

Enhancing students' engagement and learning through peer assessment in group projects

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Abstract. Aiming at enhancing students' active engagement and deep learning in a large-class setting, this study introduced group projects along with peer assessment among tertiary-level students in different cohorts. Following the designated pedagogical approach and assessment criteria illustrated by the course instructor, students' learning experiences related to project preparation and peer assessment in a compulsory course were observed for three consecutive years. Students expressed a high degree of agreement that the flexibility allowed in selecting group members and project contents promoted their interests in conducting projects on diverse environmental issues beyond the lecture materials and helped them develop teamwork and interpersonal skills. Regarding peer assessment, the observed resemblance among teacher-assessed and peer-assessed grading in most cases indicated that students could successfully develop critical evaluation skills required for the peer assessment. Moreover, students provided positive feedback on the peer assessment method and responded that this exercise triggered reflection on their own work, which could be useful for enhancing their deep learning and understanding of the subject. However, unsurprisingly, some students requested more guidance and directions given by the course instructor regarding project selection and grading criteria ahead of the peer assessment. It is also interesting to note that students' comments varied regarding the weighted fractions of project marks allocated to the teacher (50%) and peer (50%). Some students underscored that the teacher's grading should have a higher weighting than those of peer students, which may improve the fairness in marking. These various comments could assist us to better implement peer assessment in other courses. In all, given the students' positive learning attitudes and improved evaluation skills, peer assessment of group projects can be considered as a comprehensive approach for engaging students in deep learning experiences and higher-level understanding of broader knowledge.

Keywords: Tertiary Education, summative assessment, teaching pedagogy, collaborative learning, Reflection/Evaluation, deep learning.

INTRODUCTION

Assessing students' acquisition of knowledge and skills is an important component of the formal higher education system. To ensure an effective and progressive learning environment for students, assessments should be carefully designed and thoughtfully aligned with the intended learning outcomes of the subject matter. In addition to traditional lecture-based assessment

conducted by the educators, student-centered assessment such as peer assessment has attracted considerable attention in recent years for enhancing students' learning experiences in universities, particularly when group work is incorporated into the formal course contents (Chiriach, 2014; Bushell, 2006; Gatfield, 1999). Peer assessment is a pedagogic approach driven by the



Figure 1. Wide-ranging benefits of peer assessment approach.

students/learners to evaluate their peers at the same level in a qualitative and/or quantitative manner, usually based on pre-defined benchmarks. The active involvement of students in the evaluation process may help create a sense of responsibility leading to their learning advancement (Davis *et al.*, 2007).

Peer assessment: Underlying concept and benefits

Peer assessment usually involves students providing formative feedback or summative grades, or both, to other students' work based on a set of evaluation criteria. It is an innovative pedagogical approach or assessment method used in academic settings, and can be considered a collective or participatory exercise that underscores the active engagement of students to improve their learning experiences. The peer assessment process can be referred to as an arrangement for students and learners to evaluate the quality of work, related learning products, and/or the performance of other equal-status learners or individuals of similar competencies. "Peer assessment activities can vary in a number of ways, operating in different curriculum areas or subjects. A wide variety of products or outputs can be peer assessed, including writing, portfolios, oral presentations, test performance, and other skilled behaviors." (Topping, 2009).

Usually, two categories of peer assessment methods, i.e., formative and summative, are elaborated and deployed in the literature, in which students are assessed

by their peers in a qualitative and quantitative manner, respectively (Li, 2011; Liu and Carless, 2006). "Students may critically reflect on different aspects of the learning activity and provide feedback to their peers in a formative peer assessment, while in a summative peer assessment process, students' contribution and accomplished tasks are graded by their peers." (Dutta *et al.*, 2023). Engaging students in purposefully designed peer assessment can bring multiple benefits in diverse quality enhancement (Figure 1) and favourably augment their learning experiences. For instance, peer assessment can help to improve their conceptual understanding, communication skills, generating inference, integrating ideas, creating accountability, etc. (Reinholz, 2016). Notably, students need to learn how to recognize and apply a set of assessment rubrics or evaluation criteria in judging the work and/or performance of their peers, which are often difficult to be developed in other learning activities of a typical undergraduate curriculum.

Moreover, the peer assessment process requires learners to take responsibility for their actions and encourage reflection and critical analysis of their own learning. "The purposes of peer assessment go well beyond conceptual understanding. For example, teachers may look for evidence of good collaboration skills, the ability to solve complex problems and make thoughtful decisions, and the ability to give effective and articulate arguments as indicators of students' progress." (Davis *et al.*, 2007). Therefore, peer assessment exercises can be vital for equipping students with desirable attributes and

life-long skills in assessing others' work or performance critically and providing constructive feedback. During the process, they may in turn develop self-reflection and critical thinking skills to improve their individual abilities and collective performance. However, it is often questioned if students can perform peer marking appropriately with their limited experiences, particularly when the mark is counted toward the academic grades. In this case, it is suggested to combine peer-assessed marks with teacher-assessed marks to enhance the validity of the overall assessment (Freeman, 1995). Peer Assessment is an important teaching and learning strategy that is advantageous for students as well as teachers, who may better understand the students' needs and adjust the learning environment accordingly for further improvement of tertiary education (Ratminingsih *et al.*, 2017).

Peer assessment in group projects

Group work provides a collaborative learning environment where students work through a task or solve a problem together. It may offer a good opportunity for team members to share ideas, discuss strategies, clarify differences, exchange viewpoints, and construct new knowledge that is highly advantageous for students' learning and future career development. Group work can also more closely resemble real work situations where collaboration and cooperation are necessary for carrying out diverse tasks. In other words, group work may help students develop skills for better employability. Considering the great potential to enhance students' learning, academic performance, and teamwork skills, etc., peer assessment in group projects has been widely accepted in the educational sector worldwide (Chiriac, 2014; Bushell, 2006; Gatfield, 1999; Falchikov, 1995).

Peer assessment is often employed in group projects to evaluate the performance and contribution of team members within a group; alternatively, selected groups are assigned to assess other groups' performance. "Peer assessment is a potentially well-suited method for assessing and enhancing the knowledge and skills that are activated during the group work process since students can easily observe the contributions made by their group members." (Bong and Park, 2020)". During the summative assessment of group work, peers may allocate marks to individual team members considering their contributions, which can be a challenging task in some cases due to substantial time and effort required to do so. Otherwise, the whole team might be graded as one where all team members receive the same mark or grade representing the overall performance and contribution of the group (Kennedy, 2005). The latter may enforce a stronger sense of accountability and teamwork among team members, as they share the grade equally as a team, which means the group's success or failure depends on the collective effort of all team members. When assigning the same grade to

the whole group, there is a chance of encountering a "free-rider" attitude of some team members where benefits may be reaped by students who contribute less effort in the group projects. Nevertheless, well-structured and intellectually challenging group projects with sufficient complexity can be useful to address this issue (Davies, 2009).

This study was conducted in a large-class setting recurrently for three academic years in a compulsory course of Civil and Environmental Engineering curriculum. This approach highlighted students' whole learning experiences in preparing the group projects and conducting the peer assessment exercise. The objective of this study was to promote meaningful engagement of students in a group work and encourage positive learning attitudes through implementing a peer assessment approach for the evaluation of group projects. It was anticipated that the integrated use of group work and peer assessment would stimulate students' self-directed learning and motivate students to pursue deep learning instead of surface learning. Students flexibly prepared project work and provided their preferences and feedback regarding peer assessment exercises and responses given by students from different years were compared and discussed.

MATERIALS AND METHODS

Student engagement in group projects

This study organized group projects in combination with peer assessment activities in an undergraduate course of Civil and Environmental Engineering curriculum in a higher education institution. The pedagogical activity was conducted in a large-class setting with approximately one hundred and sixty students per academic year, and the exercises were repeated consecutively for three years for comparison and analysis across students in different cohorts. Student groups were formed at the beginning of the course by themselves under the guidance of the course instructor. Each group consisted of four or five students and was allowed a great degree of flexibility in selecting the project topics, contents, and reference resources according to the preferences of team members. Following the project brief provided by the course instructor, students within all groups managed to prepare the project work within the designated timeframe and finally delivered a group presentation in front of the entire class for peer assessment and grading.

Assessment framework

Group presentations were subjected to evaluation by the course instructor as well as peer assessment by selected groups based on pre-designated benchmarks and

Table 1. Questionnaire for collecting feedback from students regarding group projects and peer assessment

Group project	
Q1	Self-selection of project topic stimulates my interests in the subject
Q2	Flexibility in the project content and resources (<i>e.g.</i> , not confined to lecture materials) is preferred
Q3	Flexibility in the project timeline (<i>e.g.</i> , absence of starting times and progress reports) is preferred
Q4	Team project allows a more comprehensive and realistic assessment than individual assignments
Q5	Group work in the course helps develop my teamwork and interpersonal skills
Peer assessment	
Q6	Assessing the work of other groups (<i>i.e.</i> , peer assessment) enhances my learning and understanding
Q7	Assessment method and criteria are explicitly explained upfront and throughout the course
Q8	The fact that the project will be assessed by peers helps me reflect on my work from others' points of view
Q9	A combination of "peer assessment" and "lecturer assessment" is preferred to "lecturer-only assessment"
Q10	Individual contributions to the project (which is not currently assessed) should be evaluated by peer assessment within groups

assessment criteria. The assessment method and criteria were explicitly explained by the course instructor upfront and reiterated halfway through the course. A summative assessment approach was implemented for the group projects, which contributed to 20% of the total marks of the course assessment to stimulate students' interest and motivation towards their self-directed learning. Each group project was quantitatively graded by the course instructor and individual peers from selected groups. It should be noted that peer marking was conducted anonymously and two or three different groups were assigned to evaluate each group project. To ensure the reliability and fairness of the assessment process, grading from the course instructor weighted 50% of the allocated project marks, while assessment by the peers (mean scores) weighted the other 50% of marks for group projects as given in Equation 1, where;

$$\text{Group's average score} = (0.5 \times \text{score given by teacher}) + (0.5 \times \text{mean score given by peers}) \dots\dots\dots(1)$$

The total mark designated for the group project was equally distributed into 5 categories related to project content and presentation, *i.e.*, introduction, understanding, arguments, conclusions, and presentation skills.

Post-project student feedback

A questionnaire survey was administered among participating students at the end of the projects to collect their feedback on group projects and peer assessment exercise in different student cohorts over three years. In total, ten questions were included in the survey (**Table 1**), where questions one to five (Q.1-5) were designed to collect students' feedback on their involvement in group projects, mainly focusing on project selection, flexibility in project content, project timeline, teamwork, and skill

development through group activities. The remaining five questions (Q.6-10) were designed to collect students' feedback specifically related to peer assessment, highlighting assessment criteria, benefits achieved through this exercise, and their preference for "peer assessment" over conventional "lecturer-only assessment", and on whether individual contributions to the project should be evaluated by peer assessment within groups as well. Students rated their feedback for specified questions on a five-point Likert scale, where 5 = Strongly agree, 4 = Agree, 3 = No strong view, 2 = Disagree, and 1 = Strongly disagree. The average score was calculated for each question in the student feedback questionnaire, reflecting overall feedback from the students who participated in a particular year. The results from three consecutive years are presented in respective figures and compared in the later sections.

RESULTS AND DISCUSSION

Group projects

Considering the student-centered pedagogy adopted in this study, student teams were encouraged to self-organize their project selection, content preparation, and final presentation for assessment. The flexible approach to project topics and content selection successfully stimulated students' interest in exploring a wide range of topics related to Civil and Environmental Engineering beyond what could be covered in typical lectures in a large-class setting. Considering the preference and learning interests of team members, every team selected a specific topic and prepared necessary and relevant contents for the presentation in front of the entire class. The diversity of topics selected by different groups, as shown in **Table 2**, indicates that students' self-directed learning could be enriched through flexible involvement in project activities. The topics presented over the three years were

Table 2. Wide range of topics presented during group projects over three years

Categories			
Classic environmental concerns	Pollution/contamination/ catastrophe-related issues	Sustainability/water/ energy/waste-related concerns	Local concerns
- Tragedy of Commons	- Petrochemical Contamination from Industrial Malpractice	- Environmental Engineering: Sustainability	- Talking Trash - Zero Waste Strategy in NZ
- Ozone Depletion: A Case Study in Global Environmental Engineering	- Ganges River Pollution	- Recycling: A Study of International Practices and Feasibility	- Fruitgrowers' Chemical Company in Mapua
- Overpopulation: People, People Everywhere	- Xenoestrogens - What are They Doing to You?	- Biofuels: The Way of the Future?	- Christchurch Smog: The silent killer
- The Natural Phenomena of Climate Change	- The Chornobyl Disaster: An Examination of the Event, Consequences and Subsequent Views towards Nuclear Power	- E-waste - Out of Sight, Out of Mind?	- The Potential of Tidal Power in New Zealand
- Leaded Petrol, Lead Astray?	- Are We All Turning into Girls? Endocrine Disruptor Compounds	- The Use of Sludge as an Energy Source	- Nuclear Power in New Zealand: A Green Alternative?
- Biomimicry: Does Mother Nature Put Out?	- Oil Spill in the Niger Delta	- Biosolids as a Fertiliser	- Getting Nasty with Pests - Analysis of Pest Control in New Zealand
- Depression or Depletion? Environmental Effects of Pharmaceuticals	- 2010 Gulf Oil Spill	- The Effects of Overpopulation on Solid Waste Management	- Methyl Bromide: Effects on Humans and a Case Study on Port Nelson, New Zealand
- The Industrial Revolution: H2O to H2S?	- That Damn Dam - Three Gorges Project	- Electronic and Electrical Waste Management	- Mining in New Zealand: Is It Our Future?
- Anthropological Environmental Impact on Antarctica	- The Effects of the Atomic Bomb on Hiroshima	- Water Conflict in Developing Countries	- Consequences of an Orphan Mine: Tui Mine, New Zealand
- Life on Mars: Environmental Challenges	- Hungary Toxic Sludge Spill	- The Great Pacific Garbage Patch	- DDT Doesn't Fall Far from the Tree - Mapua FCC Site Remediation
- Coral Reefs - Why Should We Care about Them?	- Chloride Found at Levels That Could Harm Aquatic Life in Northern USA	- Effects on the Environment from Large Sporting Events	- Mining in New Zealand: Is It Our Future?
- Pesticidal Impacts on Humans and the Environment	- The Bhopal Gas Disaster	- Exporting Pollution: Electronics Recycling in the Third World	- Mining Our National Parks
- The Buzz on Bees: Global Pollinator Decline	- The Environmental Damage of Wars	- Shrinkage of the Aral Sea	- Didymosphenia Geminata ("Didymo") in New Zealand Waters
- Methane Emissions	- Methyl Mercury Fishy Business		- Impacts of Dairy Farming in New Zealand
	- 1080 Poison		

remarkably diverse and covered crucial issues and significant concerns related to the subject matter.

In general, group projects can be sorted into four main categories, i.e., topics related to (i) classic environmental concerns, (ii) pollution or catastrophe-related issues, (iii) sustainability, water, energy or waste-related concerns, and (iv) local concerns about environmental issues. For instance, one notable example of the diverse topics chosen by the student groups is the presentation on the "Tragedy of Commons", which is a classic environmental

concern around the world. It refers to the depletion of common ecological resources caused by some individuals prioritizing their own interests over the long-term sustainability of these resources for the whole community and future generations. Other student groups came up with significant and global environmental concerns such as climate change, ozone depletion, and pesticide impacts on humans and the environment, etc. Various sustainability issues related to resource circulation, water-related conflicts, and energy- and waste-related issues, such as

e-waste and biofuels, were presented by different student groups. In addition, several contamination-related cases which happened around the world, as well as the issues related to important local concerns, were critically evaluated and discussed in group projects.

A wide range of topics or contents exemplified by students in these group projects revealed their diverse interests in the subject as well as the related fields, which is a desirable characteristic for students at the university level. "It has been argued that the freedom and challenge that students experience as a result of solving the problems that arise in designing and building their projects result in high levels of student engagement due to the cognitive challenge as well as the strong affective, ethical and aesthetic dimensions that form part of a well-designed project." (Kokotsaki *et al.*, 2016). Diverse interests and considerable engagement in group projects in this study may facilitate the expansion of students' knowledge and augment their self-directed learning experiences in higher education and future career development.

During the final presentation, each student team was evaluated by both course instructor and their student peers, based on pre-defined evaluation criteria, including introduction, understanding, argument, conclusion, and presentation skills. The grading process was weighted, with 50% of the total project mark assigned by the course instructor and the other 50% assigned by the mean scores from student peers in selected groups. This exercise was repeated consecutively for three years generating a considerable amount of data (i.e., grading for different groups) over the study period. Selected grading results from the three years are presented in [Table 3](#), [4](#), and [5](#), respectively, which can serve to illustrate the summative assessment approach.

In general, the peer assessment approach was welcomed by students, as observed over three academic years during this study. Interestingly, peer marking was remarkably consistent when assessing a better-performing group. For instance, Group A in the first year obtained 18.3 out of total 20 marks ([Table 3](#)), indicating a very good performance. All peers rated the group between 3 to 4 out of 4 marks in each category. The consistency in peer assessment indicated a high level of agreement among peers that can result in a reliable peer marking, which aligns with a relevant study by Weaver and Esposto (2012). Moreover, by comparing the grading in the first and second year, it can be seen that project marks given by the course instructor were comparable to the mean score given by the peers. As an example, in the case of Group C in the first year ([Table 3](#)), the sum of mean scores given by the peers was 16.1, which was very close to the sum of marks in various categories given by the teacher, i.e., 16. A similar observation was noticed for Group A and B in the second year ([Table 4](#)). In some cases, e.g., for Group A in the first year and Group C in the second year, mean scores by peers were slightly lower (18.3 and 11.90, respectively) compared to the score given by the teacher (20 and 16,

respectively), which might be due to different preference or reserved marking by students.

Overall, comparable grading provided by both teacher and peers indicated that students were able to recognize the grading criteria and develop the required skills for critical evaluation of academic performance of their peers. However, peers' mean scores by students in the third year ([Table 5](#)) were consistently higher than that of the score given by the teacher, pointing towards more generous marking provided by the students in this cohort during project assessment. For instance, for Group A, peer grading was 3 marks higher (16) compared to the teacher's grading (13). When considering the weight fractions of the teacher's and peers' marking, the combined grading was useful for establishing the validity and fairness of the group project assessment. For instance, Group A obtained an average of 14.5 when considering both teacher's and peers' grading, which was lower than the peer grading alone but higher than the teacher's grading alone. This suggested that the combined grading is an effective approach for group project assessment, as supported by Freeman (1995).

Students' feedback on group work and peer assessment exercise

Feedback regarding group project activities and the peer assessment exercise was voluntarily collected from the participating students, and remarkably, three hundred and ninety-six responses were collected over the three academic years in this study. Comparative scores for different categories related to group projects and peer assessment are presented in [Figure 2](#) and [Figure 3](#), respectively. The students' feedback showed a high agreement in several categories. For instance, student rating for Q1 ranged from 3.8 to 4.4 (Self-selection of project topic stimulates my interest in the subject), which substantiates the enhanced engagement and motivation among students through the diverse selection of project topics as previously mentioned. The majority of the students who participated in this study over three different years also showed a high agreement for allowing flexibility in project content and resources (Q2, the mean score ranged from 3.8 to 4.6) and preferred that it should not be confined to lecture materials only. The given flexibility in the project timeline was preferred by the students (Q3, the mean score ranged from 3.6 to 4.2). Therefore, as illustrated by these findings, adopting flexible project learning can help develop a sense of responsibility and stimulate self-directed learning for tertiary-level students (Kokotsaki *et al.*, 2016); however, regular monitoring of students' contribution may be needed to track their progress in the appropriate direction.

While students expressed a high agreement for the self-selection of project topics and flexibility in project content and timeline, their opinions were neutral regarding the

Table 3. Grading achieved in different groups of students in the first year (illustrated for selected groups only)

1 st Year		Grading											
Evaluation criteria	Group A											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	4	3	3	4	4	4	3	4	4	4	4	3.7	3.85
Understanding	4	4	3	3	3	4	4	4	4	3	4	3.6	3.80
Argument	4	4	4	3	3	4	4	3	4	3	3	3.5	3.75
Conclusion	4	3	3	4	4	4	4	4	4	2	4	3.6	3.80
Presentation Skills	4	4	4	4	4	4	4	4	4	3	4	3.9	3.95
Sum	20	18	17	18	18	20	19	19	20	15	19	18.3	19.15

Evaluation criteria	Group B											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	2	2	2	2	3	2	4	3	3	2	2	2.5	2.25
Understanding	3	2	2	3	3	2	4	3	4	3	3	2.9	2.95
Argument	3	3	3	2	2	2	4	3	3	2	2	2.6	2.80
Conclusion	2	3	1	1	2	2	4	3	3	3	2	2.4	2.20
Presentation Skills	2	3	2	1	2	2	3	4	3	1	2	2.3	2.15
Sum	12	13	10	9	12	10	19	16	16	11	11	12.7	12.35

Evaluation criteria	Group C											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	4	3	3	3	3	4	3	4	3	3	3	3.2	3.60
Understanding	3	4	3	3	3	3	3	3	3	3	4	3.2	3.10
Argument	3	3	2	2	4	4	2	4	4	3	4	3.2	3.10
Conclusion	4	4	4	3	4	4	2	4	2	3	3	3.3	3.65
Presentation Skills	2	3	3	3	3	4	2	4	4	3	3	3.2	2.60
Sum	16	17	15	14	17	19	12	19	16	15	17	16.1	16.05

benefits of group work for the related skill development compared to individual assignments. The mean score for Q4 ranged from 3.0 to 3.4, comparatively lower than the mean scores in other categories (Figure 2). This observation clearly indicated that students might have sceptical views on the perceived benefits of group projects, which probably differ from the course instructor's

perspectives and assumptions. In contrast, students rated comparatively higher in Q5, which sought their opinions about whether group work in the course helps develop their teamwork and interpersonal skills. These results highlight that group work and peer assessment together as a pedagogical approach can greatly enhance students' motivation, cooperative learning, and interpersonal skills,

Table 4. Grading achieved in different groups of students in the second year (illustrated for selected groups only).

2 nd Year		Grading											
Evaluation criteria	Group A											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	2	3	3	3	2	3	3	3	2	3	3	2.8	2.40
Understanding	4	3	2	3	3	3	4	3	3	3	4	3.1	3.55
Argument	4	2	4	2	3	3	3	2	3	3	3	2.8	3.40
Conclusion	2	3	4	4	3	3	3	3	3	3	4	3.3	2.65
Presentation Skills	3	4	2	4	2	2	4	3	2	3	3	2.9	2.95
Sum	15	15	15	16	13	14	17	14	13	15	17	14.90	14.95

Evaluation criteria	Group B											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	4	3	3	3	2	3	4	3	4	4	4	3.3	3.65
Understanding	4	3	4	4	4	4	4	4	4	3	3	3.7	3.85
Argument	4	3	4	4	2	4	4	4	4	3	4	3.6	3.80
Conclusion	3	3	3	4	4	4	3	2	3	3	4	3.3	3.15
Presentation Skills	2	2	4	3	3	3	4	4	3	3	3	3.2	2.60
Sum	17	14	18	18	15	18	19	17	18	16	18	17.10	17.05

Evaluation criteria	Group C											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	3	3	2	2	2	2	1	2	3	2	3	2.2	2.60
Understanding	4	3	2	3	3	2	3	3	3	3	3	2.8	3.40
Argument	4	2	1	2	3	3	3	3	2	3	3	2.5	3.25
Conclusion	3	2	2	2	3	3	2	3	2	3	3	2.5	2.75
Presentation Skills	2	3	1	2	1	2	2	1	2	2	3	1.9	1.95
Sum	16	13	8	11	12	12	11	12	12	13	15	11.90	13.95

which are consistent with previous research (Divaharan and Atputhasamy, 2002)

Notably, the neutral views expressed by the students on peer assessment (i.e., mean scores) over the three consecutive years might indicate the need for greater clarity and more guidance in the assessment process. In

the case of Q6, which asked if assessing the work of other groups (i.e., peer assessment) enhances student's own learning and understanding, the mean scores ranged between 3.0 and 3.5. A similar score was obtained for Q7 representing "Assessment method and criteria are explicitly explained upfront and throughout the course"

Table 5. Grading achieved in different groups of students in the third year (illustrated for selected groups only).

3 rd Year		Grading											
Evaluation criteria	Group A											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	3	3	4	3	3	4	3	2	3	3	3	3.1	3.05
Understanding	3	3	3	4	3	4	2	2	3	3	4	3.1	3.05
Argument	2	4	4	4	3	4	3	3	4	2	4	3.5	2.75
Conclusion	2	3	3	4	4	4	3	2	4	4	3	3.4	2.70
Presentation Skills	3	3	3	3	3	3	3	2	3	3	3	2.9	2.95
Sum	13	16	17	18	16	19	14	11	17	15	17	16.00	14.50

Evaluation criteria	Group B											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	2	3	1	3	2	3	2	2	1	2	2	2.1	2.05
Understanding	3	3	3	4	3	4	2	3	3	3	3	3.1	3.05
Argument	2	2	3	2	2	4	2	4	3	2	4	2.8	2.40
Conclusion	1	1	3	3	3	3	2	4	2	3	4	2.8	1.90
Presentation Skills	2	3	2	3	2	2	2	3	2	2	3	2.4	2.20
Sum	10	12	12	15	12	16	10	16	11	12	16	13.20	11.60

Evaluation criteria	Group C											Mean score by peers	Average
	Teacher	Peer 1	Peer 2	Peer 3	Peer 4	Peer 5	Peer 6	Peer 7	Peer 8	Peer 9	Peer 10		
Introduction	3	3	1	3	3	2	4	3	3	3	3	2.8	2.90
Understanding	3	3	3	4	4	3	3	3	4	4	4	3.5	3.25
Argument	4	2	2	3	3	2	3	4	2	3	4	2.8	3.40
Conclusion	3	2	2	4	2	3	4	3	3	3	3	2.9	2.95
Presentation Skills	4	3	2	3	3	2	3	4	3	3	4	3.0	3.50
Sum	17	13	10	17	15	12	17	17	15	16	18	15.00	16.00

(mean scores ranged between 3.0 to 3.4). In this case, some students expressed disagreement, possibly due to some sort of challenges in understanding and recognizing peer assessment methods and criteria that could be different from other courses and require more attention. However, a comparatively better mean score was obtained

in Q8 ranging from 3.0 to 3.7, which demonstrated the beneficial effects of peer assessment in triggering reflection on student's own work from peers' points of view. Therefore, project work is proven effective for stimulating students' thoughts and reflection, which is essential for their learning enhancement.

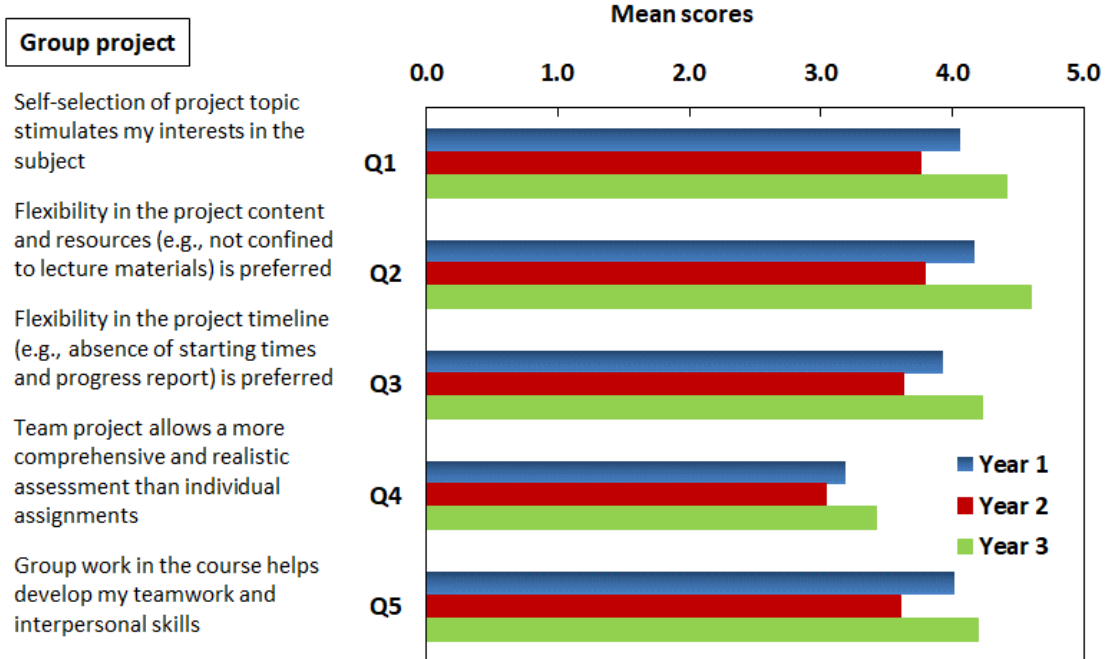


Figure 2. Mean scores for various questions designed to collect feedback from students regarding group project activities (n = 396).

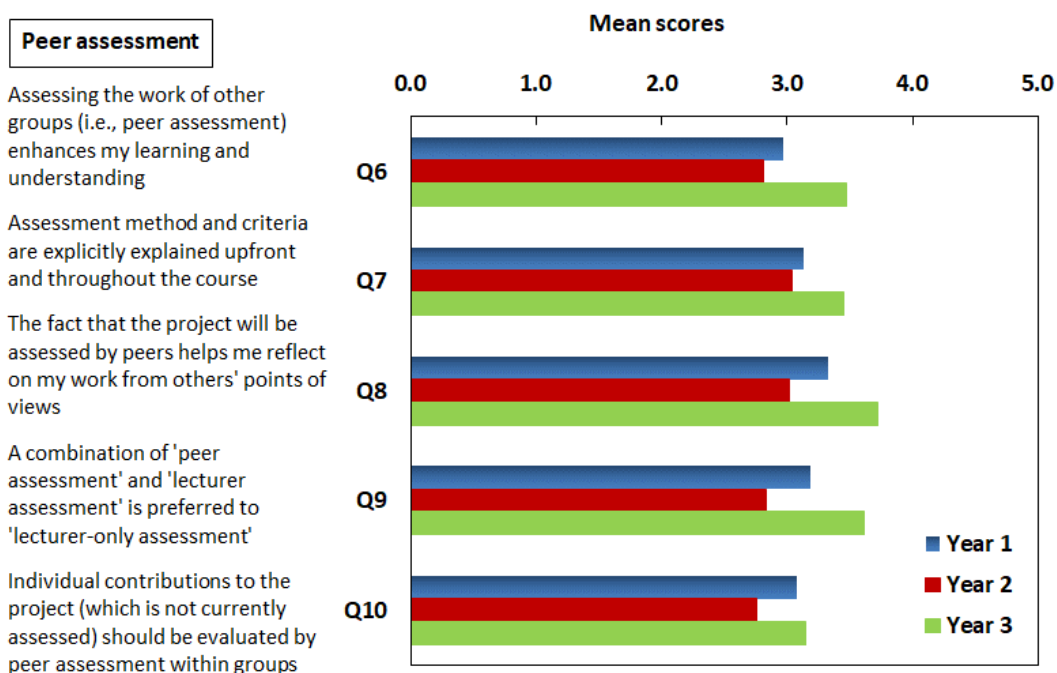


Figure 3. Mean scores for different questions designed to collect feedback from students regarding the peer assessment process (n = 396).

When comparing between “lecture-only assessment” with a combination of “peer assessment” and “lecture assessment”, the majority of the students in the first and

third year preferred the combined one (Q9, mean scores 3.2 and 3.6 respectively), while students in the second year were neutral in their opinions. In addition, students’

mean scores in Q10 (ranging from 2.8 to 3.1) revealed neutral views in all three years, i.e., no strong agreement could be observed among the students for evaluating individual contributions to the projects during peer assessment. This observation may suggest efficient collaboration among the students for conducting the project work and there is an acceptable equality in shared contributions among team members.

In the voluntary feedback, the students shared views and provided qualitative feedback on their learning experiences, grading criteria, prospects, and limitations regarding group projects and peer assessment exercises. These can serve as suggestions for future improvement. The majority of the students expressed positive sentiments about the pedagogic exercise, describing it as an innovative and enjoyable experience that helped them to build self-confidence and develop interpersonal skills, such as public speaking, presentation skills, and research skills. These observations align well with the feedback ratings provided by different student cohorts, as discussed earlier. Original comments from the students in different academic years are quoted below;

“Unique assessment hasn’t been used in any of our other courses. Got a forum for PowerPoint presentations & public speaking. Overall a good form of assessment.”

“This gives people confidence in speaking in public. This is a very good assessment as this highlights the environmental issues around us. Keep this as an assessment.”

“Great project/great opportunity to practice public speaking.”

“Good and interesting type assessment. Helps develop research skills & knowledge of real-world environmental problems. The presentation helps to develop individuals’ self-confidence.”

Despite the general positive feedback on group projects and peer assessment exercises, some students provided different viewpoints and constructive criticisms regarding their learning experiences. For example, one student commented “Project seemed largely unrelated to course material, and didn’t help to understand of examinable content.” Several students pointed out that they would have appreciated more guidance and direction when selecting topics for their projects, as it was difficult to find content directly relevant to the lecture materials. They suggested having a more specific outline for the group presentation, particularly about the structure for presentation content and suggestion for a list of possible topics. However, the majority of the students appreciated the flexibility that allowed for self-selection of topics and choosing their own groups. In contrast, some students found it challenging to apprehend the grading criteria, and additional explanation on grading criteria was desired. Future studies can benefit from providing more contextual guidance, clearer requirements, and more explicit grading

criteria for students to follow.

“Good learning experience, yet criteria need to be more clearly defined.”

“As the group is self-selected, this is not an issue, as long as marking criteria is flexible too, need more clarification about marking criteria.”

“Not bad but little information on the requirements was provided.”

“Make a broader marking scale, not just 1-4.”

Although the peer assessment exercise was mostly welcomed by the students, some expressed varied thoughts and mixed feelings about the pedagogic approach. Students in a few groups felt that the peer assessment within groups leads to equal distribution of effort. In contrast, some students perceived that some members contributed more than others, while others had only minimal contributions. Questions were also raised regarding whether all members should speak to earn presentation marks. Some students believed that group work could reduce quality, although no obvious case was observed among students. Furthermore, a smaller group size consisting of three members was preferred by some students for better collaboration and cooperation within the groups. Overall, mixed views and different comments might be commonly expected when group work and assessment are implemented in a large-class setting. While most students recognized the benefits of peer assessment, there were divergent opinions on the weighting of marks assigned by peers and the instructor. Many students expressed a desire for greater weighting to be assigned by the instructor, as the group project was worth 20% of the total grade in the subject. Some students were hesitant to assess their peers’ work as they lacked experiences in academic marking. Selected remarks from students are quoted below;

“Course teacher should have the final say on the marks.”

“Maybe more marks weighted to the lecturer, the last groups have a disadvantage as everyone bored, individual evaluations were not satisfactory in some cases too.”

“Overall this exercise was great, but requires some tweaking, i.e., more formal marking.”

“More weight behind lecturer mark as we have little experience in marking.”

“Less reliance on peer assessment i.e., lower % for peer. Relatively small workload, it seems like an easy 20%.”

“Think a team of lecturers/environmentalists should mark the whole thing as it is more fair, otherwise, less contribution from student marks.”

“Grades could be decided 75% by lecturer and 25% by peer review.”

CONCLUSIONS

The combination of group projects and peer assessment

methods employed in this study proves to be advantageous for improving students' active engagement and providing a good basis for diverse skill development. This study provides important insights regarding students' learning attitudes and teamwork, reflecting their feedback on the perceived usefulness of the pedagogical approach. Group work can arouse students' interests in various environmental concerns and broaden their knowledge in the subject and the related fields. In addition, peer assessment offers significant learning benefits by fostering reflective thinking and critical evaluation among the participating students. Meaningful feedback and constructive suggestions obtained from the students in this study can assist course instructors to design more effective strategies for group projects and peer assessment exercises in the university curriculum, which can give students more fruitful learning experiences. Overall, the findings of this study provide a valuable contribution to the field of educational research, highlighting the significance of integrating peer assessment in group projects to enhance student engagement and learning outcomes in tertiary-level courses.

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