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# Assessment development to enhance student engagement and academic integrity in teaching engineering courses

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## ABSTRACT

### CONTEXT

Assessment and student engagement are crucial aspects of engineering courses. In recent years, due to the influence of pandemic, many courses have been delivered either online or in blended mode. It becomes more challenging to engage students in active learning and to conduct effective and reliable evaluation to assess student learning outcomes. There is a need to explore effective assessment strategies which can address the assessment and student engagement problems in engineering courses and can improve the overall learning experience and outcomes for students.

### PURPOSE OR GOAL

This study aims to investigate innovative assessment approaches in the teaching of engineering courses, in order to promote student engagement and to ensure the academic integrity. The research questions are, how can we engage students as partners in assessment development? How effective is the Student Negotiated Assessment activity in promoting students learning?

### APPROACH OR METHODOLOGY/METHODS

Engaging students as partners is employed for the assessment development in this study. This is through a Student Negotiated Assessment task, in which students are provided with opportunities to work as partners in learning and teaching, especially in assessment development. Students are asked to develop multiple choice questions on selected topics in this course as an assignment, and also to sit an online quiz with some questions contributed from students. Reflections from students are submitted and analysed.

### ACTUAL OR ANTICIPATED OUTCOMES

It has been shown from the student experience of course that students have enjoyed the Student Negotiated Assessment in which they are engaged as partner in the learning and teaching activities. It is much more engaging than just attending lectures or sitting an exam.

### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

This study examines assessment development and student engagement in engineering courses. It explores innovative approaches by involving students in assessment development. The outcomes reveal positive student experiences, increased academic integrity, and improved reliability of assessment results.

### KEYWORDS

Assessment, student engagement, integrity.

# Introduction

The learning and teaching in higher education face many challenges in student engagement and academic integrity in recent years. Some dramatic changes in the nature of higher education have been highlighted in (Biggs & Tang, 2011), such as the greater diversity in the student population, an overall lowering of academic standards. In addition, although the advancement of technologies provides numerous means and opportunities for enhancing the learning experience, such as the wide use of laptops and smart phones in classrooms, it also brings up concerns in terms of distractions and potential for academic misconduct (Biggs, 2007). The outbreak of the COVID-19 pandemic forced many educational institutions to shift towards remote and online learning. Even in the post-COVID age, it seems that blended mode teaching is still widely employed with online lectures and face-to-face labs or workshops. The virtual learning environments can make it harder for students to actively engage with course content and interact with their peers and lectures. For some assessment tasks such as assignment or online quiz, ensuring academic integrity is becoming a challenging problem. As the virtual learning environments become increasingly prevalent, it is critical to prioritize and enhance student engagement to ensure a positive and enriching student experience (Holmes, 2018).

In learning and teaching, assessment is conducted to assess how well a student's performance compares to the criteria in the outcome statement (Biggs & Tang, 2011). There is usually a need for constructive alignment between learning outcomes, learning activities and assessment tasks, which can be done by demanding the students to engage the learning activities expected in the outcomes. Due to the aforementioned challenges, traditional teaching is not effective in engaging students in active learning. According to the constructivism theory, the learners construct knowledge with their own activities, and that they interpret concepts and principles in terms of the 'schemata' that they have already developed (Biggs, 1996; Biggs & Tang, 2011). Therefore, teaching is supposed to engage students in active learning and to build their knowledge in terms of what they already know, rather than a matter of transmitting knowledge to students. Assessment is a vital part of learning and teaching in almost all courses. It is well recognised that what and how students learn is largely determined by assessment (Holmes, 2018).

Recent research has shown that some tangible benefits for all can be resulted in when students and teachers work together in an authentic partnership with the potential to enhance many areas of higher education remarkably (Mercer-mapstone et al., 2017; Snelling et al., 2019). The benefits include improved student engagement, increased motivation for learning and teaching by both students and teaching staff, and enhanced inclusiveness in teaching practices as well. Matthews argued that engaging with students as partners is the future direction for the student engagement movement, and it would be meaningful in higher education to create opportunities for students to share responsibility and ownership for their own success (Matthews, 2018). A recent investigation (Dai & Matthews, 2023) showed that while students as partners (SaP) is gaining attention in higher education as universities worldwide rethink pedagogical practices through a relationship-rich lens, the learner-teacher dynamics are also changing in China and there is an openness to position students as partners (in contrast to a view of students as followers). In a case study (Streule et al., 2022), students were engaged as partners in education space design. It was reported that identifying the nature of student expertise is key to these projects, and it was evidenced that students are experts in how students learn, socialise, and interact in various spaces. Love and Crough presented a trial of a SaP approach to increase engagement in a second-year biochemistry course (Love & Crough, 2019a). In their study, students were invited to choose two topics for the course and negotiate the number of student-generated questions as assessment for learning. It provided opportunities for the educators to learn from students through their engagement, feedback and insightful reflections. It was reported that the process also contributed positively to students' self-regulated learning (Love & Crough, 2019b).

In this study, an application of "students as partners" in the assessment development of a mechanical engineering course is presented. It is aimed to promote student engagement and to

ensure the academic integrity. The details of a “Student Negotiated Assessment” approach are presented in the methodology section, followed by the outcomes and discussions.

# Methodology

To support innovative learning and teaching, a trial run of assessment development to enhance student engagement and academic integrity was carried out through engaging students as partners in a mechanical engineering course. This was a course on manufacturing technologies for year 2 mechanical engineering students, which provides a practical and theoretical introduction to fundamental manufacturing technology with a primary focus on metal processing technologies and their applications in modern manufacturing industry. Students were expected to acquire knowledge of different manufacturing methods and to gain an understanding of the practical limitations of each method, which could help in the design of a part or product, and with the selection of the most economical method to manufacture a given design. This course included lectures, tutorials, and labs (manufacturing workshops and computer labs on CAD/CAM). The assessment tasks comprised problem-solving assessments (10%), lab reports (30%), final exam (50%), and a newly proposed Student Negotiated Assessment - Assessment development and quiz (10%).

In Student Negotiated Assessment, students were provided with opportunities to work as partners in learning and teaching, especially in assessment development. There were two parts in this assessment task, i.e., firstly, students were to develop multiple choice questions on selected topics in this course, and secondly, a quiz was to be organised with a number of these questions selected for all students to take part in. Each task contributed to 5 marks. To align with the University’s Teaching and Learning Framework, the implementation of technology enhanced Active Learning and Authentic Assessment strategies was set as a focus. It requires the student to become a cognitively active participant in the learning process, and not simply a recipient of content. Authentic Assessment focuses students on applying and demonstrating their knowledge and skills through tasks they may encounter in their post graduate working lives. In this Student Negotiated Assessment, it was believed that the student can purposefully engage in a range of activities to reflect, discuss, evaluate, apply, and create using the content provided.

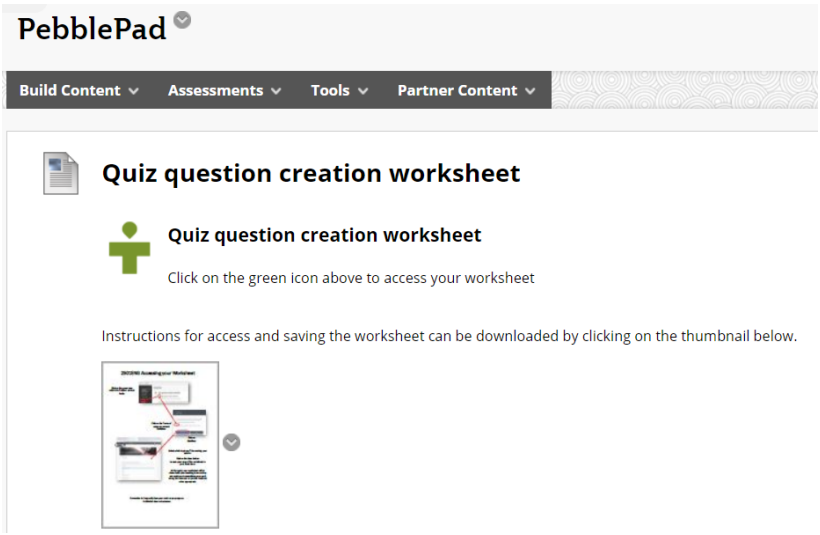
In Part 1 of this task, students were required to develop a multiple-choice question on a selected topic in this course, and to provide reflections on this task. There were a few topics they could choose, which was aligned with the main content in the course lectures covered in the first half of the trimester, i.e.,

- Measurement and tools
- Engineering materials
- Mechanics of machining
- Turning
- Milling
- Grinding

PebblePad was used as a platform for the implementation of this work. A template of a Quiz question creation worksheet was set up for the students to create and input their questions. After students click the PebblePad icon and enter the PebblePad template, they could see the instructions as shown in Fig. 1. Students could then follow the instructions, develop the multiple choice question, and input it into the places in the template. In addition, they were also required to complete a few questions to reflect on participation in the assessment design for the course. An assessment rubric for the MCQ development task was developed as shown in Fig. 2.

Our students should have sat many exams with multiple choice questions (MCQs) included, but most of them had never had any experience in creating an MCQ. Therefore, a basic training was needed to facilitate students. A brief guideline for designing multiple choice questions was posted on the course website as a reference resource. It provided fundamental knowledge and explained the key terms in writing MCQs, such as the question or unfinished statement, the answer options,

including the distractors and the correct response. Furthermore, it was also explained in a tutorial session with some examples and tips provided.




**Design a multiple choice exam question**

Write your multiple choice question below with all four answers and indicate if each is correct or incorrect. Resources for designing multiple choice questions have been added to the Learning@xxxxxxxx website under the course contents link.
There should be only ONE correct answer within the four answers provided.

**Note:**

1. All question will be checked using Turnitin and SafeAssign to ensure that they have not been copied directly from the internet or textbooks, as this would be plagiarism.
2. The same question submitted by different students will result in a loss of marks for both students

**Fig. 1. PebblePad interface and Instructions on how to design and input the multiple choice questions**

| | Excellent | Good | Poor |
|---|---|---|---|
| Is the question relevant to the topic? | very relevant | relevant | not relevant |
| Is the question clear to the reader? | very clear | clear | ambiguous |
| Does the correct answer include all of the essential details? | all essential details | most essential details | few essential details |
| Are the alternative answers plausible? | very plausible | plausible | not plausible |
| Is the question challenging? | challenging | moderate | easy |

**Fig. 2. Assessment rubric for the MCQ development task**

Students were also asked to provide a reflection about this activity. The following guidelines were provided. For questions 1-4, the answer should be a number from 1-5, where 1 means the least, and 5 means the most positive.

> *It's important for engineers to be able to reflect on projects and experiences to evaluate actions taken and decisions made and the outcomes of those experiences. Learning from*

*successes and mistakes contributes to the learning process and promotes personal understanding. The following questions and prompts provide you with guidance for the self-evaluations on this "students as partners" learning experience.*

**Question 1**. Please rate your experience as being a partner in the design of the assessment.

**Question 2**. Please rate the importance of being able to contribute to the assessment of the course.

**Question 3**. As a partner in the assessment design, were you more engaged in the course.

**Question 4**. As a partner in the assessment, rate the impact this had on your learning in the course.

**Question 5**. In what way did designing the multiple-choice questions impact your learning?

**Question 6**. As a partner in assessment design what did you particularly like and/or what could be improved?

**Question 7 (Reflection)**. Please provide any additional comments you'd like to contribute on your experience with designing multiple choice questions for the assessment of the course.

In Part 2 of the task, students were required to conduct an online quiz which includes 10 multiple choice questions. Five of the questions were from a pool with MCQs developed by students in Part 1 of the task, and another 5 were from a pool provided by the course instructor. Students were provided with one week time window to complete this quiz.

The online quiz was implemented on the Blackboard platform. As the quiz was conducted by students with a free time window and without proctoring, it was necessary to randomising the questions so that each student was provided with a test containing questions than were different from other students taking the same test, in terms of the questions, and/or the order of questions and answer choices within a question. This was achieved by using the following strategies when deploying the test:

Development of question pools with enough MCQ questions. The teaching staff selected and modified a considerable number of MCQs from the textbook resource to be used as a fundamental question set, and created quite a lot of questions which were unique in nature and could not be found from current internet websites. These were built as question Pool 1. Furthermore, the teaching staff carefully reviewed the MCQ questionnaire created and submitted by students, and selected around 60% from them with reasonable qualities and build another question Pool 2 after some minor but necessary revisions.

Using Blackboard to randomise test questions. From the two MCQ question pools, two randomization blocks were inserted into the test so that different students got different questions. Each randomization block was comprised of five questions that were randomly pulled from each question pool. Each question was worth 0.5 point. The probability of two students getting the same questions was almost impossible. Furthermore, the answer choices for a specific question were randomly ordered.

# Outcomes and Discussions

There were 51 students enrolled in this course. Amongst them, 46 students completed the submission of the MCQ creation assignment before the due, while 3 students submitted overdue by 3-5 days. There were 38 students submitted the MCQ and reflection with high standard and got full mark of 5, and 7 students were awarded a mark of 4 due to some minor issues. As to the MCQ online quiz, there were also 46 students sat the quiz as expected. The mean mark was 4.3, with a standard deviation of 0.9. The highest mark was 5, for which 19 students were awarded,

while the minimum mark was 0.5 for one student only. The distribution of the MCQ quiz results is shown in Fig. 3.

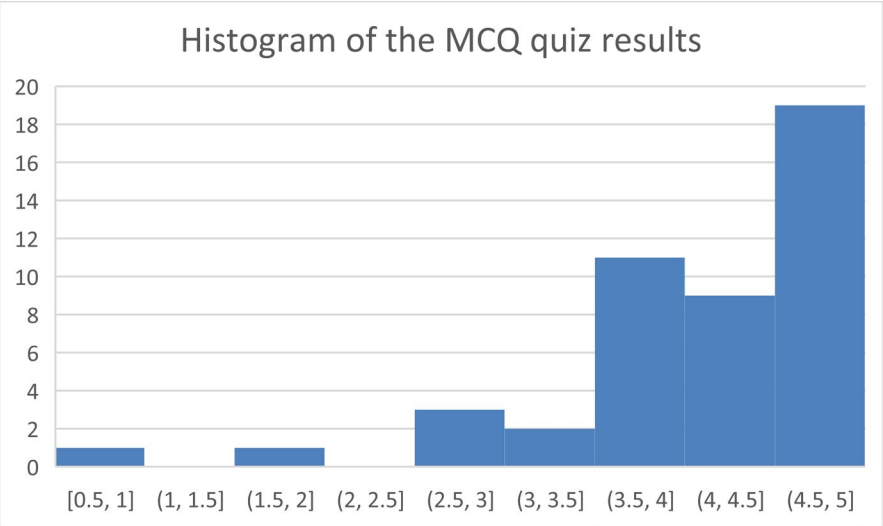



**Fig. 3. Histogram of the MCQ quiz results**

**Table 1: Statistical results of students response to reflection questions 1-4**

| Questions | Ave. score | Std. Dev. |
|---|---|---|
| 1. Please rate your experience as being a partner in the design of the assessment. | 3.94 | 0.81 |
| 2. Please rate the importance of being able to contribute to the assessment of the course. | 4.00 | 0.83 |
| 3. As a partner in the assessment design, were you more engaged in the course. | 4.13 | 0.82 |
| 4. As a partner in the assessment, rate the impact this had on your learning in the course. | 3.77 | 0.72 |

The statistical results of students' response to reflection questions 1-4 are listed in Table 1. In total there were 47 valid responses received. Overall, the responses were very positive. A high percentage of students felt that as a partner in the assessment design, they were more engaged in the course, with 16 students voted 5, and 24 students voted 4, to Question 3. It is noted that there was one student voted a 1 to this Question, which means he considered that he was less engaged.

From the responses to the open-ended reflection questions 5-7, it is evident that most students believed that the experience as being a partner in the assessment design had a very positive impact on their learning and teaching. Some sample reflections are listed in Table 2.

Analysis of student reflections revealed that this task prompted them to revisit lecture content, deepening their grasp of course topics and enhancing their overall knowledge. Students reported a positive impact on their learning. The process of designing multiple-choice questions (MCQs) proved more engaging than merely answering them. It encouraged students to gain in-depth knowledge of their chosen topic while also exploring other subjects. This fostered critical thinking, active learning, additional research, and summary creation.

It should be noted that implementing this assessment development activity demanded significant time from teaching staff. However, the outcomes were highly encouraging and promising. This methodology has the potential for extension to diverse assessment types and application across

other courses. Furthermore, integrating self and peer assessment activities with assessment development tasks can further elevate student engagement.

**Table 2: Sample student inputs to the reflection questions 5-7**

| ***Question 5. In what way did designing the multiple-choice questions impact your learning?*** |
|---|
| By designing my own multiple choice question, I was able to solidify my knowledge of the course, as I went through all of the lectures we had done before deciding upon milling as my chosen multiple choice topic. I chose this topic because I initially did not understand it as well as the others, and so by making this multiple choice question, I made sure to go back over the milling lecture and enhance my understanding of the topic. |
| Designing this multiple choice question has impacted my learning positively. I had to consider various areas, within each of the 6 topics, that could be used as a potential multiple choice question. In doing so, I had to establish what I knew about each area, and look through the lecture notes (if my knowledge was lacking), so that I could think of plausible answer options if I were to base my multiple choice question on that area. Hence, this task has allowed to improve upon my knowledge regarding the 6 topics taught so far. |
| I first reviewed the chapter and decided between a calculated answer or a knowledge question, this encouraged me to not only review the topic content, but select a question which I feel the answer is important to know in industry. |
| It allowed for a greater understanding in grinding, milling and turning operations as the task required us to not only find the correct answer to questions, but allowed myself to understand the reasoning on why this was the correct answer by looking for incorrect answers. |
| ***Question 6. As a partner in assessment design what did you particularly like and/or what could be improved?*** |
| I liked that I was able to contribute to the creation of the assignment rather than just doing another assignment as in most courses. To improve this assignment more question could be created for different topics of the course to further encourage reading through more material and thus getting a better understanding of each topic. |
| I particularly liked the insight this task provided into what the lecturer must go through when writing our assessment pieces. I now have a much greater appreciation for the knowledge, work, and effort that the lecturer and tutors put into the course. In addition, it has provided me with a better understanding of the construction of multiple choice questions, which will hopefully help me to better answer the many multiple choice questions I am sure to come across in the future. |
| I liked that we had to construct our own multiple choice question, as I think they are widely utilised in exams/quizzes because they can quickly and effectively assess the student's knowledge of a topic, and can easily be marked using scanners/computers. However, I think this assessment item can be improved by asking the student to create 1 multiple choice question for each of the 6 topics. Rather than improving/consolidating their knowledge of 1 topic, this would allow them to do that for all 6, hence being a more beneficial exercise. |
| I liked being on the other side of the test question; creating, not completing. It gives you a greater understanding of how they work and how questions can be manipulative if made correct. The aim of this particular assignment was also an innovative way of learning rather than the usual assignment structure. I believe this task was clear and easy to understand but an improvement that could be made is the option to make a few questions. This will give the marker a better understanding of what the student is capable of rather than judging one particular question. |
| ***Question 7 (Reflection). Please provide any additional comments you'd like to contribute on your experience with designing multiple choice questions for the assessment of the course.*** |

| |
|---|
| I really enjoyed the opportunity to contribute to the assessment for this course, and because of it, I have been able to go through all of the concepts covered in the lecture and evaluate my knowledge of the different topics covered. This assessment made me refer back to lectures, my notes, and the textbook, thus compiling my knowledge gained in this course. |
| I liked designing my own multiple choice question, as I found it interesting to learn about the principles which are used to create questions (stems) and convincing distractors, to ensure that only students with a good understanding of the topic will be able to select the correct answer. In addition, I liked that it also helped me to consolidate my knowledge regarding the 6 topics learnt so far. This made it not just an assessment item, but a learning activity for me as well. |
| I found this to be a very interesting exercise and hope to find more lecturers using this format for testing in the future. |
| Designing the multiple choice question was a new and engaging experience for me. Not only did writing the question make me think of a question but think about the types of questions I could be asked as well as how the writer of the final exam will be thinking in regards to writing the multiple answers we are given for each question. I recommend this method learning for all subjects as it encouraged a high engagement in class and in study. |

# Conclusions

This paper presented a study on assessment development and student engagement in an engineering course by engaging students as partners. This included two tasks for students to participate in an assessment item, i.e., to develop multiple choice questions on selected topics in this course, and to sit an online quiz with some questions contributed from students. Students provided reflections to the activities. It was shown that most students believed that the experience as being a partner in the assessment design had a very positive impact on their learning and teaching. The outcomes reveal positive student experiences, increased academic integrity, and improved reliability of assessment results.

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## Copyright statement