team contribution during the semester.	All Respondents	**55%**	**30%**	**15%**
	At least one poor team member	*58%*	*30%*	*13%*
	No poor team members	**54%**	**30%**	**17%**
e) Using self and peer assessment facilitated by SPARK improved my group work experience?	All Respondents	**54%**	**28%**	**18%**
	At least one poor team member	*52%*	*32%*	*15%*
	No poor team members	**56%**	**20%**	**23%**

7. Discussion

Table 1 shows that in agreement with previous surveys approximately 30% (27 respondents out of 95 (28%)) of students responded 'neutral' when asked whether self and peer assessment facilitated by SPARK had improved their group work experience. However only 6 (22%) of these students (ie 6 of the 27) also reported that they had no poor team members clearly suggesting that our hypothesis is incorrect. In addition, the fact that the neutral responses to the question *"Using self and peer assessment improved my group work experience"* for students in groups with at least one poor team member (32% neutral, 15% disagree) is significantly larger than for those in well functioning teams (20% neutral, 23% disagree) also contradicts our initial hypothesis. While these results are far from definitive being only from one trial they clearly refute our initial hypothesis. That is, students who responded neutral as to whether self and peer assessment facilitated by SPARK

improved their group work experience cannot be assumed to be primarily members of well functioning teams.

In total 30 respondents out of the cohort of 95 reported that they had no poor team members. To investigate whether students in well functioning teams receive the same benefit from using self and peer assessment as those in teams with at least one poor team member we compared the survey responses for each group. Overall the results (see Table 1) for both groups, with the exceptions of the instances discussed below, are remarkably similar.

Firstly, not surprisingly (given that the authors have previously shown that self and peer assessment reduced the instances of free-riders (Willey and Freeman, 2006b)) a higher percentage of students with at least one poor team member (62%) found using self and peer assessment made team work fairer than those in well functioning teams (53%). It is not unreasonable to assume that good students in groups with poor team members saw the fact that marks were moderated in accordance with assessed contribution added fairness to the teamwork process.

Secondly a higher percentage of students with at least one poor team member (75%) found using self and peer assessment improved their ability to both give and receive feedback compared to those in well functioning teams (53%). In the absence of more specific data we can only speculate as to the cause of this result. However, one could argue that teams that contain at least one poor team member provide more opportunity to practise and develop feedback skills increasing engagement with the feedback process. Probably a more significant contributor to this result is an attitude reported by some students in the survey free response questions and feedback discussions, that they mainly focused on the free-rider deterrent aspect of using self and peer assessment. Those in well functioning teams commented that they had little to discuss in the feedback session as everyone in the team "pulled their weight". Typically they did not take the opportunity to discuss in what way they could have done better or how they could have improved their project and hence missed the opportunity to benefit from feedback that may have assisted their ongoing professional development. Furthermore this may explain why nearly a quarter of students in well functioning teams (23%) reported that self and peer assessment did not improve their group work experience. This situation is unlikely to improve, while students continue to perceive self and peer assessment as an instrument to facilitate fairness, rather than providing opportunities to reflect and feedback to assist learning.

Although the reported data needs to be treated with caution as it was only collected during one semester, in one subject, it suggests that the benefit students gain from self and peer assessment processes is probably more a function of how each individual student engages with these processes rather than how well their team functioned. Hence while the evidence contradicts our hypothesis that a significant number of students who were neutral as to whether self and peer assessment improved their group work experience were probably members of well functioning teams, it also suggests that those in well functioning teams may potentially benefit less from self and peer assessment processes. While further investigation is required it does appear that participation in a team with at least one poor team member allows students to engage with learning opportunities (eg having to provide feedback on and / or resolve performance issues) that are denied members of well functioning teams. As to whether the advantages outweigh the

disadvantages of being a member of a dysfunctional team is the subject of ongoing research.

The fact that our original assumption was incorrect means we can not ignore the fact that 46% of students (ie 28% neutral and 18% disagree) reported that the use of self and peer assessment did not improve their group work experience. It is the authors' intention that all students would benefit, both from the reflective nature of self and peer assessment and the feedback it provides. It is apparent that if this aim is to be achieved that we must do more to ensure that all students and in particular those in well functioning teams engage with the process.

8. Recommended Changes

Since our initial 2007 trials reported in this article we have developed SPARK^{PLUS} (see acknowledgement, Willey & Gardner, 2009). Like the original version of SPARK, SPARK^{PLUS} assists students to make their self and peer assessments by requiring them to rate each other over multiple criteria (Figure 2). However, SPARK^{PLUS} has been extended beyond assessing student's contributions to a team project, to also facilitate student's self and peer assessing individual work and to improve their judgment through benchmarking exercises (Willey & Gardner, 2008; Willey & Gardner, 2009).

In addition to the SPA and SAPA factors SPARK^{PLUS} produces a third factor or mark, the calculation of which depends on the type of task that has been selected. Furthermore SPARK^{PLUS} allows allocation of criteria to different attribute categories, providing the potential to track a student's development throughout their degree. Students can monitor their performance and identify their strengths and weaknesses through the category based SPA and SAPA factors (Figure 2). Alternatively, students can view their results as a graphical representation via a radar diagram (Figure 3) where performance in a particular category is depicted by the position of the SPA factor envelope compared to 1 with the SAPA envelope identifying any discrepancies between a student's self perceptions and the perceptions of their performances by their peers. The recording of these diagrams in an e-portfolio allows students to track their attribute development throughout their degree program. Future developments will allow an overall diagram to be produced that combines a student's performance in a number of subjects, over a year or their whole degree.

Take in Figure (2) Willey & Gardner paper 2

For more details on the functionality of SPARKPLUS see Willey & Gardner (2010).

Take in Figure (3) Willey & Gardner paper 2

In an effort to increase both student engagement and the benefit received from using self and peer assessment processes we introduced a number of changes including.

1: extending our previous reported feedback process (Willey & Freeman 2006b). to focus on learning and not just assessment outcomes and providing a language to enable tutors to better explain both the value of using self and assessment and how to interpret the results.

Students are now actively encouraged by their tutors to view using self and peer assessment as a learning opportunity in which participation will not only assist them in developing their professional skills and provide feedback but help their team produce a better project.

After each student's SPA and SAPA factors are shared with all team members, groups are guided through a feedback process. This process begins with students sharing positive feedback with the focus not just being on what their peers did well but also on what they learnt from their peers. This is followed by a process of self evaluation where students share with their group what they have learnt or discovered about their strengths, weaknesses or performance from the exercise. Students are encouraged to identify how they could improve their own performance and in what way they would approach the task differently if they had to do it again. In the final stage of the feedback process students are asked to suggest how others in their group may have approached their tasks differently to achieve a better group result, how aspects of their peers' behaviour affected the team (highlighting the benefits to the group of any recommended behaviour changes) and to reflect on how their peers could have learnt more from the process. Furthermore, students are asked to share what they consider to be the weaker aspects of a peer's contribution and how this could have been improved.

The in-class discussion concludes by teams agreeing how to improve their overall team and individual performance for the remaining parts of the project and /or in future group work opportunities.

Whether this feedback process will prove effective in increasing the benefits that students receive from using self and peer assessment processes is the focus of ongoing research. However, our initial trials have been positive.

2: We used the new functionality of SPARK^{PLUS} to assign assessment criteria to one of three categories of graduate attributes that engineering students should develop during the course of their degree. To make the process relevant to students we chose to use the competency units from Engineers Australia Accreditation Policy (Engineers Australia, 2004) as the three attribute categories:

- Knowledge Base
- Engineering Ability
- Professional Attributes

Our intention being to focus students on ongoing learning, provide more detailed feedback, help students to identify their individual strengths and weaknesses and track their development.

Being a criteria-based tool SPARK^{PLUS} allows academics the flexibility to choose or create specifically targeted criteria to allow any task or attribute development to be assessed. However, consistently using common categories (like the three described above) 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 track students' development as they progress through their degree.

"Take in Figure (4) Willey & Gardner paper 2*".*

While we're currently investigating the impact of linking attribute categories to professional competencies we conducted an initial trial in Spring (second) semester 2007. The survey results from this trial are shown in Figure 4. The 'Strongly Agree' and 'Agree' responses were combined to give an aggregate result (SA/A), as were the 'Strongly Disagree' and 'Disagree' responses (D/SD). The percentage of any unanswered responses are generally not shown but can be calculated by subtracting the provided results from 100%.

We found students responded positively to the changes (89 respondents (35%) from an eligible cohort of 255, volunteered to complete the post subject survey). 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, while 71% agreed that the use of these categories helped them to identify and monitor their individual strengths and weaknesses.

In general for an innovation to be successful students must see it as being both useful and adding value to their education. Mindful of this, to increase student engagement, when this attribute tracking trial was introduced to students we discussed how they could use the results in their e- portfolios to demonstrate their competence to prospective employers. Like the successful graduates (Scott & Yates (2002)), employers are also aware that a student's skill level in generic attributes are a good indicator of how successful and valuable they will be as an employee. Despite this, the development of these attributes is not typically recorded in academic transcripts and in some cases, for example teamwork, may potentially be more fairly assessed by student peers. The inclusion of self and peer assessment to track students' development within different attribute categories is one method of providing evidence of this development.

Furthermore, we found that requiring academics to allocate their assessment criteria to different attribute categories has 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 and not just test the acquisition of knowledge. This was evident when some academics first implemented self and peer assessment processes like those reported in this paper. After initially trying to allocate their existing assessment tasks to different attribute categories in some cases they discovered that they were heavily weighted towards the knowledge category. Occasionally the methods used to assess this knowledge were in some sense testing a student's memory. Curiously while memory is rarely listed as a subject learning outcome it is often tested in assessment tasks. This realisation led to the innovative redesign of tasks to assess and hence better achieve the desired learning outcomes. In particular, in our case academics were challenged to design assessment tasks that had components that contributed to all three attribute categories. Assessment tasks have now been designed with the intention of promoting learning. Even end point assessments now more thoroughly test a student's application or ability to combine and apply requisite knowledge rather than just testing this knowledge itself.

After the appropriate practices and processes have been developed our ultimate aim is to provide students with two transcripts on graduation, one identifying their academic achievement and the second their professional attribute/skill

development. Respondents (65%) reported that this form of reporting would increase their motivation to address their weaknesses as they were identified.

9 Conclusion

While the reported data needs to be treated with caution as it was only collected during one semester, in one subject, it clearly contradicts our original hypothesis that a significant number of students who were neutral as to whether self and peer assessment improved their group work experience were probably members of well functioning teams. Instead the results indicate that the benefit students gain from self and peer assessment processes is more a function of how each individual student engages with these processes rather than how well their team functioned.

However we do find that there is potential for those in well functioning teams to benefit less from self and peer assessment processes with participation in a team with at least one poor team member providing students with learning opportunities (eg having to provide feedback on and / or resolve performance issues) that are denied members of well functioning teams.

We also find that some students focused on the free-rider deterrent aspect of using self and peer assessment. Typically these students did not take the opportunity to benefit more from both the reflective nature of self and peer assessment and the feedback it provides.

It is apparent that for students to receive the potential benefits from self and peer assessment processes we must do more to ensure all students, including those in well functioning teams, engage with the process.

As a first step we have changed feedback sessions to focus on learning and not just assessment outcomes. In addition preliminary trials suggest that student engagement will be 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 produce assessment tasks that promote learning and better access attribute competence.

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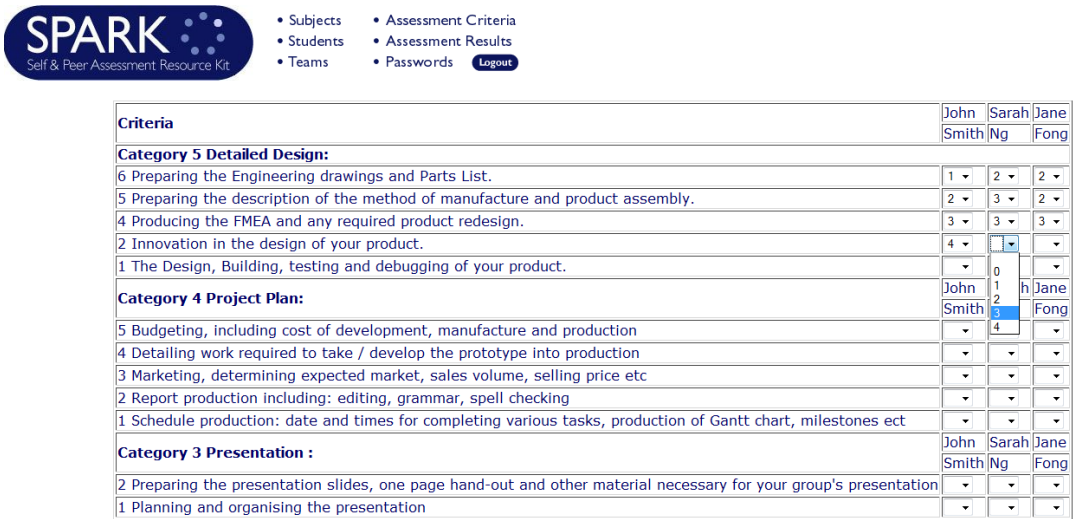
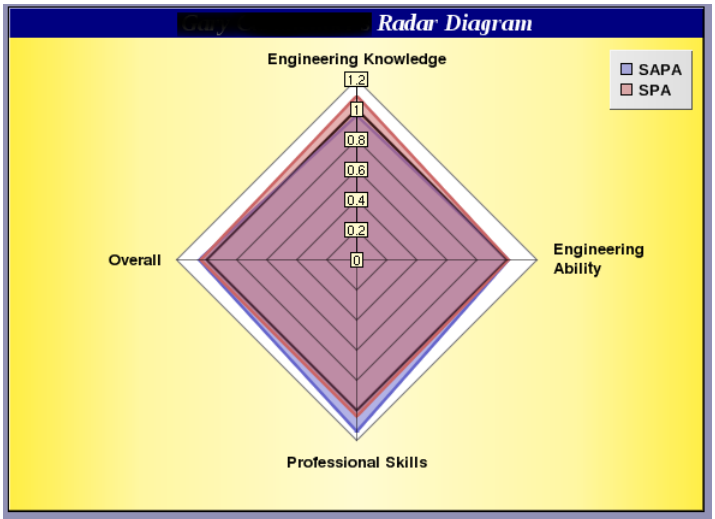


Figure 1: Partial screen shot of SPARK assessment screen, showing assessment criteria.

Figure 2: A student's SPARK^{PLUS} 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 3: SPARK^{PLUS} Student Radar Diagram reporting attribute categories with results table

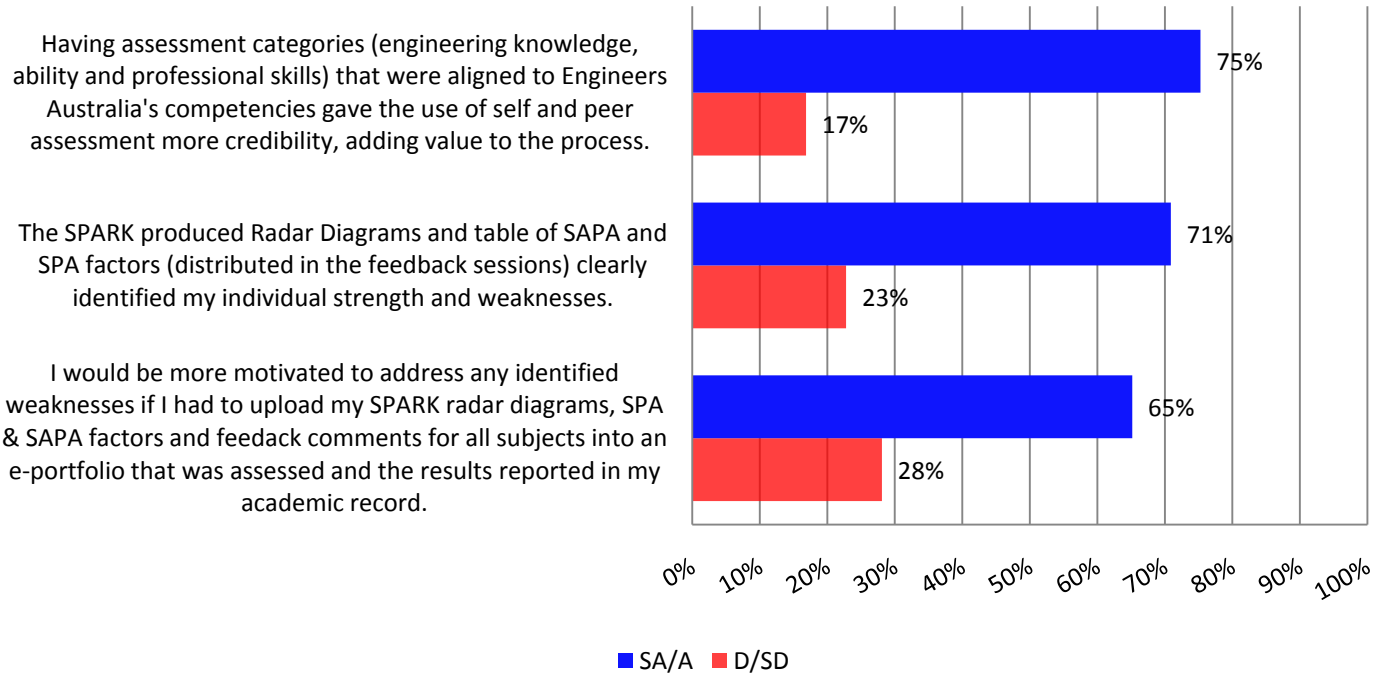


Figure 4: Results from the post-subject student survey Spring 2008.