Effectiveness of Massive Open Online Courses (MOOC) Among Mechanical Engineering Students After Covid-19: A Survey

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ABSTRACT

This paper focused on the effectiveness of A Massive Open Online Course (MOOC) among mechanical engineering students at Universiti Teknologi MARA (UiTM) Pasir Gudang Campus after COVID-19. MOOC is a model for delivering online learning content to anyone enrolled in a course, with no limit on attendance. The effectiveness of online learning platforms depends on various factors, such as the platform's design, the quality of instructional materials, and the level of student engagement. Thus, subject MEC291 (Mechanics and Material Lab) is offered to semester 3 students in the Faculty of Mechanical Engineering. MOOC MEC291 consists of videos of theories, experimental procedures, experimental simulation, discussion, and student feedback. This survey was distributed to all 212 students registered for the Mechanics and Materials Lab course. The results indicated that MOOC platforms had effectively helped the students understand their laboratory work and enhanced their learning ability even in online platforms during and after the pandemic. The findings of this paper can inform policymakers, educators, and students about the potential of online learning platforms in Malaysia and help them address the challenges associated with this mode of education.

Keywords: MOOC, engineering, academic performance, ODL, Survey

INTRODUCTION

Online learning has become increasingly prevalent in higher education, including in the field of engineering. This learning mode offers several advantages, such as flexibility, accessibility, and access to a wide range of resources (de Souza Rodrigues et al., 2021; Habib et al., 2021; Jiang et al., 2021). In Malaysia, the effectiveness of online learning for engineering students has been a topic of interest and research.

The University Technology MARA (UiTM) recognizes the importance of online research databases in improving educational outcomes and promoting research among its students and academic staff. Additionally, a pilot study conducted among engineering students in Malaysia recommended the provision of online simulations to enhance laboratory-based courses (Mat Isa et al., 2022). These findings highlight the potential benefits of online learning for engineering students in Malaysia.

The COVID-19 pandemic has further accelerated the adoption of online learning in Malaysia, prompting educational institutions to rapidly integrate digital platforms and tools to ensure uninterrupted student learning across the country. Due to the pandemic, the closure of educational activities resulted in an unplanned shift from traditional education to a setup exclusively involving digital teaching and learning (Ibrahim & Baharudin, 2023; Jafar et al., 2022; Yap et al., 2023) .A study conducted at Merlimau Polytechnic in Melaka aimed to explore mechanical engineering students' perceptions regarding the effectiveness of synchronized online learning during the pandemic. This study provides insights into the challenges and opportunities of online

learning for engineering students in Malaysia (Ibrahim & Baharudin, 2023; Isovitsch Parks et al., 2023; Koh & Wong, 2021).

To enhance the quality of online teaching and learning in Malaysia, there is a need to make the learning experience enjoyable and innovative (Hadibarata et al., 2023). Project-based learning has been identified as a practical approach to enhance students' knowledge and capability in solving real-world engineering problems (Maladzhi et al., 2024). Therefore, integrating open-source resources and providing affordable and accessible solutions are crucial in enabling a quality remote teaching and learning experience for engineering students in Malaysia.

Significant steps have been taken by Universiti Teknologi MARA (UiTM) to implement creative digital solutions to provide active virtual learning experiences for their students. To ease the online learning process for UiTM students, Massive Open Online Courses (MOOCs), an internet-based course, were offered to the students. A typical MOOC has specific start and end dates, a defined topic of study, facilitators, and assessments. Students were encouraged to watch a short video of lectures and graphical information and complete the assessments that are graded either automatically or by peers. Students can choose what content they wish to learn, which makes their learning personalized and at their own pace. Fig. 1. shows the overview of the platform.

Fig. 1. Overview of UiTM MOOC Platform

In the Faculty of Mechanical Engineering, UiTM Johor, Pasir Gudang Campus, the subject Mechanics and Material Laboratory (MEC291) course is offered to semester 3 students. MOOC MEC291 consists of videos of theories, experimental procedures, experimental simulation, discussion, and student feedback. The course consists of practical work involving investigations and analysis in mechanics and material science. Unlike theoretical subjects, this course adheres to various challenges as it is a practical course requiring the students to prove their understanding through hands-on and practical work.

When the wave of COVID-19 hit Malaysia, public and private universities had to be closed to adhere to the government's Restriction of Movement Order (RMO). COVID-19 has affected the students' education as they must stay home during the lockdown. To ensure continuous learning, teaching, and learning activities were delivered through online learning. Since then, there has been high demand and usage of the MOOC platform.

Hence, after 5 years of RMO, MOOC is still ongoing among students in the university. Thus, this research investigates the effectiveness of Massive Open Online Courses (MOOCs) among engineering students after COVID-19. A survey has been distributed to the students, and the results will be discussed in this paper.

LITERATURE REVIEW

The evolution of online learning has significantly impacted engineering education, particularly in the Malaysian context, where digital delivery has gained momentum in recent years. Kamaludin & Susdarasen emphasized that the rapid adoption of online distance learning (ODL) during the COVID-19 pandemic presented both challenges and opportunities for students and educators, revealing gaps in infrastructure and adaptability (Kamaludin & Sundarasen, 2023).

Socioeconomic factors also play a crucial role in determining student success in online learning environments. Mat Isa et al. found that civil engineering students from lower-income families experienced considerable

barriers during online learning, including inadequate learning devices and unstable connections, further exacerbating the educational divide (Mat Isa et al., 2022).

Many institutions have shifted towards virtual laboratories to overcome the absence of physical laboratories. A systematic literature review by Wahyudi et al. highlighted how virtual labs have been successfully utilized in engineering education to simulate real-world experiments, allowing students to practice skills remotely while maintaining conceptual understanding (Wahyudi et al., 2024).

Earlier work by Balamuralithara and Woods provided a foundation for understanding the implementation of simulation and remote labs, arguing that virtual labs enhance engagement and reduce logistical burdens (Balamuralithara & Woods, 2009). Moreover, Potkonjak et al. demonstrated that virtual laboratories can effectively replace or complement traditional labs in science, technology, and engineering education, especially when well-designed and properly integrated into curricula (Potkonjak et al., 2016).

In parallel, project-based learning (PBL) has gained attention as a method to sustain interactivity in remote settings, and a 21-year meta-analysis concluded that PBL significantly improves practical skills, theoretical comprehension, and collaborative learning, especially in engineering programs (Hidayat et al., 2024). Supporting this, Lavado-Anguera et al. reviewed the literature on experiential learning. They confirmed that PBL fosters critical thinking and real-world application in engineering education, making it well-suited for online formats (Lavado-Anguera et al., 2024).

Hadibarata et al. explored the integration of problem-based learning in engineering courses. They observed that it encouraged active participation and self-regulated learning, instrumental in online classrooms (Hadibarata et al., 2023). Meanwhile, Khandakar et al. demonstrated that implementing multi-course PBL enhanced academic outcomes and promoted sustainability awareness, aligning well with modern engineering education goals (Khandakar et al., 2020).

The COVID-19 pandemic has accelerated the adoption of online learning in Malaysia. The study aimed to develop practical online and software-related approaches based on students' impressions. The study's findings can contribute to developing more effective online learning strategies for engineering students, particularly in remote learning necessitated by the pandemic.

MOOCs form an essential part of the educational response to the pandemic. As mentioned before, the subject MEC291 is offered to semester 3 students. MOOC for MEC291 consists of videos of theories, experiment procedures, experimental simulation, discussion, and student feedback. Fig. 2. shows the overview of the MOOC, and Table 1 shows the list of nine experiments in MEC291.

Table 1. List of Experiments in MEC291

Course	Experiment
Strength of Materials	i. Tensile test ii. Torsion test iii. Straight beam experiment
Material Sciences	iv. The effect of heat treatment on the microstructure of steel v. Observation on the microstructure of cast iron vi. Hardness test
Dynamics	vii. Wheel and axle apparatus viii. Crank and slider mechanism ix. Flywheel apparatus

Fig. 2. MEC291 MOOC Platform

METHODOLOGY

This research is quantitative and based on a survey. A questionnaire based on a five-point Likert scale was the instrument used in the investigation. This survey was distributed online to all mechanics and material lab students at the Faculty of Mechanical Engineering, UiTM Johor, Pasir Gudang Campus, ranging from group A to M. Google form, an online questionnaire tool, was the platform to collect the data from respondents in this research. From the total of 212 registered students from the overall semester 3, only 191 responses were received, with a 90.1% response rate. Table 1 below portrays the distribution of respondents based on group.

Table 2. Respondent's Profile

Group	Frequency (No.)	Percentage (%)
A	7	3.7
B	24	12.6
C	12	6.3
D	15	7.9
E	14	7.3
F	15	7.9
G	12	6.3
H	8	4.2
I	11	5.8
J	14	7.3
K	21	11
L	24	12.6
M	14	7.3
Total	191	100

Table 2 shows that most students were from Group B and L (12.6%), followed by Group K (11%), Group D and F (7.9%), Group E, J, and M (7.3%), Group C and G (6.3%). Group I (5.8%). Group H (4.2%) had the highest percentage, and the lowest rate was indicated by Group A students (3.7%). The percentage proportion by Group amongst the respondents, considering the total enrolled students for this subject from February 2025 to June 2025 for the Faculty of Mechanical Engineering, UiTM Johor, Pasir Gudang Campus. differences when interpreting the results.

There are 11 questions asked in the survey to evaluate the student's effectiveness in the MOOC MEC291 for Mechanics and Materials Lab. The satisfaction level was rated using a 1-5 Likert scale of 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree.

Table 3. Respondent's Questions

Elements	Questions
Learning to understand	The demonstration video helps me understand the laboratory procedure before I conduct the experiment.
	The demonstration video is clear and helps me understand the concept of the experiments.
	The demonstration video is a compulsory requirement in the online laboratory class.
Feeling	Do you enjoy learning remotely, especially for MEC291?
Effectiveness	The MOOC is effective for me to understand all the experiments.
	Rate your satisfaction with the demonstration video in MEC291.
	Overall, please describe your experience, especially concerning the MEC291 subject.

According to Table 3, there are three elements of students' satisfaction with this subject: learning understanding (three questions), feeling (one question), and effectiveness (three questions). The development of the question is based on quantitative techniques to obtain a comprehensive understanding of the effectiveness and challenges of online learning among mechanical engineering students in the Faculty of Mechanical Engineering, UiTM Johor, Pasir Gudang Campus.

FINDINGS

In collecting data, after the number of students in each group was determined, the questionnaires were distributed among the students. They were asked to answer the questionnaire. Their responses to the questionnaire were used as quantitative data. All the responses will be discussed in this section.

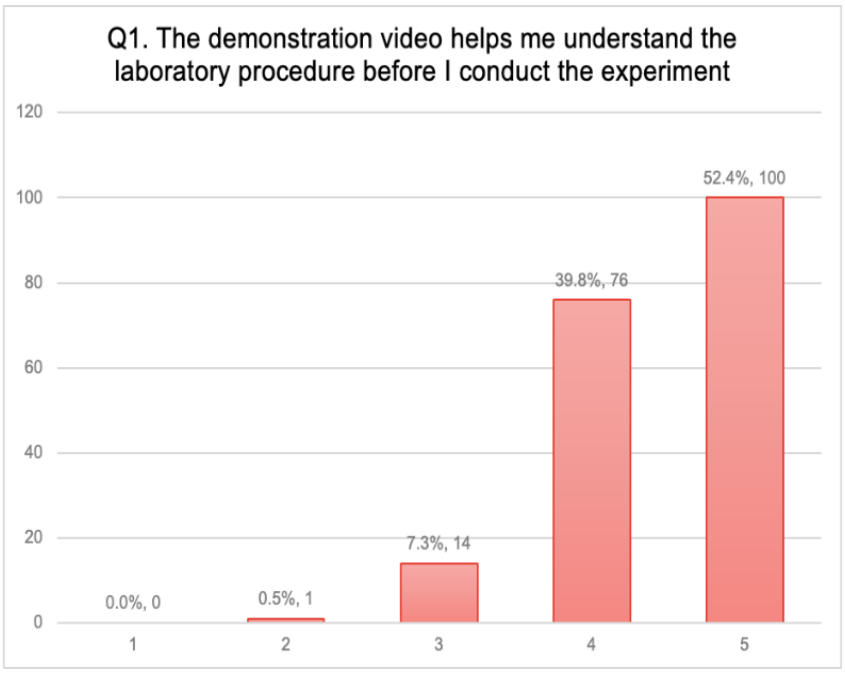

Fig. 3. Question 1- The demonstration video helps me understand the laboratory procedure before I conduct the experiment

The analysis of student feedback on the statement, "The demonstration video helped me understand the laboratory procedure before I conduct the experiment," reveals a compelling affirmation of the video's pedagogical value. Based on the 281 responses, 92.2% of students agreed (39.8%) and strongly agreed (52.4%) that the video effectively supported their understanding. The highest positive response indicates that most students found the video a meaningful and practical learning aid, especially in laboratory-based education, where procedural clarity and visual cues are essential.

Interestingly, only 7.3% of respondents remained neutral, possibly reflecting a group that neither benefited significantly nor faced any disadvantages from the video. Even more telling is the negligible percentage of students; 0.5% expressed disagreement, and none strongly disagreed. The survey suggests a widespread acceptance of video demonstrations as a legitimate and effective supplement to traditional laboratory instruction.

This finding is supported by Brame et al., who highlight that educational video can significantly improve students' conceptual understanding and procedural accuracy when designed with cognitive load principles in mind. Integrating signaling, segmenting, and active learning prompts within video content fosters deeper engagement and improved retention of complex scientific processes (Brame, 2016). Similarly, a study by Onyeaka et al. demonstrates that pre-laboratory video demonstrations positively influence student preparedness, reduce anxiety, and increase participation levels in laboratory sessions, particularly in STEM education contexts (Onyeaka et al., 2023).

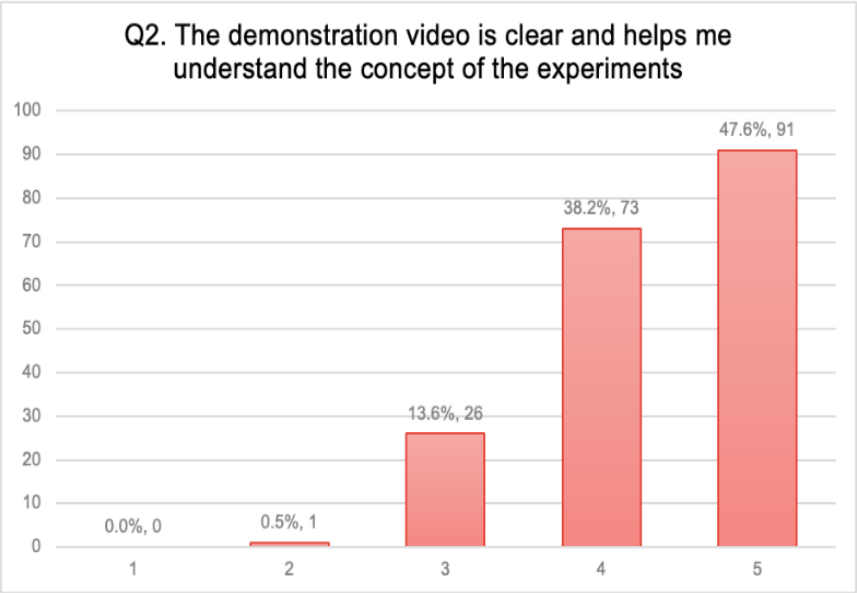

Fig. 4. Question 2- The demonstration video is clear and helps me understand the concept of the experiments.

The analysis of student responses to Question 2 indicates a strong consensus on the effectiveness of demonstration videos in enhancing conceptual understanding of laboratory experiments. Out of 191 respondents, 47.6% (91 students) strongly agreed, and 38.2% (73 students) agreed that the demonstration video was clear and facilitated their comprehension of the experimental concepts. 85.8% of participants voiced positive feedback regarding the clarity and educational value of the video content.

A minor participant, 13.6% (26 students), selected a neutral response, suggesting that while the video may have been helpful, it did not significantly impact their understanding. Only 0.5% (1 student) disagreed, and none strongly disagreed, indicating minimal negative perception of the video's effectiveness.

Given the positive student feedback and supporting literature, it is recommended to continue integrating clear and well-structured demonstration videos into laboratory instruction. Enhancements such as interactive elements, subtitles, and multilingual support could further increase accessibility and effectiveness, catering to diverse learning needs.

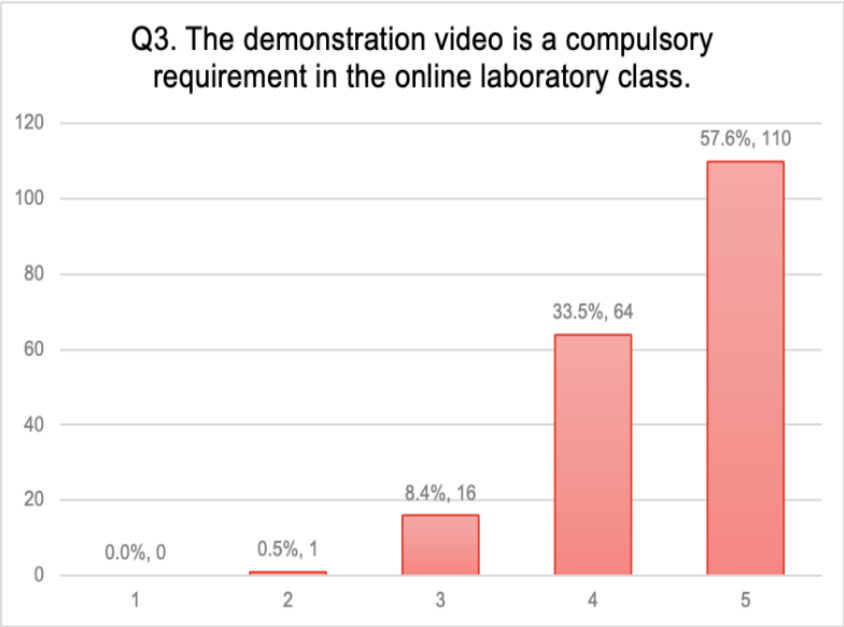

Fig. 5. Question 3- The demonstration video is a compulsory requirement in the online laboratory class.

The response to Question 3 strongly indicates that students perceive demonstration videos as a compulsory requirement in online laboratory classes. Of the 191 respondents, 57.6% (110 students) strongly agreed, and 33.5% (64 students) decided that videos should be compulsory. Combining the more than 90% reflects widespread reliance on and appreciation for demonstration videos, especially in environments with limited physical laboratory access.

Only 8.4% (16 students) responded neutrally, and only 0.5% (1 student) disagreed. Notably, no respondent strongly disagreed, underscoring the universal recognition of video content as an essential instructional support tool in virtual lab settings. This understanding reflects user preference and supports instructional design theory that stresses the importance of multimodal learning and visual scaffolding in technical education.

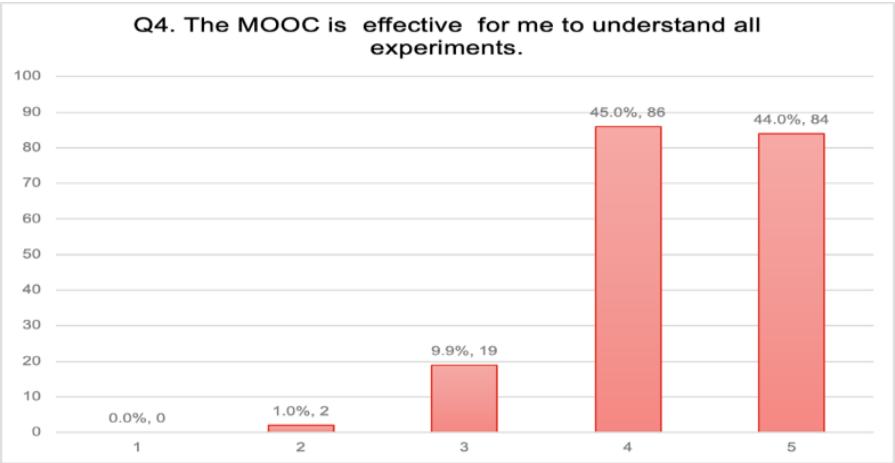

Fig. 6. Question 4- The MOOC is effective for me to understand all experiments.

From the responses, it's clear that most students feel that the MOOC (Massive Open Online Course) is genuinely helpful in helping them understand all the experiments in their course. Out of 191 students, 44.7% (84 students) strongly agreed that the MOOC was effective, and 45.0% (86 students) also agreed. 89.7% of students found the MOOC helpful in understanding the experimental content.

Meanwhile, 9.9% or 19 students selected a neutral response. These students may have found the MOOC moderately useful or needed more interaction or support to benefit from it fully. Only two students (1.0%) disagreed, and no one strongly disagreed, which is a strong sign that the MOOC content was well received overall.

The survey demonstrates that most students understand how the MOOC is constructed, most likely because it provides flexibility, structured modules, and on-demand learning. With experiments often being complex or hands-on, having access to online explanations, videos, or quizzes can make it easier for students to revisit concepts at their own pace. It also supports independent learning, especially for those who prefer studying outside traditional class hours.

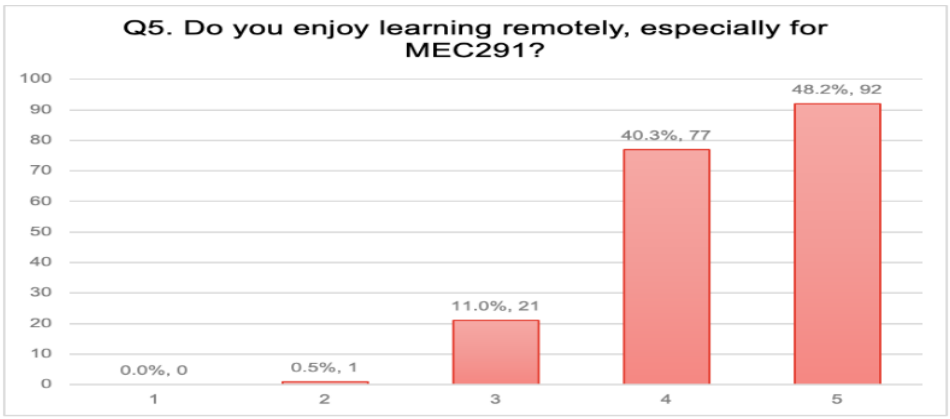

Fig. 7. Question 5- Do you enjoy learning remotely, especially for MEC291?

The analysis of student responses to Question 5, "Do you enjoy learning remotely, especially for MEC291?" reveals a highly positive perception of remote learning within this course. Out of 191 respondents, 48.2% (92 students) reported intense enjoyment, and an additional 40.3% (77 students) agreed that they enjoyed the remote learning experience, totalling 88.5% positive responses. This overwhelming majority suggests that students have received the delivery of MEC291 online. Only 11.0% (21 students) remained neutral, and a mere 0.5% (1 student) expressed disagreement, while no student selected "strongly disagree," indicating minimal resistance to the remote format.

Several factors may contribute to this favourable outlook, including the flexibility of online access, the comfort of learning from home, the integration of clear instructional videos, and an overall supportive course structure. The data suggests that the remote delivery of MEC291 supports student engagement and enhances their learning satisfaction. Given these findings, educators are encouraged to continue offering high-quality online learning environments and consider hybrid approaches for future course iterations. However, further feedback should be gathered from the neutral and dissatisfied respondents to ensure inclusivity and continual improvement in online course design.

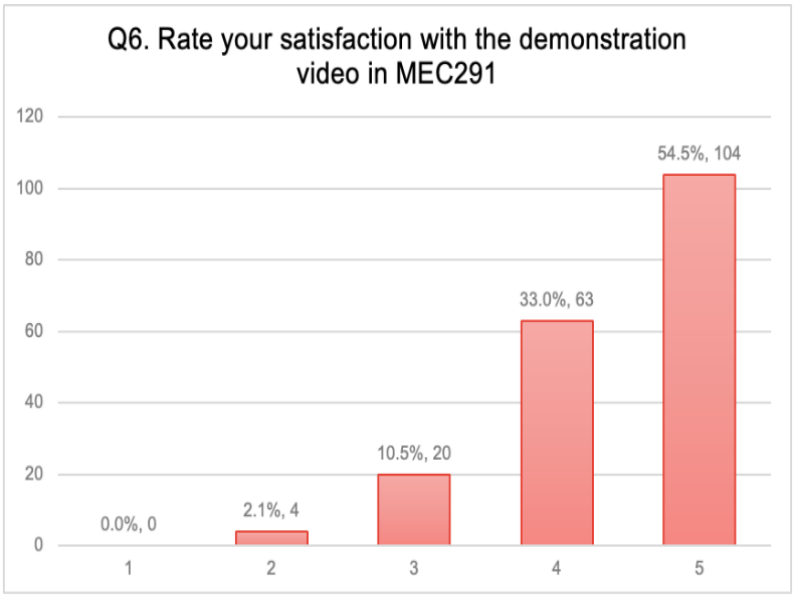

Fig. 8. Question 6- Rate your satisfaction with the demonstration video in MEC291.

Based on the results, it's safe to say that most students are satisfied with the demonstration videos provided in MEC291. Nearly half of the respondents, 33.0% (63 students), rated their satisfaction as a 4 out of 5, and another 54.5% (104 students) gave it a full 5, which shows a firm overall approval of the videos. Combined, that's 87.5% of students feeling satisfied or very satisfied.

A smaller portion, 10.5% (20 students), gave a neutral rating of 3, suggesting that while the videos were helpful, some students felt there was room for improvement, maybe clarity, engagement, or additional explanation. Only four students (2.1%) rated their satisfaction as 2, and none gave the lowest score of 1, indicating that almost no one was outright dissatisfied.

It is a good sign that the demonstration videos are doing well. Students likely appreciate that the videos make it easier to understand the experiments before doing them, especially in a technical subject like MEC291. The high satisfaction rates could be linked to clear visuals, step-by-step instructions, and the ability to rewatch the videos as needed.

Still, since a few students felt neutral or slightly dissatisfied, getting more detailed feedback might be worth seeing if certain parts of the videos could be improved, such as adding subtitles, clearer audio, or showing mistakes to avoid during experiments.

For the effectiveness element, “Overall, please describe your experience, especially concerning the MEC291 subject”, most respondents gave positive feedback based on their experience learning in MOOC. Table 4 shows several comments from respondents about their experiences.

Table 4. Respondents’ comments on their experience in MEC291

No	Comments from respondents
1	MEC291 is done professionally and has been thought through to face the challenges of online classes and face-to-face
2	The video provides detailed information and step by step for students to understand and prepare for their lab test
3	This subject helped me to gain some experience in handling experiments in the lab
4	The demonstration videos help to understand all experiments
5	I enjoyed experimenting, and the video that the lectures provided helped me to experiment better
6	It was an excellent experience for me because it helped a lot to understand the subject
7	Useful for the future. Because we can learn how to experiment
8	This subject has taught me how to run an experiment
9	It increases my knowledge, and I can experiment. Thank you
10	Very fun, and it helps me gain more knowledge

CONCLUSION

Findings from this study point to the fact that MOOCs have been strong in the Faculty of Mechanical Engineering, UiTM Johor, Pasir Gudang Campus. MOOCs have helped promote the concept of innovative e-learning that enhances students' learning ability through guided online experimental processes. The universities may also assess the strengths and weaknesses of MOOC as an online learning platform and decide whether it is viable to replace the current conventional teaching method.

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