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IMPROVING TEAMWORK AND ENGAGEMENT: THE CASE FOR SELF AND PEER ASSESSMENT

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Abstract

There is a reported competency gap between the teamwork skills required by employers and those developed by engineering students during their undergraduate courses. While project-based learning increases the opportunities for team interaction, it does not necessarily produce the skills required to function effectively in a team. Students also report negative perceptions of project-based learning due to problems with free-riding team members. Appropriately supported assessment and practice activities must be included to motivate students to learn and develop these skills. We report the impact of introducing instruction (lectures), practice (team project) and more importantly assessment (rewarding individual contributions) to develop team skills. Oral team presentations have an individual component and the team mark for written reports is adjusted for individual contributions using self and peer assessment. A confidential online tool is used to collect and collate the student self and peer assessment ratings used both for formative feedback and improvement as well assessment purposes. The online collection of assessment ratings and their automated conversion to two assessment factors significantly reduced the administrative burden of using self and peer assessment with large classes. We found the method reported here improved student teamwork, engagement and satisfaction. In addition, it facilitated students supporting each other to develop their teamwork skills in an engineering context while requiring only a small commitment of academic resources.

Keywords: Self and peer assessment; SPARK; Online; Teamwork; Project based learning.

Introduction

The objective of this paper is to report the benefits to students and staff when self and peer assessment is used concurrently throughout a multi-staged teamwork project. Academics should find self and peer assessment, particularly if supported by the open-source software, an effective asset where a project-based curriculum is used to facilitate the development of teamwork. Thoughtful use will also address two major problems typically associated with team assessment [1, 2]. First, team members contributing inadequately, known as 'free-riders' or 'passengers', are usually not penalised because the same team mark is typically awarded to all team members. Second, without clear assessment criteria and supporting scaffolding, students typically experience team projects taking an excessive amount of time.

Background and motivation

Recent Australian government and OECD reports note that teamwork is a valuable attribute required by the professional community [3, 4]. Professional engineers require skills of collaboration, communication and the ability to work in teams [5, 6] in addition to being technical competent. Scott and Yates [7] 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. Others [8-10] note the competency gap between the teamwork skills required by employers and the level of teamwork skills developed by engineering students during their undergraduate courses. Team-based assessment projects are often used to develop these skills.

While such projects increase the opportunities for team interaction they do not necessarily facilitate the development of teamwork skills [8]. 'Teamwork doesn't magically happen' [11]. 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 [2, 11]. Leach et al [12] and Michaelsen [13] recommend students remain in permanent teams for the duration of a semester to allow them greater opportunities to progress through the stages of development to the point that they can be productive. In addition, if we are to successfully achieve teamwork as a learning outcome, we need a method of assessment that promotes such outcomes since 'from our students point of view, assessment *always* defines the actual curriculum' ([14], p. 182, emphasis added).

One teamwork strategy is to require students to work in their teams collaboratively in class. This is a useful solution to overcoming out-of-class teamwork problems, namely the temptation to submit a poorly integrated project resulting from a divide-and-conquer strategy and the temptation of some team members to be a free-rider [13]. However, students struggling under rising fees also may be tempted to miss classes because they are relying on paid part time employment. Furthermore, many academics prefer to use valuable class time to expand on the disciplinary concepts presented in texts and notes and therefore prefer (the majority of) teamwork to be completed out-of-class Thus, solutions to deal with out-of-class team assessments need to be developed.

It is often difficult for an academic to fairly assess the contribution of individual students to a team project since most of the work may have occurred outside of scheduled lecture or tutorial times. Accordingly, grading the contribution of individuals to a team task has increasingly been handed over to the team members themselves since they have the most relevant information [15]. In addition, to providing fairer assessment self and peer assessment is also reported as assisting students to develop important professional skills including developing student's reflective and critical skills.[16] [17]. Lejk et al [18] surveys a number of the different methods of deriving individual grades from team assessments. Typically team members evaluate themselves and or each other. This evaluation is then incorporated into an individual student's assessment either as an addition to the team assignment mark or by adjusting the team assignment mark to produce an individual mark that reflects a particular student's contribution [15].

An example of the latter was developed by Goldfinch and Raeside [19], and extended by Goldfinch [20]. Here students rate their own and their peers' contributions to a team project and these ratings are used to adjust summative teamwork marks into individual summative marks. Johnston and Miles [15] find students have a self-bias in their ratings. Lejk and Wyvill [21] find that more able students assess their own contribution as lower self assessments than their less able peers' self assessments. To obtain fair assessments students need to understand the assessment criteria and these criteria need to cover relevant aspects of the team project. This may be facilitated by involving the students in the generation of the criteria. Biggs [22] reports that this also has the advantage of increasing student engagement. The contribution of an individual student may include the completion of tasks required for the team assignment, or relate to implicit processes that improve the outcomes of the team project such as being inclusive and encouraging of others. All students in a team would rate their own and their peers' contributions against the criteria which is then used to calculate an adjustment factor for each individual member that can be applied to the team mark.

There are two additional challenges with the use of self and peer assessment. First it is time consuming to collect the ratings and enter the data for subsequent calculation. This is especially a problem in large classes typically experienced in core engineering subjects. This may explain why despite a well-documented history [19, 20] of applying self and peer assessment in higher education it is not frequently considered in engineering contexts where the administrative burden of applying self and peer assessment in large classes might outweigh the perceived benefit. A second challenge is that students' have concerns about the privacy of their ratings especially when ratings relate to summative assessments of peers. When completed in class there is a greater chance of their confidential ratings being at risk of discovery, for example while papers are being collected or even while being completed.

Freeman and McKenzie extend Goldfinch's approach by developing a confidential online tool called SPARK (Self and Peer Assessment Resource Kit [23, 24]) to collect self and peer ratings and to calculate an adjustment factor for every student. SPARK is an open-source software package that has four main benefits. First, it solves most of the administrative issues associated with paper-based approaches such as data collection and analysis. More importantly, SPARK enables students to confidentiality rate their own and their peers' contributions to a team project. Confidentiality is achieved by allowing data entry of self and peer assessment ratings online, at any time during a rating period. Online data collection reduces the chances that ratings will be inadvertently revealed through carelessness compared to a paper-based approach. A rating period allows students if necessary to modify their initial ratings following further reflection or improved conditions (eg. away from peer pressure). Third, students are assisted in making their self and peer assessments by a requirement to rate each other over multiple criteria which can include specific project tasks as well as good team practices. The use of multiple assessment criteria relating to different team tasks can be used to minimize the likelihood of the most recent task dominating perceptions of who did the work and how well it was done. Fourth, SPARK automatically generates both formative and summative assessment factors. This information not only motivates improved project outcomes because students realise individual contributions matter, but also enables students to improve their generic teamwork and critical evaluation skills.

SPARK automatically produces two weighting factors. The SPA or Self and Peer Assessment factor is a weighting factor that can be used to change a team mark for a project (stage) into an individual mark.

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

Individual mark = team mark * Individual's SPA

For example, if a team's project mark was 80 out of 100 and a team member receives a SPA factor of 0.9 , they would receive an individual mark of 72 to reflect a lower than average team contribution as perceived by a combination of themselves and their peers. Alternatively, if not used to moderate summative assessment the SPA factor can be used formatively to assist student development.

The second factor calculated is the SAPA or Self Assessment to Peer Assessment factor. It is the ratio of a student's own rating of themselves compared to the average rating of their contribution by their peers. This has strong feedback value for future development both for self-critical reflection and peer evaluation.

$$\text{SAPA Factor} = \sqrt{\frac{\text{Self ratings for individual team member}}{\text{Average of ratings for individual by peer team members}}}$$

It provides students with feedback about how the rest of the team perceives their contribution unsullied by their own opinion. For example, a SAPA factor greater than 1 means that a student has rated their own team performance higher than they were rated by their team peers. Conversely, a SAPA factor less than 1 means that a student has rated their own performance lower than they were rated by their peers.

In this paper we report the use of this tool to facilitate confidential self and peer assessment to focus students' efforts to learn and practice the skills required for teamwork and produce improved team outcomes. Freeman and McKenzie caution that SPARK must be carefully implemented to extract these benefits including the discouragement of the free-rider concern and fairer assessment.

Method

Electrical Engineering Design is an undergraduate engineering subject at the University of New South Wales. We chose to modify the subject and the assessable teamwork component to address the problems experienced in previous semesters similar to those raised by Mills and Treagust [1] (free-riders and excessive time requirements) and to address the teamwork skills competency gap [8-10]. The team-based project involves developing a unique product from initial concept to the production of a prototype.

Several changes to develop teamwork were made to the subject including:

- Teamwork instruction and practice. Students were given instruction on team work skills and how to both give and receive feedback with opportunities to practice these skills.
- Planning and reporting teamwork processes. When developing their project plan a team is encouraged to distribute the work among team members (giving consideration to their individual abilities). Each team records minutes from regular team meetings where progress is discussed and team issues considered. In addition, all students are required to complete three short online progress reports collected using the survey questionnaire feature of the University's learning management system (WebCT) [25]. Together these are available to resolve any disputes that may arise regarding an individual's performance.
- Larger teams. Team size was doubled to four to allow for a fuller experience of team dynamics and the development of the appropriate teamwork and communication skills. While larger

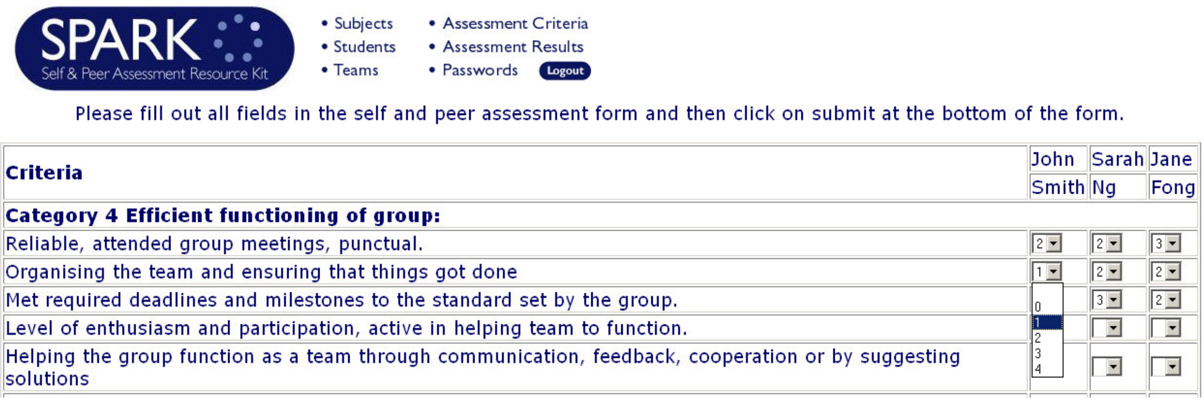
teams could not be accommodated given the existing laboratory facilities and scale of project, they may have introduced additional logistical burdens such as arranging meeting times.

The following changes were made to align assessment to the desired learning outcomes:

- The project had three stages. Two of the assessment tasks were written team reports (worth 12% and 13% respectively). To reflect a typical industry experience the first report included a project proposal, requirements analysis and system design while the second report contained the detailed design, production and manufacturing requirements including a costing and marketing analysis. The third assessment task was a team oral presentation (worth 15%) made to a fictitious group of managers, comprising students and staff, demonstrating a functioning prototype and making a business case for funding.
- Each stage had some individualisation for assessment. The oral team presentations were followed by individual questioning. This allowed students to be marked individually on both their presentation skills and technical knowledge. The team marks for the two written team reports were individualised by applying self and peer assessment.
- Self and peer assessment using SPARK was implemented to produce individual marks from the team mark received for each written report. The SPA and SAPA factors were generated from a number of criteria relating to different aspects of the project.
- Students participated in setting the assessment criteria (used by the whole class) via an online discussion forum allowing the students some ownership of the assessment.
- Assessment criteria related both to specific engineering project tasks and importantly to team maintenance and team building. The latter criteria are intended to provide additional encouragement for students to work as a team. These criteria included:
    - Helping the team function effectively through communication, feedback, cooperation or by suggesting solutions
    - Organising the team and ensuring that things got done
    - Reliably and punctually attending team meetings, laboratory sessions and team-agreed deadlines and milestones to the standard set by the team.

A screen shot showing a number of the criteria is shown in figure 1.

Figure 1: SPARK screenshot showing a number of the criteria relating to team maintenance.


SPARK
Self & Peer Assessment Resource Kit

- Subjects
- Students
- Teams
- Assessment Criteria
- Assessment Results
- Passwords

Logout

Please fill out all fields in the self and peer assessment form and then click on submit at the bottom of the form.

Criteria	John Smith	Sarah Ng	Jane Fong
Category 4 Efficient functioning of group:			
Reliable, attended group meetings, punctual.	2	2	3
Organising the team and ensuring that things got done	1	2	2
Met required deadlines and milestones to the standard set by the group.	0	3	2
Level of enthusiasm and participation, active in helping team to function.	1 2		
Helping the group function as a team through communication, feedback, cooperation or by suggesting solutions	3 4		

In-class opportunities to discuss the SAPA and SPA factors encouraged students to further develop their subsequent contribution and improve the team's ability to produce a better project outcome.

To research the impact of the revised learning and assessment strategy, data was collected in two ways. Students provided data via a number of online feedback surveys over the semester. These incorporated 5 point Likert scale statements, demographic data and free-response comments. In addition, the coordinating academic maintained a reflective journal. This contained details and reflections on experiences, anecdotal student feedback and reflections following regular interactions with an experienced academic developer familiar with the software.

Results

Of the 180 students (28 female), an average of 140 students participated in the surveys. 98.5% of the respondents were full-time students, 99% being under the age of 25.

Student preconceptions of teamwork

Table 1 contains student views of teamwork prior to commencing the subject. The greater majority (78%) agreed that teamwork provides synergistic benefits. However, a significant majority (54%) indicated that they disliked it because previous free-rider experiences were not penalised.

Table 1: Student preconceptions of teamwork.

Statement	Disagree (Strongly)	Neutral	Agree (Strongly)
I like group work, as I benefit and learn from the opinions and skills of others	5%	17%	78%
I don't like group work, as in my previous experience the members putting in the most effort get the same mark as those who contribute less to the work	18%	28%	54%
In my previous group work it has been common for some group members not to pull their weight (not to do their share)	15%	15%	70%
I don't like group work as you have to deal with conflict between group members	38%	31%	32%

Revised student perceptions of teamwork

Table 2 contains student post-experience perceptions of teamwork.

Students responded positively to their teamwork experience that incorporated a holistic approach to learning and assessment activities. 80% indicated that the project had enabled them to develop teamwork skills. Overall 49% of students indicated that their teamwork experience had been improved by using SPARK. 51% agreed that SPARK helped make teamwork fairer and 56% agreed that it encouraged otherwise non-performing team members to put more effort into their assigned project work. Relevant criteria and the ability to rate them confidentially are clearly important (75% and 65% respectively).

Table 2: Student perceptions of teamwork after experiencing a holistically integrated teamwork learning and assessment strategy.

Statement	Disagree (Strongly)	Neutral	Agree (Strongly)
The project has enabled me to develop skills necessary for working as part of a team	4%	14%	80%
Knowing that questions would be asked in the oral presentation encouraged team members to learn about all aspects of the project.	10%	14%	75%
Overall my group work experience has been improved by using SPARK	16%	35%	49%
Compared to my previous experience with group work at University, SPARK has made group work fairer	14%	34%	51%
Using SPARK (that allows individual marks for group work) has encouraged otherwise non performing group members, to put more effort into their assigned work for the project	14%	29%	56%
I found using SPARK improved my ability to assess both my work and the work of other group members	11%	26%	62%
The fact that self and peer assessments can be entered confidentially is important to the success of SPARK.	7%	19%	75%
It is important that students participate in generating the assessment criteria used by SPARK	7%	28%	65%
Methods for resolving conflict within a team environment should be taught in my engineering course at university	9%	15%	76%

Discussion

Effects on students

Team skills are important for working engineers. Although most engineering degrees include assessable team-based projects, we found that in general students possessed little if any knowledge about the key skills required to successfully work in teams. A strategy of instruction (lectures), practice (team project) and assessment (rewarding individual contributions) motivated the development of team skills.

We maintain that without appropriately aligned assessment our objective would not have been achieved. Students' reported that the inclusion of an individually-marked oral presentation motivated them to learn all aspects of the team project and not just focus on their individually-assigned tasks. However, it was the introduction of self and peer assessment via SPARK that proved to be of considerable benefit in promoting the development of teamwork skills. Most students reported that they thought SPARK had not only made their teamwork fairer but that its presence had encouraged team cooperation, commitment and increased individual student engagement. In the free-response comments and anecdotal feedback students commonly reported SPARK provided an incentive to work both diligently and continuously throughout the semester. This was typified by the following comment.

> *'SPARK forced me to consider my own contribution to the group and make sure I was pulling my weight. The criteria worked well and my group received marks very close to what we all expected without any attempts to engineer our marks.'*

Consistent with Freeman and McKenzie [23], confidentiality was greatly valued by the students with 75% agreeing that it was important to SPARK's success. Students also reported that the fact that SPARK included assessment criteria relating to team maintenance, that is how well team members cooperated and resolved conflict, encouraged them to resolve their own problems rather than seeking academic intervention.

As previously reported students were encouraged to participate in setting the assessment criteria (used by the whole class) via class discussions and an online discussion forum. This was designed to increase student engagement as reported by Biggs [22] and to facilitate students familiarity, understanding and promote a common interpretation of the assessment criteria. Rust et al [26] report that this engagement assists in developing student understandings of the assessment criteria and their application. While students appeared to have a good understanding of the assessment criteria (due to interactive class discussions), we found that on the first use of SPARK their engagement and involvement in setting the criteria was limited. However, after submitting their first assessments and hence actually having to use the criteria to assess themselves and their peers, students were much more actively involved in setting the criteria for the second SPARK assessment. Their main concern was to ensure that the criteria accurately and unambiguously reflected the required team tasks.

One unexpected benefit from providing students with the SAPA factor in the early stages of the team project, was that students reported it encouraged them to be more realistic and honest in their own self assessments. The potential embarrassment of receiving a SAPA factor much higher than 1.0 appeared to be a motivating reason in achieving this. Further investigation is warranted into both why students chose to release factors to team peers, although there was no requirement and the resulting impact on student honesty.

Another side effect of using self and peer assessment with well-chosen criteria made available early in the semester, was that students immediately focused on team dynamics and outcomes, resulting in time efficiencies. One student commented that the criteria '*set a pattern from the beginning of session so that everyone KNEW that they had to pull their weight*'. Students reported that compared to their previous teamwork experiences, less time was wasted for example by non-attendance at meetings or chasing the free-riders to complete their assigned task. This addresses in part the student concerns that project-based learning takes an excessive amount of time [1].

There were some student concerns with the use of SPARK for self and peer assessment. Some of these were related to the software (eg. prior submissions need to be re-entered rather than simply edited if students wished to change their initial ratings) and others were related more to the theory behind the programming of SPARK. The main example of the latter relates to the calculation for the SPA factor used to convert the team mark to an individual mark. A number of students expressed concern that SPARK has a normalising effect on student assessments as perceptions in differences are square rooted in the calculation. For example, even if one student made a relatively greater contribution over a number of project team tasks included in the assessment criteria, they only received a comparatively modest increase in their individual mark compared to the marks received by the other team members. Conversely, unless a student completely failed to contribute across a number of team task or maintenance criteria, they would not receive a large penalty compared to the individual marks received by the rest of their team. While this may be true, we believe that using a more linear transformation that produced a wider distribution of marks may only serve to emphasise competition amongst team members at the expense of collaboration.

Another feature students would like included to improve their learning relates to the level of feedback possible with SPARK. Many students commented that SPARK would be more useful if it provided more detailed feedback than just the current limitation of the two aggregate (SPA and SAPA) factors. One student commented for example that SPARK could be improved by allowing *'team members to view more detailed … results, so that they can improve on weaknesses perceived by rest of group'.* For example a student may wish to know how their peers perceived they perform in a particular aspect of teamwork. While this was assessed in the criteria, the SPA and SAPA factors provided are generated using all the criteria and represent an aggregate response. While the software allows for some criteria to be left out of the calculation (called prompting criteria), aggregates of subset criteria are currently not possible. This means students are unable to receive explicit indication of how well they performed in any particular criterion or set of criteria that may reflect a particular skill set. This limitation may be mitigated by encouraging peers to provide such feedback during in-class discussion of factors or during regular team meeting.

A small number of students reported that they thought that the inclusion of self and peer assessment was stressful and that it had the potential to generate conflict between team members. One student commented that self and peer assessment *'destroys the sense that 'we are all in this together' as people get marks at the expense of others'.* Pope [27] finds that 'students undergoing self and peer assessment report higher levels of perceived stress than students undergoing faculty marking only'. This stress may result from a number of factors including inexperience, the fear of hurting or being hurt by team peers. The relationship between these increased stress levels and the reported increase in student performance as a result of using self and peer assessment is unclear [27]. However, students should be forewarned that they may experience increased stress during the self and peer assessment process. We maintain that to encourage development of the full range of teamwork skills, students should be prepared by providing instruction and practice in teamwork, conflict resolution and giving and receiving feedback before undertaking self and peer assessment for the first time. Students responded positively to this suggestion with 76%

agreeing that conflict resolution should be taught in their engineering course at university.

Overall changing the format of the project to be more practice-based and aligning assessment to achieving teamwork learning outcomes, especially supported by the introduction of self and peer assessment via SPARK, was highly successful.

Effects on academics

In most instances the methods reported in the literature [28-30] for applying self and peer assessment are not practical for large classes (> 150 students). As academics' are continually being asked to do more with less, the implementation and administration burden of including self and peer assessment needs to be considered. The introduction of SPARK allowed the coordinating academic to reap the rewards of including self and peer assessment as part of a pedagogical course redesign without the administrative burden or additional resources that would be required doing it manually. In addition, SPARK yielded other academic efficiencies for example, the coordinator had to spend relatively little time acting as an arbiter in disputes between team members – a task that had previously been very time consuming. This can probably be attributed to both the inclusion of instruction on the different aspects of teamwork and the inclusion of explicit criteria to assess these skills. This assessment provided incentives for teams to apply these skills to resolve teamwork issues independently.

However, while self and peer assessment appeared to add real value to the team project experience, there were several limitations in using the SPARK software. Some were of a technical nature that could be improved with future revisions of the software. For example, there were frequent requests from students to renew passwords they had forgotten. This process could be automated. Other concerns raised by students related to a desire for more flexibility such as the ability for teams to have different criteria. This could be achieved by using a limited number of SPARK criteria with generic labels allowing each team to apply their own interpretation.

A more serious problem that may arise relates to the reliability of the SPARK output. Like any process, the quality of the output depends on the quality of the input – in this case student honesty with their ratings. A typical comment provided by one student about this was *'The system relies on honesty from the participants. If one or more of the group* *members try to sabotage the system by giving outrageous marks, intervention is required'.* This problem exists whether an online tool is used or not [15, 31]. In the case reported here, the coordinator took some steps to authenticate the ratings produced by the first use of SPARK. Any student with a SPA factor less than 0.8 or with a SPA factor less than 0.85 and a (SAPA – SPA) factor greater than 0.4 resulted in the student and their team being interviewed one member at a time. These interviews were to check the validity of these ratings and determine if discrimination or sabotage had deliberately occurred. In the seven cases that met this requirement the low SPA factors awarded were warranted. Five of the students admitted to not making a fair contribution. The remaining two students claimed that they deserved a better rating but were unable to produce any evidence to support their claims.

While not a specific focus of our research we believe the high level of academic honesty reported here was in part due to the fact that before using SPARK students were made aware that any anomalies would be checked to determine if deliberate sabotage had occurred. Another contributing factor was the potential embarrassment of receiving a SAPA factor much higher than one. We should stress that this was also the first time that any students at the University had used SPARK and subsequent uses may provide opportunities for students to develop sabotage strategies. Interesting, when SPARK was used again (to assess the second report) there appeared to be several instances of poor students inflating their self assessments which is consistent with other research [19]. Being the end of the semester, there was no opportunity to interview students or a second opportunity for students to share their SAPA factors. Whether this contributed to these inflated ratings is the focus of ongoing research. The SPARK developers are currently considering changes to the program to reduce the chances of undetected sabotage occurring as proposed by [32].

While SPARK assists tremendously with the administrative burden of self and peer assessment, it is not a hands-off process that will automatically produce benefits if introduced [23]. Thought must be put into the subject design. For example the coordinator made efforts early in the semester to discuss the purposes and usefulness of using self and peer assessment with students to elicit their engagement. Further engagement was achieved by actively negotiating the criteria. Finally, the need for good teamwork was promoted and reinforced throughout the life of the project during lectures, laboratories and in the online environment. Although this research was completed using SPARK version 1, it is still somewhat cumbersome and requires a little patience and perseverance to implement successfully. A newer version currently under development will be more user-friendly and provide additional features including more comprehensive formative feedback. Notwithstanding these technological limitations, the concept of computer-assisted self and peer assessment remains clearly beneficial.

Conclusion

The ability to work effectively in a team is a highly desired attribute to succeed as a professional engineer. Undergraduate courses often use team-based projects to provide opportunities for peer learning and encourage students to develop teamwork skills. However, these outcomes will not automatically happen without careful pedagogical planning, including the appropriate orientation of assessment. A common problem of team-based projects arises when free-riders that contribute less are awarded the same result. This has negative consequences for students' experiences, the development of teamwork skills, and for staff who may need to intervene to resolve conflict arising from free-riders.

In this paper we report on the use of a multi-staged project redesigned to include the development of teamwork skills in engineering students. To achieve this we found that students not only needed instruction on teamwork skills and opportunities to practice these skills, but also a tightly designed and motivating assessment regime. Self and peer assessment was facilitated by an online tool called SPARK. This made it possible to implement self and peer assessment in a large class without the administrative burden required of paper-based approaches. We found using SPARK not only motivated students to develop teamwork skills but also addressed their concerns regarding free-riders and time demands. Of particular value in achieving this successful outcome was the combination of confidentiality, multiple and appropriate assessment criteria, and the availability of both summative and formative feedback obtained using SPARK.

This research builds on previous work investigating the usefulness of self and peer assessment, and in particular that relating to using SPARK [23]. SPARK facilitated our use of formative scaffolding to support summative self and peer assessment to encourage the development of teamwork skills in engineering students. While the major limitation of this research relates to the sample, namely it is based on work in one subject during one semester with a single academic, the results are positive and support previous findings in other disciplines. Teamwork skills can and should be developed by potential engineers during their studies. This paper provides a basis for future research to both confirm our findings and produce further enhancements. Without further research the development of core generic skills in engineering students will be inadequate. The profession is too important for this to be left to chance.

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