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THE POSITIVE EFFECT OF PEER FEEDBACK IN AN ENGINEERING GROUP PROJECT

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Abstract

In a Mechanical Engineering Capstone Project where students work in project teams, a peer assessment is carried out where each student is required to assess each of their team members' performance. The peer assessment is a rating tool that used numerical values of 0 - 10 for five areas of assessment. Each student had to complete this assessment for each of their team members. It was later decided that a compulsory feedback section should be added to enable the instructor to evaluate the team dynamics. Initially this feedback was intended for the instructor's own use. Upon reflection, it was decided that the feedback should be made available to each student without revealing which team member gave them which feedback. This anonymity allowed for greater honesty with the intention of fully exploiting the learning opportunities inherent in this exercise. The impact of their peers' feedback on the students was evaluated through an open-ended survey. The result revealed the positive impact of peer feedback.

Keywords: Capstone project, Mechanical engineering, Peer feedback.

1. Introduction

The Mechanical Engineering Group Project (MEGP) is a core module in the B. Eng. (Hon) Mechanical Engineering programme offered at Taylor's University School of Engineering (SOE). It is an engineering capstone project conducted over two consecutive semesters comprising of Mechanical Engineering Group Project 1 (MEGP1) and Mechanical Engineering Group Project 2 (MEGP2). It requires students to work in project teams to conceive, design, implement and operate complex value-added engineering systems [1]. The offering of this module is consistent with the requirements mandated by the Engineering Accreditation Council (EAC) regarding the need for a complex design project [2].

The combined learning outcomes (LOs) of MEGP1 and MEGP2 map to all of the programme outcomes (POs) of SOE's B. Eng (Hon) Mechanical Engineering programme. In view of this the assessment components of the MEGPs are carefully crafted to ensure that they facilitate the attainment of the LOs which in turn ensured the attainment of the POs. One of these LOs states that the students are expected "to demonstrate effectiveness as a team member and/or team leader", being derived from the PO that states that students are required to "function effectively as an individual and in multidisciplinary settings with the capacity to be a leader". The assessment method chosen to measure this LO's attainment is the Peer Assessment because it was decided that only their peers in the same project team can best assess a student's attainment.

The Peer Assessment employed in MEGP is a rating tool that uses numerical values of 0 - 10 for students to assess their peers in their project teams in five areas of assessment. These five areas where the students are as follow:

i. Contribution
ii. Problem-solving
iii. Attitude
iv. Focus on task
v. Working with others

The Peer Assessment contributes 5% to the entire module. The Peer Assessment score is not revealed to the students so as not to place undue pressure on the peer assessors. It was later decided that in addition to the numerical scores, a compulsory written feedback section should be added. Initially this feedback was intended for the module coordinator's own use in assessing the team dynamics. Upon reflection it was decided that the feedback should also be made available to the students but without revealing which team member gave them. It was anticipated that there was a great learning opportunity to be found in this, that honest feedback from peers working together in the same team would prove to be very helpful to a student's personal development.

The current literature on the use of peer feedback in an educational setting focusses primarily on the assessment of peers' academic work. These peer assessments may be either formative or summative although the formative is more common. Such feedback whether they are confirmatory, suggestive, or corrective were considered to have positive effects on learning if they were received thoughtfully and positively by the intended recipients [3].

It was not only the students receiving feedback that benefitted from peer feedback but the students who gave feedback also benefitted from giving feedback. This is because it helped them to learn better in the subject matter where they gave feedback to their peers [4]. It was shown that active engagement by students in reviewing their peers' projects and assignments facilitated these students' own learning [5, 6]. In addition, in the process of giving feedback the students could also acquire other fundamental graduate skills important in professional life beyond university [7].

While giving and receiving feedback were important, it was also crucial to understand what influences a recipient to act on the feedback received. In a study on the peer feedback of writing, it was found that two factors influenced students to act on peer feedback. These factors were overall praise and location, i.e. the specific location of the issue [8]. This same study also found that while overall praise motivated students to implement feedback, nonetheless mitigating praise, which is praise used to mitigate a criticism, had the opposite effect. Hence identifying an issue accurately, its specific location, as well as genuine praise appeared to be the primary motivators for the recipients to act peer feedback.

A study found that the differences between peers' and tutors' feedback were not significant especially in some areas such as offering advice [9]. Other studies found that students considered peer feedback helpful especially in English writing [10, 11]. This observation was also true for pre-service teachers [12]. Hence peer feedback is generally seen as helpful by its recipients.

The above literature focused on peer review and/or peer feedback on academic work rather than on teamwork. Nonetheless it may be useful to consider them as some of these findings may also be applicable to the teamwork context that this study address.

While there is much literature regarding peer review in the context of academic assignments, the literature for peer review on teamwork is significantly scarcer. One study conducted on Merchandising Management undergraduates found that peer evaluations was a significant predictor of attitudes towards teamwork [13]. This was because it allowed students the opportunity to report if they did a fair amount of work or if another team member did not, and that it also served as an opportunity to communicate any negative aspects of a team experience to the instructor. The effect is that this helped reduce their frustration. Nonetheless this study did not mention about making the peer feedback available to the students for their improvement. The study was about using the peer evaluation as a rating tool and whatever feedback given was only for the instructors' knowledge.

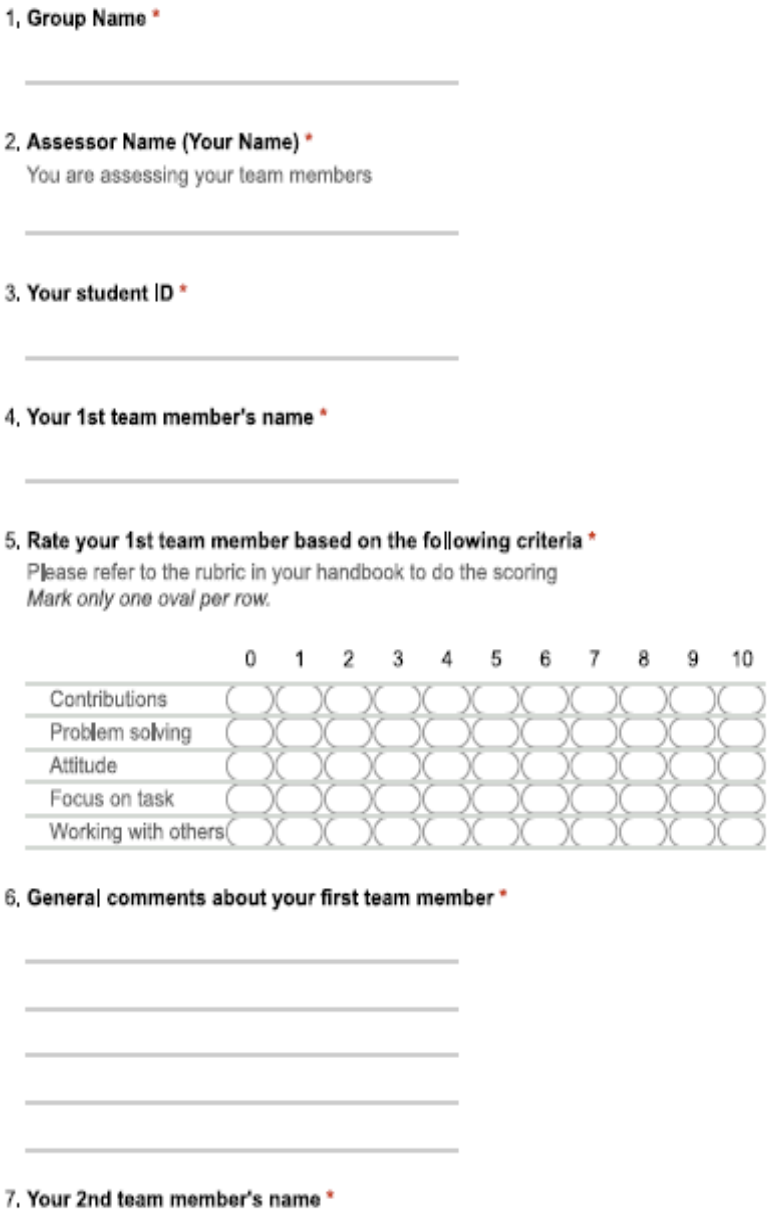
Since the current literature is predominantly about peer feedback on academic assignments rather than on the performance of the students working together in the same team, this presented a gap that this study could investigate. The question posed is about how peer feedback when it is made available to students working on the same team help in their personal development. The context in which this study is situated is the mechanical engineering capstone project.

2. Methodology

The Peer Assessment considered in this study was conducted at the end of the MEGP1 semester when the students already had one full semester to work together.

The feedback obtained through the Peer Assessment was compiled by the module coordinator and was given to the students when they returned to start MEGP2. The students were allocated sufficient time to digest the peer feedback after which a survey was conducted to obtain their responses to the feedback using Google Form.

Figure 1 shows a section of the Peer Assessment. It has a feedback section at the bottom as can be seen in item 6 of the form.



1, **Group Name** *

2, **Assessor Name (Your Name)** *
You are assessing your team members

3, **Your student ID** *

4, **Your 1st team member's name** *

5, **Rate your 1st team member based on the following criteria** *
Please refer to the rubric in your handbook to do the scoring
Mark only one oval per row.

	0	1	2	3	4	5	6	7	8	9	10
Contributions											
Problem solving											
Attitude											
Focus on task											
Working with others											

6, **General comments about your first team member** *

7, **Your 2nd team member's name** *

Fig. 1. A section of the peer assessment form.

Figure 2 shows one sample of peer feedback for a student. The name of the peer assessor was not revealed to the feedback recipient.

Team Member A receiving feedback	Giving feedback
He is the most versatile team member I have ever had since he is always the one who unites the team together while doing project. Although some people may think that he did not contribute much to the team, he actually does while others are not looking. He usually does his work solo while others are still contemplating the difficulties. He will always show up when the team needs him the most.	Member B
Brings a unique perspective to team as the issue we are tackling is close to home for him.	Member C
Generates ideas during discussion and always volunteers to finish up the task.	Member D
Came up with a lot of good ideas during the conceiving stage of the project. He was the one who steered us towards building a robot for flood situations as he was affected by the floods in 2014-2015.	Member E

Fig. 2. A sample of peer feedback.

An open-ended survey on the effect of peer feedback on the recipients was carried out through Google Form. The survey questions are listed below. It included asking if the peer assessors found it easy to give feedback.

1. Do you consider the feedback you received as positive or negative? Explain why.
2. Were you surprised by the feedback you received? Explain why.
3. Describe your initial reaction upon reading the feedback.
4. Were the feedback helpful or not helpful to you? Explain why.
5. Do you agree or disagree with the feedback? Please explain.
6. Did you discover anything about yourself or your actions that you were not aware before this? Please explain.
7. What will you do differently (or will not do differently) based on your team members' feedback? Please explain.
8. Was it easy to give feedback to your team member? Explain why.
9. What did you hope to achieve in giving feedback? Please explain.

The respondents were assured of complete anonymity in the publication of the survey results. There was no compulsion imposed to respond. Response was strictly voluntary, and honesty was requested. 18 out of 31 students responded representing a response rate of 58%.

3. Results and Discussion

Table 1 shows the survey results of these 18 respondents. Next sections deal with the details and discussion of the feedback.

Table 1. Survey results.

Survey question	Yes (Number)	Yes (%)
Considered feedback received as positive	15	83.3
Surprised by the feedback	6	33.3
Positive initial reaction	14	77.7
Feedback was helpful	16	88.9
Agreed with the feedback	16	88.9
Discovered something about self previously unaware of	9	50.0
Will do things differently	14	77.7
Easy to give feedback	15	83.3

3.1. Positive versus negative feedback

83.3% (15/18) of the respondents considered the feedback received as positive. This was higher than expected. However, it corresponded to the ease of giving feedback to their peers where 83.3% (15/18) found it easy to give feedback to their peers. This can be attributed to the fact that most of the feedback was positive and constructive. This result corresponded with a study which observed that students were generally positive towards each other in giving their review [12]. That study was conducted in an academic context, but it does appear that the same phenomenon also occurs in a teamwork context.

Generally, the positive feedback made the recipients feel validated for their efforts and contributions. This can be observed from a sample of their responses below.

- *"I would say that I was quite surprised and pleased upon reading the feedback"*
- *"Surprise mixed with being motivated"*
- *"Surprised and happy as it was surprising that I had not notice this before and happy that I could know about"*
- *"Happy to receive positive feedback."*
- *"Happy that my teammates thought of my contribution as helpful."*

For the 3 (16.6%) respondents who felt that they received negative feedback, these were their responses.

- *"There is one negative feedback from some group member. He said that I was not performing but I have done a lot of work. I think maybe he has got personal problems with me."*
- *"Negative, as it mostly talks about my shortcomings."*
- *"Negative as all of it is positive feedback but I need to know my weaknesses."*

Only the first two can be considered as having received negative feedback. While they seemed to be somewhat unhappy about it yet in their responses in subsequent survey questions indicated that they accept it and will work on improvement. The third respondent did not receive any negative feedback but felt undeserving of the positive feedback. This feeling was evident in this respondent's response to the question about agreeing or disagreeing with the feedback. In her response, she wrote that *"I don't really agree as I could have helped more in the group project"*. To address this issue in future, the feedback section would be

separated into two sections with one for giving positive feedback and another for giving negative feedback.

According to Patchan et al. [8], praise is helpful for acting on feedback when it came to writing assignments. However, was there a similar effect the context of personal development? 77.7% (14/18) of respondents indicated that they will do things differently as a result of the feedback received. This question is further answered in section 3.7. On the other hand, this study had discovered that negative feedback also motivated action (see Section 3.7). From these responses it appeared that both positive and negative feedback motivated the recipients to act.

3.2. Unsurprised by feedback

33.3% (6/18) of respondents were surprised by the feedback received. 3 of the respondents were surprised that the feedback was better than what they had expected to receive while the other 3 were surprised because it was considered to be somewhat negative to them.

The following are the comments from those who were surprised because the feedback was better than they had expected:

- *"Yes. I thought I did well but not really at all the time."*
- *"Yes. Team members have given positive feedback on my performance which in my opinion could have been better."*
- *"A bit surprised as I expect to get some negative feedback due to my lack contribution to the team"*

The following are the comments from those who were surprised because the feedback was not as good as they had expected:

- *"The negative of course surprised me. As I mentioned earlier it was opposite to what I have done."*
- *"Yes, I thought I had put in sufficient effort already."*
- *"A little bit. Some advantage and disadvantage could be recognized."*

The rest of the respondents indicated that they were not surprised. The respondents seemed to be fairly well aware of their strengths and weaknesses as well as their contribution to their teams. Despite that most of them still appreciated the feedback (see Section 3.4). Such an outcome is consistent with literature that mentioned that confirmatory, suggestive and corrective feedback have positive effects on learning [3]. Despite that study being conducted on academic assignments but it does appear that the same effect also occurs in teamwork settings.

3.3. Positive initial reaction

Majority of the initial reaction to their peers' feedback was positive as indicated by 77.7% (14/18) of the respondents. 16.7% (3/18) of respondents considered their initial reaction as neutral while only one respondent (5.6%) expressed negative initial reaction. He was *"too disappointed of the negativity".* However even this respondent accepted the criticism and indicated a willingness to change as noted in his responses to subsequent questions.

The responses in this section further reinforced the observations in Section 3.2 regarding the positive effects of peer feedback in a teamwork setting. This was true even in the case of the respondent who received the negative feedback. For the three respondents who regarded their initial reaction as neutral, two of them showed a willingness to change. Only one respondent felt that his current performance was good enough because of good comments from his team members and as a consequence decided that there was no need for any changes.

3.4. Helpful versus unhelpful feedback

88.9% (16/18) of respondents found the feedback helpful. The reasons they gave included that the feedback motivated them to work harder, helped them for their future personal development, showed them what needed to be improved, help them to understand how their team members viewed them and also the fact that their contributions were appreciated. This is in agreement with a study which mentioned that feedback whether it is confirmatory, suggestive, or corrective have positive effects on learning if the recipients received it thoughtfully and positively [3]. Despite that study being done in the context of academic assignments, the same was also shown to be true in the context of teamwork.

The 2 (11.1%) respondents who found the feedback unhelpful did so because they felt that the feedback did not accurately reflect their contribution. One of them felt underserving because the feedback was better than her own opinion of her contribution while the other felt that the feedback was unfair to him due to criticism from one of his team members even though the other team members gave encouraging feedback. He was concerned about the possible misuse of the feedback system although this concern was unfounded. These type of response were in the minority. The majority found the feedback from their team members to be helpful.

The high percentage of respondents who considered the feedback helpful is not unusual. The tendency to consider peer feedback helpful is consistent with several studies done in the context of academic assignments [10, 11]. Once again it seemed that whatever was applicable in academic assignments was also applicable to teamwork.

3.5. Agreement with feedback

88.9% (16/18) of respondents agreed with the feedback they received. Among the comments made by them are as follow:

- *"Agree. A positive or negative feedback should be taken as an opportunity to improve oneself as life is all about learning."*
- *"Agree. I should relax more."*
- *"Agree. Can learn from here for my future"*
- *"Agree. One of it focuses on punctuality and I agree that I needed to work on that."*
- *"Agree. Most of the feedback is consistent with other peers that are working with me."*

Of the remaining two respondents, one disagreed while the other could not decide. The one who disagreed was the same student who found the feedback unhelpful because of feeling undeserving of the good feedback. While the other

considered that the feedback was not specific enough and therefore was not able to agree or disagree. This was consistent with the literature that feedback had to be specific [8] Even though that study was about academic assignments, but the observation appeared to be just as applicable to teamwork.

3.6. Discovered something about self

50% (9/18) respondents found something about themselves, which they were unaware of previously. The following is a sample of their responses:

- *"I discovered that I am a slow learner and it is hard for me to come up with fresh ideas"*
- *"Yes. In my opinion, I did not give 100% to the team, however they still recognized my contribution and gave me a positive feedback which will make me even more motivated."*
- *"Yes. Sometimes it is clearer when people observe me."*
- *"Apparently my team members think that I have good leadership qualities. But I think I still have much to improve."*

The other 50% who responded that they did not find anything about themselves that they were previously unaware of mostly gave a simple one word "no" as an answer. The four who elaborated further gave the following responses:

- *"Nope. Because I tried my best to contribute to the project."*
- *"No. Punctuality has always been mentioned in the group."*
- *"No, it was all quite obvious to me"*
- *"Not really, but I don't know how to explain"*

From these responses, it seemed that some students discovered something about themselves that they were previously unaware of while for others the feedback merely confirmed what they already knew about themselves. Regardless of the 50/50 split, when it came to implementation of the feedback they received, 77.7% indicated a willingness make changes and these also included those who had responded with a "no" about having discovered something new about themselves. This observation reinforced the value of confirmatory feedback [3].

3.7. Implementation of feedback

77.7% (14/18) of respondents would make some positive adjustments to further improve themselves and/or their performance as a result of the feedback received. These included all of those who considered that the feedback they had received were negative as well as most of those who considered their feedback to be positive. The following is a sample of their responses:

- *"I will try to spend more time communicating with the group members to ensure that we fully understand what everyone is doing and our progress."*
- *"Try to be more engaging in the meetings that we had and to better interact with them more."*
- *"I will work smarter and reduce last minute work."*
- *"Improve on my punctuality"*

- *"I will do differently as I intend to improve even though the feedback was positive rather than feeling too happy of the outcome just because I have done something good"*

The four who responded that they had no need for adjustments felt that what they were doing was good enough based on the positive feedback they received, and they decided that they only needed to continue performing as they had before.

Ultimately the saying that "actions speak louder than words" must hold true. Hence the responses in this section would determine if this feedback activity had been successful. Results were encouraging as 14 out of 18 respondents had indicated an intention to improve based on the feedback from their peers. These respondents encompassed the entire range of confirmatory, suggestive and corrective feedback received, confirming that feedback had a similar effect on teamwork as it does in academic assignments.

3.8. Giving feedback

In terms of giving feedback, 83.3% (15/18) of respondents found it easy to do. Reasons given were that they had wanted their team members to improve, they were appreciative of their team members' efforts, that they were already well acquainted with each other and also about the importance of being honest with their team members. These were all positive reasons.

The 16.7% (3/18) of respondents who did not find it easy to give feedback to their peers gave the following reasons:

- *"It's not easy because the feedback form consumes a lot of my time."*
- *"It was okay. Sometimes you just don't want to hurt their feelings if it involves negative comments."*
- *"Not really, one of the members really didn't do a lot and was not active in the team but as friends, we tend to help each other anyway"*

One of them considered giving feedback as time consuming while the other two found it difficult to give negative comments. It is also possible that the respondent who found giving feedback time consuming was because he found it difficult to give negative feedback to his team mate.

50% (9/18) of respondents gave feedback with the intention of helping their team members improve. One respondent's intention was to achieve better understanding among team members. Another respondent hoped to achieve "a motivating and honest comment." Still one more hoped that each team member will know "what they did right". The remaining respondents seemed to have misunderstood this question and gave invalid answers. In future surveys this question would need to be better constructed.

3.9. Further discussion

From the survey results it appeared that feedback from peers working together in the same project team was able help students to develop personally. The feedback was generally well received, and the majority indicated a willingness to improve and to do things differently. There were some minor issues encountered such as a respondent feeling undeserving, unfounded concern over possible exploitation of

the system, feedback being not specific enough and some did not quite understand a survey question. These were a small minority.

4. Conclusion and Recommendations

A survey was conducted on to assess the effect of peer feedback on the personal development of students in a mechanical engineering capstone project. The response rate to the survey was 58%. Among the respondents, 88.9% indicated that the feedback was helpful while 77.7% indicated that they will make improvements based on the feedback received. This showed that the peer feedback from team members can play an important role in the personal development of a student.

There are several recommendations to improve the study. Firstly, the study can be repeated with a larger sample size. Secondly, the feedback section in the peer assessment form can be divided into two sections with one section for positive feedback and another section for negative feedback or rephrased as "room for improvement". In addition, the instruction in this section would ask for specific examples to substantiate both the positive and the negative feedback given to the peer. Thirdly the survey form can be expanded to include a question on whether in giving feedback, did the one giving the feedback identified areas for their own personal improvement. Lastly a question in the survey form could be better phrased.

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