SPARK[PLUS] for Self- and Peer Assessment on Group-Based Honours' Research Projects

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Abstract

This paper explores an application of an online tool SPARK[PLUS] (Self and Peer Assessment Resource Kit) for the self and peer assessment on the group-based Honours' research projects. The Honours' research projects in School of Civil, Environmental Engineering at University of Adelaide are running in a small group of students (typically four students or less) working with an academic supervisor in a selected area for one year. Since the research project is self-directed study, it is very difficult to fairly assess the contribution of individual students to the group-based research project. The paper-based method of self and peer assessment for the Honour's research projects was used in the previous years. The same mark was often distributed and no feedback was given. Both the students and academic staff were not satisfied with the paper-based method of self and peer assessment. Thus an online tool SPARK[PLUS] together with a set of assessment criteria was used for the self and peer assessment of the Honours' research projects in 2010. Thirty-seven groups participated in the self and peer assessment of using SPARK[PLUS] in semester one 2010 and a series of results from the online self and peer assessment were obtained and analysed. Feedback sessions were held and substantial feedback was received from students. Based on the feedback, suggestions were made on improving use of the online tool for self and peer assessment on the Honours' research project.

Introduction

There is a growing demand from industries and government agencies for students to graduate with skills of collaboration, communication, and the ability to work in teams in addition to being technically competent. Employers expect graduates to motivate themselves, and to make continuous assessments of their own contributions to a project as well as those of other team members. However, there is 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). Although team-based projects provide the opportunities for team interaction, they do not necessary facilitate the development of teamwork skills. To achieve the goal of development of teamwork skill, a method of assessment and effective feedback is needed; the self and peer assessment can potentially solve these issues. However there is a fundamental problem with self and peer assessment when all members of the group receive the same mark and feedback. Disregarding the quality and level of individual contributions can seriously undermine many of the educational benefits that group work can potentially provide. There are a few web-based systems such as Web-PA (http://webpaproject.lboro.ac.uk/) available recently for self and peer assessment and the Self and Peer Assessment Building Block in MyUni could also be used for enhancing reflective learning skills although the information about their use to improve teamwork skills might not be comprehensive enough. An online tool SPARK[PLUS] has been reported to promote teamwork in undergraduate students in recent years (Willey and Gardner 2009). SPARK was designed to reduce the limitations of paper-based systems and enable self and peer assessment of teamwork to be used with any number of students (Freeman and McKenzie 2002). The development of SPARK began in early 1996 and considerable improvement has been made since then. SPARK enables feedback not only for assessment of team contributions, but also for collaborative peer leaning and student engagement by linking student's development to the attribute categories required for accreditation in their profession (Willey and Freeman 2006; Willey and Gardner 2008; 2009). The students also reported that SPARK[PLUS] together with criteria that specifically assessed teamwork processes had encouraged team cooperation, commitment and increased engagement (Willey and Gardner 2009). SPARK[PLUS] has been recommended for use by MEA (Mining Engineering Australia, an educational consortium formed by the Universities of Adelaide, New South Wales, Queensland and Curtin University of Technology) mining programs. However, the online tools such as SPARK[PLUS] have never been trialled, evaluated and reported for use in group-based Honours' research projects before. Thus it is necessary to implement SPARK[PLUS] for self and peer assessment on the group-based Honours' research projects, and to rigorously evaluate its use.

Description of SPARK^{PLUS}

SPARK^{PLUS} is an online tool that assists participants in making their self and peer assessments by requiring them to rate each other over multiple criteria to produce Self and Peer Assessment data. These data will be used to provide feedback to, and receive feedback from, your group members regarding contributions to the project. Based on a series of answers from each group member SPARK^{PLUS} automatically produces both formative and summative weighting factors. The SPA (see equation 1) or Self and Peer Assessment factor is a weighting factor that can be used to determine an individual's contribution to a team-based project as shown in equation 2. A student who receives an SPA factor of 0.9 for their project contributions, reflecting a lower than average team contribution as perceived by a combination of themselves and their peers:

$$SPA \quad Factor = \sqrt{\frac{Total\ ratings\ for\ individual\ team\ member}{Average\ of\ total\ ratings\ for\ all\ team\ members}} \quad (1)$$

$$Individual\ mark = Group\ mark\ x\ Individual's\ SPA \quad (2)$$

The second factor calculated is the SAPA factor (equation 3). This is the ratio of a student's own self assessment rating compared to the average rating of their contribution by their peers. It provides students with feedback about how the rest of the group perceives their contribution. For example, a SAPA factor greater than 1 means that a student has rated their own performance higher than they were rated by their peers.

$$SAPA \quad Factor = \sqrt{\frac{Self - ratings\ for\ individual\ team\ member}{Average\ of\ ratings\ for\ individual\ by\ peer\ team\ members}} \quad (3)$$

SPARK^{PLUS} not only enables students to confidentially rate their own and their peers' contributions to a team project, but also allows students to self and peer assess individual work and improve their judgment through benchmarking exercises. 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. In addition, SPARK^{PLUS} facilitates the use of common categories, to which academics link their chosen criteria, providing a means for both academics and students to track students' development as they progress through their degree. SPARK^{PLUS} automates data collection, collation, calculation and distribution of feedback and results.

The idea of using SPARK^{PLUS} is not only to make group work fairer and provide feedback on your performance but to encourage the development of your professional and teamwork skills. These skills include giving and receiving both positive and negative feedback, conflict resolution, collaboration and communication, the ability to assess both your work and the work of your peers and enhancing students engagement.

SPARK^{PLUS} together with specific criteria is currently used in group project based learning in mining courses such as mine design projects in our school (see Fig. 1). These specific criteria used for self and peer assessment in design projects usually include four categories: Job performance, Leadership, Management and Communication. The Honours' research projects within the School of Civil Environmental and Mining Engineering are conducted in group-based research projects as opposed to individual projects and that's why the potential use of online tools such as SPARK^{PLUS} is significant in terms of training students to work as part of research teams and assessing each individual member contribution including feedback from peers. As SPARK^{PLUS} has proven to effectively promote teamwork in undergraduate students (Willey and Freeman 2006; Willey and Gardner 2008; 2009), it is worth studying its application for self and peer assessment of Honours' research projects. However, the specific criteria for group project based learning in mining courses might not be appropriate for group-based research projects.

Fig. 1 Partial screen shot of SPARK user interface

Application of SPARK[PLUS] on Honours' Research Projects

The Honours' research project in School of Civil, Environmental Engineering is one-year research project in a chosen area of specialisation. In this course students worked in Semester 1 in a small group (typically four students or less) to undertake and report on an engineering research project, and will continue throughout semester 2. An academic supervisor will work with the group and the final results will include an engineering report and a conference paper. The groups will also present their results to the class at the annual student conference, held within the School, and at other times as directed. Students are required to arrange one quarter of their time to do their projects. In 2010, there are 132 students forming 37 groups in the school doing Honours' research projects and 28 academic staff in the school have been involved in supervising these projects (typically one academic is involved in 3 projects including co-supervising). Because the research project is self-directed study and most of work is done outside of lecture hours, the contribution of individual students to the group-based research project is very difficult to be assessed fairly. The paper-based method of self and peer assessment for the Honours' research projects where students rated their peer's contributions and the averaged ratings were used to moderate marks to reflect individual differences have been used in the previous years and the same mark was often distributed and no feedback was given. Thus both the students and staff were not satisfied with the paper-based way of self and peer assessment. A few online tools such as Web-PA (http://webpaproject.lboro.ac.uk/), SPARK[PLUS] and the Self and Peer Assessment Building Block in MyUni have been proposed for self and peer assessment last year in our school meetings. Since the online tool SPARK[PLUS] has been used in our school for mining projects before and it is also comprehensive enough, it was decided after discussion during the school meetings last year that SPARK[PLUS] be trialled for the self and peer assessment of the Honours' research projects in 2010. This paper presents the results from Semester 1, 2010.

The criteria for self and peer assessment in SPARK[PLUS] for Honours' research projects in Semester 1, 2010 are listed in Table 1 and there are four categories with 14 criteria. Students rate each other over the 14 criteria from five scales, that is, above average (AA: 75-100), average (AV: 50-75), below average (BA: 25-49) and well below average (WB: 1-24) and no contribution (NC: 0) as shown in Fig. 2. SPA and SAPA values will automatically be produced after students input their ratings.

Fig. 2 Student rating screen of SPARK with criteria

Table 1 Self-and Peer Assessment Criteria

EFFICIENT FUNCTIONING OF GROUP	LEADERSHIP
1. Helping the group to function well as a team 2. Level of enthusiasm & participation 3. Organising the team and ensuring things get done 4. Performing tasks efficiently 5. Suggesting ideas 6. Understanding what is required	1. Chasing and co-ordinating 2. Deciding who does what and when 3. Integrating everything at the end to answer the problem
NUMBER CRUNCHING	WRITING REPORT
1. Analysis and cross checking 2. Data & formula entry and formatting 3. Finding out how to solve problem 4. Getting new data	1. Editing format, style, grammar, spelling etc. 2. Getting extra references & appraising their usefulness 3. Producing diagrams, figures, tables

Results and Discussions

All the 37 groups completed SPARK^PLUS assessment before due date on May 15 2010 (see Fig. 2). Typical self and peer assessment results for group X generated by SPARK^PLUS are shown in Fig. 3 and the detailed SPA and SAPA factors are listed in Table 2. These results indicate that overall Member 1 had the highest SPA factor and his individual mark would be 6% higher than the group mark while Member 3 received the lowest SPA score 0.87 implying that his individual contributions to this project would be far below average mark. Group members agreed that this reflects the way the team functioned. Also the SAPA factors for Member 3 and Member 1 in Table 2 are too high at 1.39 and 1.18, respectively; this indicates that they overrated themselves highly in comparison to how peers felt about their contribution. For Member 4, she received a score of 1.02 and 0.84 for SPA and SAPA factors, indicating that although she underrated herself significantly, her peers still felt that she had average contribution to the project. Thus self and peer assessment using SPARK^PLUS provides constructive feedback to students with both SPA and SAPA values.

Another important application of SPARK^PLUS is to provide feedback to all assessment criteria so that students can see how they rate themselves compared to the average rating they receive from their team peers to identify individual strengths and weaknesses. Weaknesses were evident in those criteria where a student received low marks from the self and peer assessment process. For example, Member 3 has weakness in Report Writing since his SPA score of 0.84 for Report Writing is the lowest compared to other team members. Therefore, he has to work on this graduate attribute and achieve a better result in the next round of SPARK^PLUS assessment. Providing feedback to identify student strength and weakness is actually the most important application of SPARK^PLUS to group based project learning. The results from SPARK^PLUS can be effectively used to improve team performance and achievement of graduate attributes.
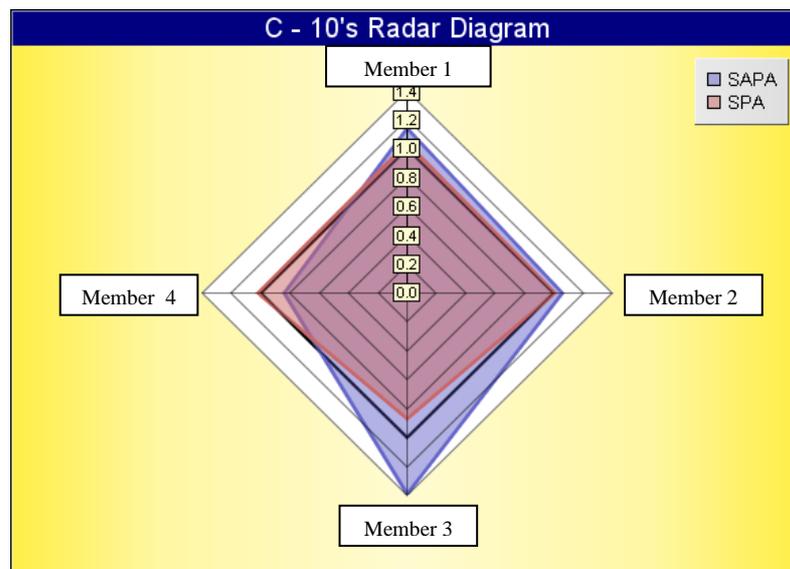

Figure 3 Radar diagram for Group A

Table 2: SPARK Ratings for Group X

Student	Efficient functioning of group		Leadership		Number crunching		Writing report		Overall	
	SPA	SAPA	SPA	SAPA	SPA	SAPA	SPA	SAPA	SPA	SAPA
Member 1	1.01	1.21	1.04	1.15	1.08	1.06	1.06	1.13	1.04	1.14
Member 2	1.03	1.04	1.02	1.01	0.95	1.1	0.97	1.09	1.01	1.06
Member 3	0.87	1.38	0.89	1.34	0.87	1.4	0.84	1.45	0.87	1.39
Member 4	1.02	0.82	1	0.88	1.01	0.89	1.03	0.77	1.02	0.84

However, SPARK[PLUS] results also indicated that out of 37 groups there were nine teams that sought to manipulate SPARK[PLUS] so that each member of the team got an SPA factor of 1.0 and, hence receive the same final individual mark. Fig. 4 and Table 3 show a manipulated radar diagram and SPARK[PLUS] ratings from the nine groups. The groups whose results are shown obviously manipulated SPARK to ensure that members of the team each got the same mark, i.e., individual mark = 1.0 x group mark. They all had the same SPA factor of 1.0 across all the criteria. Such an outcome is not realistic because each member of the team may have different strengths and weaknesses that should come out of the assessment. In this case, students felt that telling the truth would result in some of them having a lower individual mark after adjustment using SPARK[PLUS]. During feedback interviews students in the affected groups explained that they had to do that to ensure that each member of the team got the same mark. It was quite clear to us that students viewed SPARK[PLUS] as a tool to adjust the group mark to an individual mark at the end of the assessment period. It is true that the factors produced by SPARK[PLUS] are used to change group marks to individual marks, but this should not be the main function of SPARK[PLUS]. Once it was explained to the students that the purpose of SPARK is to help improve their group performance and individual achievement of graduate attributes set out in the criteria, their attitude changed and they were more prepared to embrace SPARK[PLUS] as a tool for self and peer assessment. This emphasised to us the need to explain the use of SPARK[PLUS] in assessment. Some students misconception of SPARK[PLUS] is based on their previous experiences were the tool was used to adjust the final mark to individual mark.
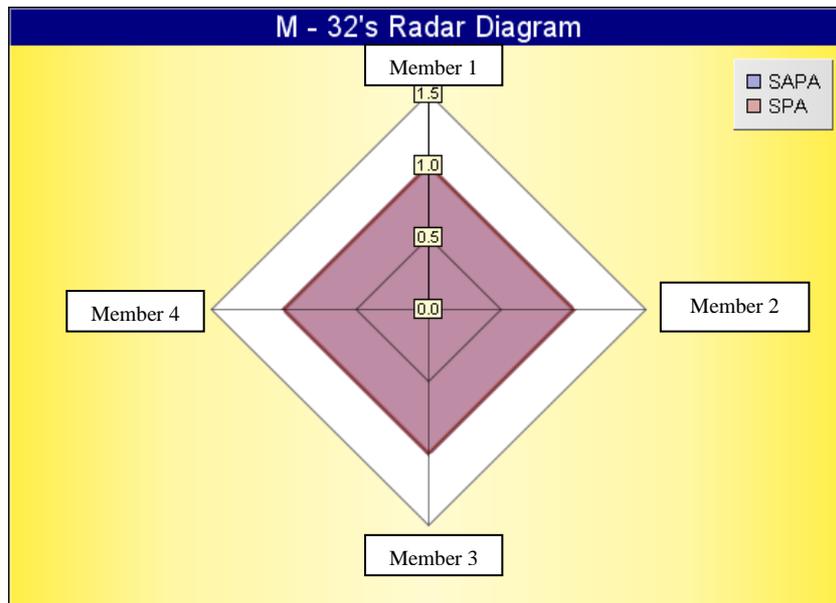

Fig. 4 Radar diagram for Group Y

Table 3: SPARK Ratings for Group Y

Student	Efficient functioning of group		Leadership		Number crunching		Writing report		Overall	
	SPA	SAPA	SPA	SAPA	SPA	SAPA	SPA	SAPA	SPA	SAPA
Member 1	1	1	1	1	1	1	1	1	1	1
Member 2	1	1	1	1	1	1	1	1	1	1
Member 3	1	1	1	1	1	1	1	1	1	1
Member 4	1	1	1	1	1	1	1	1	1	1

Improvements

Since it is the first time that SPARK[PLUS] was used for self and peer assessment on Honours' research projects, a lot of feedback has been received from students after completing their self and peer assessment using SPARK[PLUS] in semester one. Firstly many students immediately complained that there were too criteria and it was very difficult for them to rate themselves according to such detailed criteria. Secondly a lot of students said that only five minutes input into SPARK[PLUS] will determine how to distribute individual marks and results were not what they were expected. Thirdly no feedback sessions have been set for students to learn how to use SPARK[PLUS] and to interpret SPARK[PLUS] results. Based the feedback the self and peer assessment on Honours' research projects could be improved based on the above feedback.

The assessment criteria listed in Table 1 are based on teamwork in design projects or other projects to develop teamwork skills only and they need to be modified for group-based Honours' research projects. Thus a new set of specific criteria for group-based research projects have to be developed. A Research Skill Development (RSD) framework widely used in the University of Adelaide (Willison and O'Regan 2007) could be potentially used for the assessment criteria of the Honour's research projects. The RSD approach utilises the framework to monitor the development of detailed assessment processes which make it clear what research skills are being assessed, exactly how students show these skills in a particular project and what grades are associated with various levels of demonstrated skill. Therefore a survey for students rating assessment criteria from RSD framework for the research projects and the assessment criteria for teamwork used in MEA courses has to be conducted to develop unique assessment criteria for group-based research projects. A specific SELT survey on evaluation of SPARK for self and peer assessment with the assessment criteria for teamwork and RSD on Honours research projects was conducted on June 1st last semester and the collected data was processed and analysed. A set of unique assessment criteria based on specific SELT survey results have been developed (see Table 4). Then we had the students self-assess and peer assess their progress against the unique assessment criteria they established at beginning of semester 2 as exercising and the collected data are being processed and will be used to assess how well the team is collaborating.

Table 4 Unique Self-and Peer Assessment Criteria

Category 1 Research Skill Development	Category 2 Teamwork Skill Development
1. Embark on inquiry and so determine a need for knowledge/understanding 2. Find/generate /evaluate information/data using appropriate methodology 3. Organize information collected and synthesise and apply and analyse new knowledge 4. Manage the research process and awareness of HSW (Health, Safety & Wellbeing) issues	1. Coordinating, monitoring and communicating knowledge 2. Agreement, tolerance and encouragement 3. Research report write up - compile/edit/ 4. Participation, enthusiasm and an awareness of ethical social and cultural issues

Feedback sessions were held just after students completed the exercise in self and peer assessment based on the unique assessment criteria at the beginning of the semester 2. During the feedback sessions we explained to students that the main purpose of using SPARK[PLUS] is to help identify the strength and weakness of each member of the group against the unique assessment criteria, enabling academics to provide specific coaching to assist students to improve their performance in indentified areas of weakness, not just as a tool to alter individual marks of the group members. This self and peer assessment using SPARK[PLUS] also provides students the opportunities to practise and test what they have learnt from the feedback to modify their group behaviour and to improve subsequent

performance. Thus the self and peer assessment from SPARK^{PLUS} is not only for assessment of team contribution, but also facilitates collaborative peer learning, research ability and professional skill development. A group of students with manipulated SPARK^{PLUS} results said after feedback session 'we now understand that SPARK^{PLUS} is being used in this project as a feedback tool to monitor and manage graduate attributes and student participation and development. If we have understood this before carrying out our peer assessment, it would have been done in a much more accurate and useful manner.'

During semester 2 another exercising round of self and peer assessment of student progress against the unique assessment criteria will be conducted in mid-semester 2 (September) and feedback sessions will be held after collected data is processed and analysed. New SELT surveys on evaluation of SPARK^{PLUS} for self and peer assessment with the unique assessment criteria will be carried out mid-semester and end-semester. Training of academic staff and students will be conducted in mid-semester to ensure that they understand what is expected of them. It is believed that by running SPARK^{PLUS} a few times with the unique criteria and providing feedback a few times during the research project affords students an opportunity to reflect and modify their group behaviour or approach to the remaining part of the project and significantly improving their performance in the remaining stages of the project.

Conclusions and Future Work

The self and peer assessment using SPARK^{PLUS} with teamwork based criteria has been conducted on Honour's research projects in school of Civil, Environmental and Mining Engineering in semester 1 2010. Typical SPARK^{PLUS} results have been reported. It was found that the self and peer assessment using SPARK^{PLUS} provides constructive feedback to students with both SPA and SAPA and individual strength and weakness of group member can also be identified using the average rating they receive from their team peers. However, SPARK^{PLUS} results also show that many students just viewed SPARK^{PLUS} as a tool to adjust the group mark to an individual mark at the end of the assessment period, not viewed as a means for students to track their attributes development and demonstrating their competence to both teamwork and research, and definitely enhancing the students engagement on the research projects. After feedback sessions were given to students at beginning of semester 2, many students now know that feedback from SPARK^{PLUS} can be used to monitor and manage graduate attributes and student participation and development.

To improve application of SPARK^{PLUS} for self and peer assessment on Honours' research projects, future work will include:

- Running SPARK for self and peer assessment with the unique assessment criteria in mid-semester and end-semester;
- Conducting two specific SELT surveys on evaluation of SPARK^{PLUS} for self and peer assessment immediately after running SPARK^{PLUS};
- Providing feedback sessions to students immediately after running SPARK^{PLUS};
- Training of academic staff and students in mid-semester
- Developing guidelines using SPARK^{PLUS} for self and peer assessment on Honours' research project.

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