

# Reflection and peer assessment to promote self-directed learning in higher education

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**Abstract.** Reflection and peer assessment as pedagogical approaches were implemented through a group project in this study aimed to transform students into reflective and self-directed learners thereby enhancing their competence and learning achievements. To support students' learning progress and evaluate their learning outcomes, formative and summative assessments were conducted halfway through and at the end of the project, respectively, under the guidance of the course instructor. Self-reflection as a systematic reviewing process during the formative assessment enabled students to critically evaluate their own learning behavior and identify intrinsic learning needs, while team members were encouraged to provide constructive feedback to peers which could play a crucial role in improving their overall learning experiences. In contrast, the summative assessment exercise allowed students to grade their peers within each group considering pre-assigned criteria as guided by the course instructor. The summative assessment indicated contrasting performance among the two participating groups, which could be attributed to their differences in active engagement, peer interactions, and collaborative learning during the project that eventually influenced the group's performance. Though both teams were comparable in terms of competence, effective collaboration and organization among group members supplemented the learning process and turn their performance distinct. However, in some cases, the realization of learning needs was not transformed into necessary actions, which was eventually reflected in the group performance. Overall, this study demonstrated that reflection and peer assessment practice are conducive to the development of critical thinking and self-directed learning among students, which can augment their learning experiences at the university level.

**Keywords:** Self-directed learning, active learning, reflective practices, formative assessment, constructivism, transformative learning theory.

## INTRODUCTION

Engaging students in self-directed learning is essential to foster their knowledge and advance skills as competent graduates. Meaningful engagement can positively influence learning behavior and enable students to become active learners by managing their learning materials/tools as well as diverse aspects of the learning process (Choi *et al.*, 2021). When students are actively engaged in their studies, they would address their intrinsic needs and develop a deeper understanding of what they learn and make effort to improve the process of how they

learn with or even without guidance from the instructor. "In more active forms of learning, for instance, learners make their own time-planning, they choose to learn goals and activities they like, they test their progress, they take care of learning and understanding on their own, and they reflect on errors and successes." (Van Hout-Wolters *et al.*, 2000). Hence, higher education institutions should prioritize and adjust teaching and learning strategies for engaging students in self-directed learning. Such student-centric and student-driven pedagogical approaches can



**Figure 1.** Gibbs' reflective cycle (Adapted from Gibbs, 1988).

also help to realize the intended learning outcomes of undergraduate/postgraduate programmes.

### Significance of reflection and peer-assessment

"Reflection is part of learning and thinking. We reflect in order to learn something, or we learn as a result of reflecting, and the term 'reflective learning' emphasizes the intention to learn from current or prior experience" (Moon, 2004). Reflective practices can inspire students to critically think about their own learning and promote long-term retention of the obtained knowledge, skills, and experiences. Collins and O'Brien (2003) related active learning with reflective practices and defined it as "The process of having students engage in some activity that forces them to reflect upon ideas and how they are using those ideas. Requiring students to regularly assess their own degree of understanding and skill at handling concepts or problems in a particular discipline." Reflection can be an individual activity as well as a collective activity.

Students may conduct self-reflection or receive feedback and assessment from peers when involved in group activities. Self-reflection can stimulate students to question their learning philosophy and help to connect existing assumptions and knowledge with their current learning activities. In contrast, collaborative reflection during group activities can be conducive to learning diverse perceptions regarding a subject of interest and understanding why and how others observe things in different ways. During the collective reflection process, students' own assumptions may be challenged by peers, which can provoke them to re-evaluate their original perspectives and broaden their outlook in relevant fields of study (Chang, 2019).

The process of reflection can enable students to grasp a concept better, expand their horizons, and make conscious decisions for upcoming activities by reflecting on their learning experiences. Gibbs (1988) developed a cyclic model that illustrates six stages of reflection to explore an experience (Figure 1). Following Gibbs' reflective cycle, students initiate the process by describing the situation in detail regarding the overall learning

experience, while in the next stage, they explore the thoughts and feelings they had during the experience. Consequently, students go through the evaluation and analysis stage that requires reflection on both positive and negative aspects of the experience and scrutinizes the reasons behind them. Finally, they summarize the learning experience, reflect on what can be done differently, and develop a plan on how to adjust their actions to achieve better outcomes in case of a repeated experience in a similar learning environment (Gibbs, 1988). Reflection can help students to act on their realization and resolutions. However, to optimize the benefits of reflection for realizing intended learning outcomes, the reflection process and practice should be designed carefully and implemented purposefully in a well-structured manner.

In addition, the role of assessing students' learning experiences is crucial in the formal higher education system. Considering traditional classroom settings, the teacher or course instructor is the main person who has significant control over classroom learning, responsible for conducting the assessment and grading students' performance. However, in modern times, the design and implementation of assessments are becoming more student-centric involving students' active engagement (Wanner and Palmer, 2018). For instance, peer assessment has been highlighted as an effective strategy to empower students' learning, because a considerable amount of teamwork or group work is being incorporated into core subjects in higher education institutes. Reflection on learning experiences can be performed during a peer assessment process, or in other words, a peer assessment exercise can trigger reflection. Peer assessment can be formative or summative. 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' contributions and accomplished tasks are graded by their peers. Summative peer assessment can specify the quality of work; however, it does not provide detailed information to other students about how to improve their work, whereas formative assessment helps students to identify both strengths and weaknesses and suggest actions for improvement (Topping, 2018). Combining both formative and summative assessment methods may bring greater benefits to students' learning, where students can judge and grade peers' work as well as provide qualitative feedback for advancing their knowledge and skills (Liu and Carless, 2006). In other words, this combined assessment process can be instrumental in evaluating the intended learning outcomes as well as supporting the students' learning advancement (Reinholz, 2016).

### **Relevance with pedagogical theories**

The necessity of reflection and peer assessment was

highlighted in the literature in relevance to pedagogical and educational learning theories. For instance, constructivist pedagogy implies that the learning process is personal and individual, influenced by the context, where students construct their own learning based on past experiences (Dutta *et al.*, 2022). A constructivist learning environment identifies students as active agents for knowledge construction, which emphasizes the necessity of reflection during and after a learning experience. Students' reflection on past learning experiences is crucial to further improve their knowledge and problem-solving skills. In this way, reflective practices can help students to understand the relevance of the learning and make connections between their experiences with real-life scenarios in a broader context (DeLay, 1996).

In addition, in connectivist pedagogy, peer assessment and feedback are emphasized to ensure effective learning. "The idea is that knowledge is gained experientially via connections a student makes among nodes. As such, peer perspectives provide the necessary nodes for the connections (Suen, 2014)". Reflection is an integral part of transformative learning. Transformative learning theory refers to the learning process as combining life experiences with critical reflection, which signifies that new information can essentially change our opinions and understanding when our life experiences and knowledge are paired with critical reflection. Accommodating students with comprehensive learning experiences, which involve personal engagement along with stimulated reflection, was indicated as the most powerful tool that might foster transformative learning (Taylor, 2007). Mezirow (2003) elucidated how critical reflection triggers transformative learning, "Critical reflection addresses the question of the justification for the very premises on which problems are posed or defined in the first place. We very commonly check our prior learning to confirm that we have correctly proceeded to solve problems, but becoming critically aware of our own presuppositions involves challenging our established and habitual patterns of expectation, the meaning perspectives with which we have made sense out of our encounters with the world, others, and ourselves."

### **Scope of the study**

This study implemented self-reflection and peer assessment in an undergraduate course at a higher education institution and discussed how these pedagogical approaches influenced the students' learning behavior and engagement. The rationale behind this was to motivate the students intrinsically to be engaged in the active learning process through conducting self-reflection and peer assessment. The entire process was designed purposefully and embedded in group projects by incorporating structured learning activities under a guided environment facilitated by the course instructor. The major objectives of this study were to: (i) introduce self-reflection

and peer assessment as pedagogical tools to students, (ii) stimulate students' engagement in self-directed learning, (iii) promote meaningful interactions among peers to facilitate collaborative learning, and (iv) boost students' learning experiences and overall performance. Thereby, this study anticipated fostering students' engagement, self-directed and collaborative learning attitudes, and critical thinking skills by using the stated pedagogical approaches to realize the program intended learning outcomes.

## MATERIALS AND METHODS

A group project was organized and incorporated into an elective course entitled "Land Reclamation" within the Civil and Environmental Engineering program at a higher education institution. Under the guidance of the course instructor, students were engaged in the self-reflection and peer assessment exercise and divided into groups consisting of 3 to 4 members each. Each group was advised to select relevant topics to work on together throughout the designated period and generate reports and presentations at the end of the project. Though students participated in this exercise under a guided environment, they were given freedom in terms of topic selection and organization of their group activities aligned with self-directed learning. Students were informed upfront about the assessment framework applied in the group project, which involved a formative assessment conducted halfway through the project and a summative assessment conducted at the end of the project.

Halfway through the project, students participated in the formative assessment, where each student was required to conduct self-reflection on his/her own learning experiences, while peers within the group were requested to provide qualitative and constructive feedback on team members' work engagement, efforts, strengths, and weaknesses, and suggest peers for improvement when needed. In contrast, during the summative assessment conducted at the end of the project, students were allowed to quantitatively grade their peers following the given criteria provided by the course instructor. The grading comprised four different levels for marking of which "4" was considered the highest mark and "1" was considered the lowest mark. The total mark (by adding marks in different categories) given to a student by a peer individually and the average total mark given by all the group members were counted for the formative assessment. The performance of the whole group was indicated by the group's total mark calculated with reference to the average total marks of all group members. Furthermore, students provided their comments on group interactions and peer contribution at the end of the project. Students were encouraged to share their thoughts and suggestions regarding self-reflection and peer assessment exercises conducted through the group project. Learning

experiences, learning behavior, and peer interactions in response to applied pedagogical approaches were evaluated qualitatively in this study and research findings are discussed sequentially in relevant sections.

## RESULTS AND DISCUSSION

### Self-reflection and peer feedback provided in formative assessment

Halfway through the group project, students were required to submit a reflective statement regarding their learning experiences of ongoing activities and provide constructive suggestions and qualitative feedback to team members. The course instructor then provided prompt responses to the students about their progress and distributed peer comments anonymously (some of the comments had been advised to be revised more positively and constructively if needed). This formative assessment was not graded, while it mainly involved a qualitative peer assessment such that students would feel more comfortable learning from their mistakes and deficiencies. This exercise also enabled students to learn by reflecting on their own progress and learning needs as well as evaluating their peers' work in a critical yet constructive way. Students can attain the learning benefits while performing the roles both as peer assessors and peers participating in the assessment exercise (Le Hebel *et al.* 2018).

The students who assessed might benefit from getting the opportunity to scrutinize and analyze their peers' work, while the students who were assessed might acquire benefits through receiving external perspectives regarding their work and the potential improvement actions required (Boase-Jelinek *et al.*, 2013). Self-reflection and peer feedback provided by the students in different groups during formative assessment (halfway through the project) are organized in Tables 1 and 2, respectively. Students' remarks were quoted as typical examples in the tables directly without further modification.

As observed, some students were able to identify their own learning styles through the self-reflection process and realize their learning needs and knowledge gaps. "Self-assessment is a key element in formative assessment because it involves students in thinking about the quality of their own work, rather than relying on their teacher as the sole source of evaluative judgments" (Andrade and Valtcheva, 2009). Students in Table 1 generally emphasized tracking their progress along the project timeline and making a regular contribution to complete the project work on time. For instance, 'Student A' was able to frame a strategy to complete the project by the deadline. The student emphasized working by oneself on the problem first and then discussing probable solutions with group members to determine the most effective plan for teamwork. Similarly, 'Student C' suggested setting intermediate and short-term deadlines for the group, which

**Table 1.** Self-reflection and peer feedback were provided by the students during the halfway formative assessment.

<b>1st Group</b>	
<b>Student A</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Use experience to provide an overview of the possible remedies and the pros and cons of each, and let the group determine the most effective. This will use my knowledge and incorporate the whole group in the remedial plan.</li> <li>- Work to get small portions done weekly to allow enough time in the end for review and revision.</li> </ul>
	<ul style="list-style-type: none"> <li>- Continue to set deadlines for the group because we will need these deadlines to stay on track. Our project will be more complete if we stick to these deadlines.</li> </ul>
<i>Peer-1</i>	<ul style="list-style-type: none"> <li>- If you continue to take the initiative and input the background information to the report, others will be able to focus on other areas of the project (i.e. risk analysis, remediation, etc.). Everyone will ultimately contribute to each piece but it is important to complete sections of the report.</li> </ul>
<i>Feedback</i>	<ul style="list-style-type: none"> <li>- Good start on the risk screening analysis. Others will follow your lead. Be sure to keep up with all the references to make our final deliverable more complete.</li> </ul>
	<ul style="list-style-type: none"> <li>- Continue to chip away at the bigger project by working on one section and checking it off.</li> </ul>
<i>Peer-2</i>	<ul style="list-style-type: none"> <li>- Your background in risk assessment will be valuable as we progress with the project. Keep asserting your opinion and the group will benefit.</li> </ul>
<i>Peer-3</i>	<ul style="list-style-type: none"> <li>- The models and report will need to be reviewed and revised multiple times. Focusing on the end deliverable will help eliminate frustrations with different ways of getting there.</li> </ul>
<b>Student B</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Find the time during the week to make more regular progress on the project, so that it doesn't become a last-minute problem.</li> <li>- Learn more about remediation technologies so that I have a better understanding of the range of options that are available for this site</li> </ul>
	<ul style="list-style-type: none"> <li>- Maybe need to learn how to write a proper reference list. And keeping track of your references as you go would help.</li> </ul>
<i>Peer-1</i>	<ul style="list-style-type: none"> <li>- Maybe not relying too much on your previous work experience, but looking at this project with fresh eyes might help to produce a better result. For example, relying on published material rather than rules of thumb from your industry experience.</li> </ul>
<i>Feedback</i>	<ul style="list-style-type: none"> <li>- You come up with some really useful information &amp; ideas and you are particularly good at thinking 'outside the box'.</li> </ul>
	<ul style="list-style-type: none"> <li>- If you were more confident &amp; assertive at putting your ideas to the group, I think we'd all benefit. Keeping track of your assumptions &amp; making a reference list as you go would help during this project.</li> </ul>
<i>Peer-2</i>	<ul style="list-style-type: none"> <li>- Maybe need to think outside the square a little more in terms of searching strategy, when looking for information.</li> </ul>
<i>Peer-3</i>	<ul style="list-style-type: none"> <li>- If you hit a supposed 'dead-end' and aren't sure how to proceed, consider changing your focus to some other area of the project.</li> </ul>
<b>Student C</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Work on researching in small increments more consistently. It will make it easier to process the information I'm reading, and I'll get less frustrated with hitting dead ends.</li> <li>- Do a better job of suggesting intermediate and short-term deadlines for the group. We seem to work more efficiently with a set deadline.</li> </ul>

Table 1. Contd.

	<i>Peer-1</i>	<p>- You seem really well organized, but I'm not sure your expectations for the work we should accomplish are quite ambitious enough. I'm worried we'll be scrambling at the end, and I think we should spend less time discussing the finer points and more time focusing on achieving a viable end result. Also, feel free to be a little more vocal and definitive about your opinions!</p> <p>- We could use more regular group communication between face-to-face meetings. It would help to exchange more quick status updates and reply-all responses to email questions. That way the project will continue to move forward and we can get to work faster when we meet because we'll all be on the same page. Even if you don't have a definitive answer or haven't seriously looked at it yet, say that.</p>
<i>Feedback</i>	<i>Peer-2</i>	<p>- You seem efficient at getting the work and research done on your own, which is definitely admirable. Be sure to let us know what you've been working on and what you've found. Also, feel free to make suggestions for others and do a bit of constructive delegating. That way we won't waste time duplicating the same info, and we'll be more accountable for our own work.</p> <p>- We could use more regular group communication between face-to-face meetings. It would help to exchange more quick status updates and reply-all responses to email questions. That way the project will continue to move forward and we can get to work faster when we meet because we'll all be on the same page. Even if you don't have a definitive answer or haven't seriously looked at it yet, say that.</p>
	<i>Peer-3</i>	<p>- You seem to have a good understanding of what works in real-world applications, so feel free to step up and voice your opinions more often. I think it will speed the group work along.</p> <p>- We could use more regular group communication between face-to-face meetings. It would help to exchange more quick status updates and reply-all responses to email questions. That way the project will continue to move forward and we can get to work faster when we meet because we'll all be on the same page. Even if you don't have a definitive answer or haven't seriously looked at it yet, say that</p>
<b>Student D</b>		
<i>Self-reflection</i>		<p>- Getting more work done by each meeting. I know it is hard with all the other work, but we need to get a move on.</p> <p>- Getting help from the rest of my group or course instructor if I get stuck, rather than just going in circles.</p>
	<i>Peer-1</i>	<p>- Getting more work done by each meeting. I know it is hard with all the other work, but we need to get a move on.</p> <p>- Not getting caught up in the little aspects – wanting to know all about the site history when the point of this assignment is more remediation techniques and a bit of risk assessment.</p>
<i>Feedback</i>	<i>Peer-2</i>	<p>- More communication (through email or in class) with where his research/work on this project is at.</p> <p>- Take charge/ownership of one aspect of the project.</p>
	<i>Peer-3</i>	<p>- As soon as you get stuck (i.e. with information you cannot find) go and ask the course instructor about it.</p> <p>- You have a lot of geology knowledge, so maybe try to put it to use in the project if you can (possibly in the geology write-up in the report).</p>

might be beneficial to ensure better work efficiency among group members. In this way, students might feel a higher degree of motivation and ownership when they were actively engaged in the learning process. "By being

involved in some of the decisions related to their own learning the learners can connect to their prior knowledge and their needs more optimally. Furthermore, by finding out things independently, they can follow their own

**Table 2.** Self-reflection and peer feedback provided by the other students during the halfway formative assessment.

<b>2nd Group</b>	
<b>Student E</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Slightly disorganized when preparing for meetings. Should present what I have done in a more user-friendly format.</li> <li>- Behind some of the group members in terms of understanding the project and its implications. Although I contribute I think they would benefit from working with someone on the same level. I will catch up.</li> </ul>
<i>Feedback</i>	<p><i>Peer-1</i></p> <ul style="list-style-type: none"> <li>- Organized and knowledgeable about the project. Can compare remediation techniques well. Good at organizing the group, and making sure it gets done.</li> <li>- Report writing skills are excellent. The reading flows and contains everything. Top-notch, way to go.</li> </ul> <p><i>Peer-2</i></p> <ul style="list-style-type: none"> <li>- Gets good work done when assigned. Finds valuable resources online.</li> <li>- Needs to attend lectures as the material we are covering is in the project.</li> </ul>
<b>Student F</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Be able to have better time management skills, especially with group projects. I find it difficult to manage projects that are not due in the immediate future, especially if there are other assignments for the same course not to mention other course assignments as well. Therefore, I will aim to break the team project into smaller bits and give myself deadlines.</li> <li>- Be able to understand the different contaminants better and how they exist in the environment and what hazards different contaminants produce, I find this a bit confusing so aim to get my head around this before the end of the term.</li> </ul>
<i>Feedback</i>	<p><i>Peer-1</i></p> <ul style="list-style-type: none"> <li>- Good at turning up to meetings and being prepared.</li> <li>- Good at breaking our project into smaller chunks so it seems more manageable and you manage time really well</li> </ul> <p><i>Peer-2</i></p> <ul style="list-style-type: none"> <li>- Good at turning up to meetings and doing the work that was agreed on.</li> <li>- Produced good work for our last meeting but working together as a team would be easier if you came to class more so that we would all have the same knowledge in terms of remediation techniques and what we are learning about at the moment as it is relevant to the team project</li> </ul>
<b>Student G</b>	
<i>Self-reflection</i>	<ul style="list-style-type: none"> <li>- Being more concise in the work I produce. Copying the same information from different sources doesn't really take the project far! Need to work harder on processing information and making it my own work.</li> <li>- Willingness to work in a group. I prefer to work independently and avoid asking questions. To be able to make better contributions I need to be able to ask questions about the topic- particularly the chemistry involved. Need to spend more time with the team. I prefer to do work autonomously.</li> </ul>
<i>Feedback</i>	<p><i>Peer-1</i></p> <ul style="list-style-type: none"> <li>- Excellent research skills, but I haven't had the chance to see any original work/thoughts.</li> <li>- Good team member- keeps on top of things. Coordinates well with other members and likes to keep everyone informed.</li> </ul> <p><i>Peer-2</i></p> <ul style="list-style-type: none"> <li>- Has a good understanding of concepts and remediation techniques- perhaps include team members in your work</li> <li>- Very driven and wants to achieve a good result. Good leadership skills. Kind of intense.</li> </ul>

interests and motivation" (Van Hout-Wolters *et al.*, 2000). Moreover, students within a team provided constructive

comments on peers' work and offered suggestions for necessary improvement. In the formative type of

assessment, peer feedback plays a crucial role in students' learning, and relevant research indicated that constructive peer feedback promotes learning and achievement (Andrade and Valtcheva, 2009). It is recognized that peer feedback can also enhance self-assessment and vice versa because common skills would be needed in both cases (Liu and Carless, 2006). Notably, peers commented very positively about 'Student A' and appreciated her/his contribution to the group project. They perceived that 'Student A' had prior knowledge of the issue they were working on, and therefore, she/he was able to construct new knowledge relevant to the issue based on past experiences, which might align well with constructive learning theory. Moreover, peers supposed that the knowledge, initiatives, and guidance provided by 'Student A' would benefit the whole group when they collaborated as team members. This observation suggested the advantages of a connective learning environment because knowledge distribution is the cornerstone of connectivist pedagogy as discussed earlier in this article. On the contrary, 'Peer-1' opposed 'Student B' for relying too much on her/his previous industrial experiences and suggested bringing a fresh outlook regarding the project work. It could be observed that 'Student B' was challenged by the peers to re-evaluate her/his original perspectives and beliefs, which might be helpful to expand knowledge and redefine outlook for problem-solving. At the same time, 'Peer-2' appreciated 'Student B' for her/his innovative thinking, which she/he thought would be useful for the group project. In this case, differences in opinions among peers could be observed, which might result from their differences in background and learning context yet closely resemble real-world scenarios. Learning is a personal and individual process, and students often have a different extent of understanding when judging from an academic or industrial point of view. The availability of diverse feedback and multiple perspectives can enrich students' learning experiences and provoke new thoughts during the process.

It was also noted that peers underscored the importance of regular communication for 'Student C' who had considerable knowledge of the topic and a good understanding of real-life situations, however, peers suggested that the student should put more effort into developing interactions among members and work together as a team achieving a viable result within the project timeline. Similarly, communication and interactions with peers and instructors were suggested for 'Student D'. While performing self-reflection, the student tried to identify her/his learning needs and found that learning from group members could be a way forward to solve the problem when things got difficult. In this way, group work and peer assessment could benefit students to augment their knowledge and broaden the learning context by combining various perspectives through connective learning. Relevant previous studies suggested that students' learning and key capabilities could be enhanced

by self-reflection and peer assessment, where students might shift from being passive to more active learners, develop a deeper understanding of the field of study, and cultivate critical reflection skills that are essential for progressive learning (Topping, 2018; Wanner and Palmer, 2018). For instance, considering a relevant study in which a peer assessment exercise was integrated with laboratory assignments, approximately 80% of students indicated that peer assessment was beneficial for their learning and they felt better prepared for upcoming laboratory reports after participating in the activity. "The peer assessment activity helped students to better understand the requirements of scientific writing; skills which they were able to transfer to other modules within their programme of study." (Barefoot *et al.*, 2011).

Among different groups, varied comments and feedback could also be typically observed (Table 2). The students recognized their deficiencies and mostly emphasized organization and time management skills, which required further improvement. For instance, in the case of 'Student F', procrastination was an issue as she/he could not concentrate on project work when there was no immediate deadline for submission. Sometimes the student found it difficult to understand the assigned topic for the group project. The self-reflection process assisted the student to recognize what improvement would be needed to overcome the shortcomings. However, the peers appreciated the positive mindset of 'Student F' for being prepared for group meetings and giving her/his input to the group project as agreed on. In contrast, 'Student G' pinpointed her/his lack of willingness for group interactions and sharing. Through the self-reflection exercise, the student held the view that she/he preferred to work independently and avoid asking questions in general. However, following the reflective practice, she/he would be willing to take the necessary steps to make a better contribution to the project by interacting more with group mates. The peers perceived the research ability and leadership skills of 'Student G' yet advised her/him to express more original thoughts and coordinate well with other team members, which would be indispensable for overall group performance. In this way, reflective practices and peer assessment provided meaningful and timely opportunities for the students to revisit their learning plans and improve their performance. Overall, this exercise could foster the students to stimulate their critical thinking ability.

### **Summative assessment by the peers**

The summative assessment exercise conducted at the end of this study allowed the students to grade their peers' work considering pre-designated criteria. The overall grading was evaluated in two categories. The first one involved assessing the technical competence of the peer by considering three qualities, *i.e.*, applying knowledge,



**Table 3.** Peer assessment (summative) criteria and corresponding grading of individual students at the end of the project.

Criteria	Technical competence			Teamwork			Total	Average	Group average	
	Applying knowledge	Analyzing problem	Developing solutions	Communication	Cooperative work	Engagement				
1st Group	A	4	4	4	4	4	4	24	24	22.5
		4	4	4	4	4	4	24		
		4	4	4	4	4	4	24		
	B	3	4	4	3	3	4	21	22.6	
		4	4	4	4	4	4	24		
		3	4	4	4	4	4	23		
	C	3	4	4	3	4	4	22	23.3	
		4	4	4	4	4	4	24		
		4	4	4	4	4	4	24		
	D	3	4	2	3	4	3	19	20.0	
		3	4	4	4	4	3	22		
		3	3	3	4	3	3	19		
E	4	4	4	3	3	3	21	18.0		
	4	4	4	1	1	1	15			
2nd Group	F	4	4	4	4	4	4	24	18.5	
		3	3	2	1	2	2	13		
G	2	2	2	2	2	2	12	16.5		
	4	3	4	4	3	3	21			

analyzing the problem, and developing a solution. The second category assessed teamwork, which was based on three sub-categories, *i.e.*, communication, cooperative attitude, and engagement of a particular group member during the project work. Based on a 1 to 4 scale (4 being the highest mark), one student could achieve a maximum of 24 marks in total as graded by peers. However, the summative assessment showed a

distinct variation (Table 3) between the performances of the two groups as a typical example for illustration. Students in the 1st Group demonstrated excellent performance in the project both individually and as a team. On the contrary, the performance of students in the 2nd Group was comparatively lower both individually and as a team. While comparing two major categories of assessment criteria, it could be observed that both

team members obtained good grades in terms of their technical competence. However, the performance of students in the 2nd Group was deficient concerning teamwork, which indicated a lack of communication, collaboration, and engagement among the team members. Considering the six essential steps illustrated in the Gibbs reflective cycle (Gibbs, 1988), after analyzing a learning experience, students should

**Table 4.** Students' comments regarding group interactions and peer contribution at the end of the project.

<b>1st Group: Stimulating performance</b>	<b>2nd Group: Struggling performance</b>
"Very cooperative and invested in the project, good communication"	"Was a valuable teammate but often wouldn't give me his sections on time"
"Great to work with"	"Great at end of the project, the only problem was getting work from him in earlier parts of the project"
"Had a few issues, I guess you were quite busy, but you did contribute a lot"	"Good at doing the work but often very lengthy and irrelevant, needed to be changed"
"Very knowledgeable and invested in the project, huge time input"	"This project was tough work. I don't know how to assess my team members as realistically they did the bulk of the work, but this was not for my lack of trying!"
"An effective manager, worked hard, and has good knowledge"	"Put a decent effort into the project but less effort in organizing information into a relevant format"
"Very cooperative but slightly less invested"	"Communication was poor, details of a change in design were not communicated throughout the group"

focus on how they could act differently in a similar situation, and what actions would be necessary to undertake in the case they need to improve their learning experiences. Notably, while conducting the formative assessment, students in the 2nd Group identified their lack of interactions and coordination among the team members, and necessary improvements were suggested by peers. However, low scores obtained in the summative assessment indicated that their realization of necessary learning adjustment was not successfully translated into required actions and engagement, which was very much needed to enhance their learning experiences both individually as well as a team. This observation highlighted the significance of reflective and collaborative learning which was demonstrated in the performance of students in the 1st Group where team members were able to effectively share their knowledge and learn from each other, subsequently leading to outstanding group performance. Contrasting performance between the two example groups was noticeable in the students' remarks where they commented on group interactions and peer contribution after finishing the project (Table 4). Stimulating the performance of students in the 1st Group was evident in their comments, for instance, peers appreciated each other for their cooperation, hard work, and knowledge sharing. During the course of the project, some peers mentioned having a few issues, however, they could overcome the challenges while working together as a team. In contrast, struggling performance was reflected in the remarks provided by students in the 2nd Group. They pointed out their lack of organization, communication, and commitment among peers, which unavoidably affected the group's performance. One of the students expressed her/his thoughts on how she/he found it difficult to assess the team members although they contributed a lot and finished most of the required tasks. Poor team coordination and a lack of collaborative commitment were evident among students in the 2nd Group. Apart from the provision of peer feedback, the ability and willingness of team members to collaborate and

support each other could significantly influence team performance (Ndoye, 2017). Additional help and guidance from the course instructor would be useful to stimulate and engage the students in group learning activities, especially for those who were struggling with their motivation and performance. Further exploration would be needed in the future to analyze the factors that make a team collaborate well and the other factors that may be detrimental to collaborative learning, such analysis could be addressed by prospective studies.

### **Students' responses regarding self-reflection and peer assessment practice**

Apart from the formative and summative assessment regarding the competence and teamwork involving the group project, students' responses were collected about the whole exercise regarding self-reflection and peer assessment practice. In general, students embraced the opportunity of practicing self-reflection and considered it a valuable part of their learning experiences in the course. They felt encouraged and empowered to be an active learner throughout these learning activities. One student commented that the exercise was effortless as she/he was already habituated to the process and had been doing it as a part of her/his own learning previously, while another student indicated that her/his critical thinking ability was stimulated by the self-reflection practice in this project. However, some students showed discomfort and admitted that it was somewhat difficult to be critical and evaluate themselves when practicing self-reflection. This could be a challenging and unique learning experience in their curriculum. Some students' responses about the self-reflection practice are quoted below.

"Self-reflection is extremely valuable, keep it as a part of an assignment because people get busy and forget to leave time for reflection"

"I'm always pretty self-reflective so writing it down wasn't a

big deal”

“Stimulated some critical thinking”

“Hard to be critical of yourself in self-reflection”

Similar to the self-reflection practice, the peer assessment process was practically welcomed by the participating students. They considered the process important and beneficial for their learning. However, they recommended adapting the design of the peer assessment exercise considering students' diverse needs to ensure benefits for all. Students highly appreciated peers' opinions and specific feedback that empowered them to understand their work and learning experiences from the others' points of view, which could be instrumental in re-evaluating their original perspectives for expanding their knowledge and skills. Moreover, they could learn to resolve issues if any through peer interactions.

“Peer assessment is important but difficult to implement in a school setting, consider reworking the peer assessment process so everyone benefits, perhaps forward along people's self-reflection to others to facilitate the process”

“Peer assessment is very useful as they can point out things you don't see, now I know what I can do better in a team; it's not very anonymous but doesn't need to be”

“Good to know how the team felt about my work, good to see things from others' point of view”

“Prefer to work out problems as they arise in person because it creates a more productive dialogue”

“Really helpful to get feedback from peers, especially halfway through”

In contrast, it was observed that some students faced difficulties concerning peer assessment and expressed uncertainty about what was required for the exercise. For example, one student expressed her/his vague feelings about being tough on his/her peers and assessing critically although it was a good exercise to advance learning experiences. The student commented that “It's a good idea but it's hard to be specific - you don't want to be offensive mid-project”. Some other students felt uncomfortable assessing and providing feedback to peers. “I didn't like the process and was uncomfortable giving feedback, pretty neutral about my team members, and felt I had to pick flaws that weren't essential for better learning”. The student might find it difficult to dedicate her/his effort to the project work and related peer assessment tasks as required. Nevertheless, as observed in the majority of students, the peer assessment exercise implemented in this study successfully enriched students' overall learning experiences and contributed to desired graduate attributes.

## CONCLUSIONS

This study promoted active learning through self-reflection and peer assessment exercises incorporated into group

projects. The reflective practice helped students to critically evaluate their learning styles and recognize learning needs for the advancement of knowledge and skills. Furthermore, peers showed an ability to propose constructive suggestions on what could be done to improve their learning experiences and track their progress together as a team. As perceived, the majority of the students developed into mindful learners and demonstrated a greater sense of responsibility toward their own learning and accomplishing the project work as a team, though some disparity in performance was observed in different groups and individual members. The findings of this study suggested that reflection, peer feedback, and a collaborative learning environment could augment students' learning experiences. Proper design and purposeful implementation of such pedagogical approaches would be conducive to entail a positive shift in the higher education system.

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