 https://doi.org/10.24191/jeesr.v29i1.012

Evaluating a MOOC-Supported Blended-Learning Power Electronics Course: Perceived Competency and Course Performance

Norazlan Hashim*, Badrul Isa, Tuan Badrol Hisham Tuan Besar, Khairul Safuan Muhammad, Wan Noraishah Wan Abdul Munim, and Ahmad Asri Abd Samat

***Abstract*—This study evaluated a Massive Open Online Course (MOOC)-supported blended-learning implementation for the Power Electronics (EPO510) course at Universiti Teknologi MARA. The study examined changes in students' self-perceived competency, their evaluation of the MOOC, and their final course performance across three Course Learning Outcomes (CLOs): CLO1, analysing power switching device characteristics and converter operating principles; CLO2, examining converter parameters through circuit analysis; and CLO3, designing power electronic converters to meet specified requirements. A descriptive-evaluative design with a matched pre-post survey was employed involving 30 students from group CEEE2235E in the October 2025 to February 2026 semester. Data were collected through the Entrance Survey, Exit Survey, Module Feedback Survey, and official final course results. Descriptive statistics, Cronbach's alpha, paired-samples t-tests, and Pearson correlation analysis were applied. The overall mean self-perceived competency increased significantly from 1.61 before the course to 4.28 after the course ($p < 0.001$). Students also evaluated the MOOC positively, with an overall feedback mean of 4.22; the platform dimension recorded the highest mean (4.38), followed by instructor support (4.23) and content (4.12). Final course performance varied across the CLOs, with mean percentages of 52.86%, 62.82%, and 85.00% for CLO1, CLO2, and CLO3, respectively, and an overall performance of 62.13%. Correlations between survey-based measures and overall final performance were weak and not statistically significant. The findings suggest that the MOOC served as a structured support platform for blended learning in EPO510, particularly in supporting students' perceived competency and overall course experience.**

***Index Terms*—ADDIE model, blended learning, engineering education, MOOC, perceived competency, power electronics.**

This manuscript is submitted on July 14, 2026, revised on August 29, 2026, accepted on September 7, 2026 and published on October 31, 2026.

Norazlan Hashim, Khairul Safuan Muhammad, and Wan Noraishah Wan Abdul Munim are with the Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor, Malaysia.

Badrul Isa is with the Faculty of Education, Universiti Teknologi MARA Cawangan Selangor, Puncak Alam, Malaysia.

Tuan Badrol Hisham Tuan Besar is with the Faculty of Business and Management, Universiti Teknologi MARA Cawangan Selangor, Puncak Alam, Malaysia.

Ahmad Asri Abd Samat is with the Electrical Engineering Studies, Universiti Teknologi MARA Cawangan Pulau Pinang, Kampus Permatang Pauh, Malaysia.

*Corresponding author
Email address: azlan4477@uitm.edu.my

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I. INTRODUCTION

Power Electronics (EPO510) [1] is an important engineering course offered by the Faculty of Electrical Engineering at Universiti Teknologi MARA as part of the Bachelor of Electrical Engineering with Honours (CEEE223) programme. The course consists of six chapters covering the fundamentals of power electronics, with a strong emphasis on power conversion circuits, common topologies, their operating principles, and the analysis of key parameters required for practical design and application. Its designated course learning outcomes require students to analyse the characteristics of power switching devices and the operating principles of power electronic converters (CLO1), examine the parameters of power electronic converters using circuit analysis (CLO2), and justify the design of power electronic converters to meet given specifications and requirements (CLO3). Despite its importance, Power Electronics is often challenging for students because it involves abstract concepts, waveform interpretation, circuit analysis, and design reasoning.

These learning demands often require students to engage in repeated review and independent learning beyond regular classroom hours. As a result, blended learning has become an important approach in technical engineering courses because it enables students to revisit instructional materials, participate in guided activities, and extend their learning beyond scheduled lecture sessions. In this context, Massive Open Online Courses (MOOCs) can serve as structured digital support platforms that complement conventional face-to-face instruction. In the Malaysian higher education setting, particularly at Universiti Teknologi MARA (UiTM), MOOCs have been increasingly adopted to support a more systematic implementation of blended learning. Previous studies indicate that such platforms can support self-paced learning, improve access to course materials, and provide an organised learning environment that students generally evaluate positively when the content is clear, relevant, and accessible [2, 3]. Studies on MOOC acceptance and perception also suggest that learners value flexibility, relevance, and ease of use [4, 5].

One of the most widely used frameworks in MOOC development is the ADDIE model, which consists of Analysis, Design, Development, Implementation, and Evaluation [6-8]. This model supports the structured planning of learning objectives, content organisation, development of digital

materials, implementation of online learning activities, and evaluation of learner responses, making it suitable for the development of a MOOC-supported blended-learning course. However, the effectiveness of a MOOC-supported course depends not only on the availability of online materials but also on platform usability, content quality, accessibility, instructional support, and the broader design of the blended learning environment [9-11]. Earlier studies have shown that learner satisfaction and perceived learning outcomes in MOOCs are influenced by course design, instructor support, and learning engagement [12, 13]. In engineering education, blended approaches have also been associated with improved engagement and more flexible learning pathways, although successful implementation remains dependent on context, design quality, and student readiness [14].

Recent studies further support the use of blended and MOOC-supported approaches in engineering education. A systematic review of blended learning in engineering reported that the integration of face-to-face and digital activities can support the development of advanced problem-solving skills and constructive alignment between learning activities and intended outcomes [15]. Similarly, a recent systematic review of MOOCs in engineering education found that MOOCs are more effective when integrated within broader pedagogical systems, particularly through blended learning and other structured instructional approaches [16]. Recent evidence from technical engineering education also showed that hybrid learning can improve academic performance compared with fully online or conventional face-to-face delivery [17].

Nevertheless, fewer studies have examined students' self-perceived competency before and after a MOOC-supported course, their evaluation of the learning platform, and their CLO-based course performance within a single engineering module. This gap is important because perceived learning, course experience, and measured achievement represent related but distinct indicators of course effectiveness. In particular, limited evidence is available on the combined evaluation of these three dimensions within a Power Electronics course. By integrating pre-post perceived competency, students' evaluation of the MOOC-supported learning experience, and actual CLO-based course performance, this study provides a more comprehensive assessment of the role of MOOCs in blended engineering education and enables comparison between students' perceptions and measured academic achievement.

Therefore, this study evaluates the MOOC-supported blended-learning implementation of EPO510. Specifically, it examines students' self-perceived competency in relation to selected course outcomes at the beginning and end of the course, their official final course results, and their evaluation of the MOOC in terms of platform, content, and instructor support.

Accordingly, this study addresses the following research questions:

RQ1: Is there a significant difference between students' self-perceived competency before and after the MOOC-supported blended-learning implementation?

RQ2: How do students evaluate the MOOC-supported learning experience in terms of platform, content, and instructor support?

RQ3: How do students perform across CLO1, CLO2, and CLO3 based on their official final course results?

RQ4: Are students' post-course self-perceived competency and MOOC evaluation significantly associated with their overall final course performance?

Overall, the findings show that students reported improved perceived competency and responded positively to the MOOC-supported learning environment, although these perception-based measures were not strongly associated with their final course performance. These findings provide further insight into the role of MOOCs as structured support platforms for blended learning in engineering education.

The remainder of this study is organized as follows. Section II describes the ADDIE-based methodology used for the development, implementation, and evaluation of the MOOC-supported blended-learning course. Section III presents and discusses the study results, including students' perceived competency, course evaluation, and academic performance. Finally, Section IV concludes the study by summarizing the key findings and discussing its limitations and future research directions.

II. METHODOLOGY

This study employed the ADDIE model to guide the development of the MOOC in supporting the blended learning delivery of the EPO510 course. Comprising five phases, namely Analysis, Design, Development, Implementation, and Evaluation, the model was selected for its systematic approach to designing and evaluating digital learning materials.

A. Analysis

The analysis phase focused on identifying the key issues and learning needs to be addressed in the development of the EPO510 MOOC. This phase involved examining the problems faced by students in learning Power Electronics and determining the factors contributing to those difficulties. It also considered the product requirements, including the objective of developing the MOOC as a structured instructional support platform. As the foundation of the instructional design model, the analysis phase guided the subsequent design and development stages. For the EPO510 MOOC, the main objective was to develop an interactive learning platform that could support blended learning, enhance students' understanding of key course topics, and provide accessible learning materials beyond the classroom.

B. Design

During the design phase, the MOOC's instructional framework was developed, and its learning components were organised logically. A storyboard was created to outline and visualise the system flow, as shown in Fig. 1. This approach supports the blended learning model for EPO510 by aligning the course topics with the syllabus and intended learning outcomes. The process also involved structuring diverse content, including chapter notes, video lectures, interactive assignments, and exercises, into a coherent learning sequence.

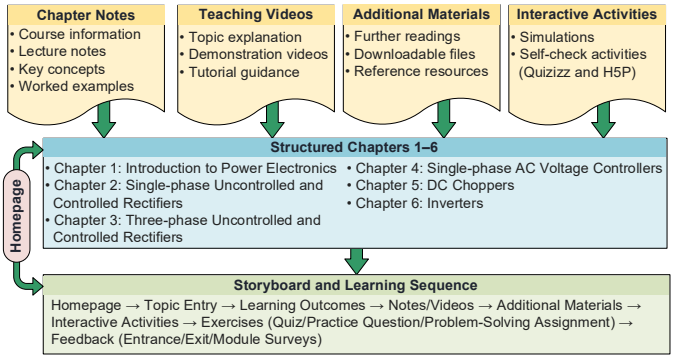


Fig. 1. Storyboard-based design flow of the EPO510 MOOC.

C. Development

The development phase focused on producing the actual MOOC materials based on the planned instructional structure and learning sequence. At this stage, the course content was transformed into digital learning resources, including chapter notes, teaching videos, additional materials, interactive activities, and exercises. The teaching videos were developed to support students' understanding of key Power Electronics concepts, while the interactive activities and exercises were included to reinforce learning and provide opportunities for practice. All materials were then organised and uploaded to UiTM's learning management system, UFUTURE, in a clear and user-friendly format. Fig. 2 illustrates the MOOC learning materials developed for Chapter 1 of EPO510 [1]. This phase ensured that the developed resources were aligned with the course outcomes, supported the blended-learning delivery of EPO510, and followed the storyboard-based design described earlier.

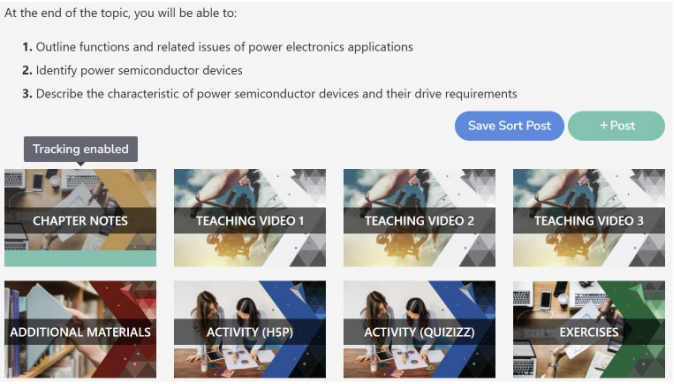


Fig. 2. MOOC learning materials developed for Chapter 1 of EPO510.

D. Implementation

The implementation phase involved the actual use of the EPO510 MOOC in the blended-learning delivery of the course. The CEEE2235E group for the October 2025 to February 2026 semester (20254I) was selected for the study. The group comprised 30 students from diverse educational backgrounds, including Foundation and Matriculation programmes, as well as diploma qualifications from UiTM and other institutions. As the study involved a single class without a control or comparison group, the findings are interpreted as changes observed following the MOOC-supported blended-learning implementation rather than as evidence of a causal effect of the MOOC. Throughout the semester, students accessed the MOOC through UFUTURE to engage with chapter notes, teaching videos, additional materials, interactive activities, and exercises that supported the topics covered in class. In this way, the MOOC functioned as an extension of classroom instruction, allowing students to revisit learning materials, reinforce key concepts, and continue their learning beyond scheduled lecture sessions. In addition, each student's progress was monitored through the completion status tracking system available on the UFUTURE platform, as illustrated in Fig. 3. This feature enabled the lecturer to monitor students' engagement with the learning materials and track their participation throughout the course.

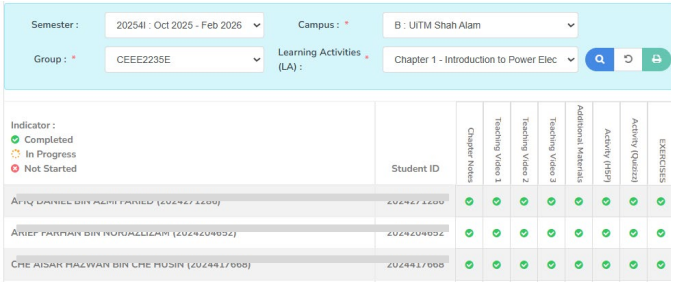


Fig. 3. Completion status tracking system in the EPO510 MOOC on UFUTURE.

E. Evaluation

The evaluation phase examined the effectiveness of the EPO510 MOOC in supporting the blended-learning delivery of the course. At the beginning of the semester, students completed the Entrance Survey, whereas the Exit Survey and Module Feedback Survey were administered at the end of the course through the UFUTURE platform, as illustrated in Fig. 4. In addition, the official final course results were obtained after grade release to determine students' performance for CLO1, CLO2, and CLO3, as well as their overall final course performance, based on Tests, Assignment, and Final Examination, as specified in the Course Assessment Plan.

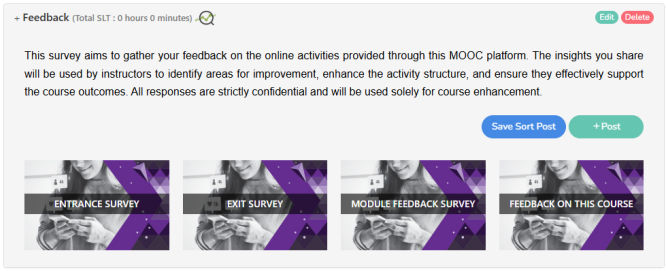


Fig. 4. Feedback survey administration through UFUTURE

The Entrance Survey and Exit Survey were designed to measure students' self-perceived competency in relation to the selected course learning outcomes. Each instrument contained the same three parallel items to enable direct pre-post comparison. As presented in Table I, Item A1 corresponded to

CLO1, Item A2 to CLO2, and Item A3 to CLO3. Although each item represents a distinct CLO, the three items collectively reflect the broader construct of students' self-perceived competency in EPO510. Therefore, an overall mean score was used as a supplementary measure of course-level perceived competency, while item-level results were retained to preserve the interpretation of each individual CLO. Cronbach's alpha was used to assess the internal consistency of the three-item scale, but the CLO-specific results remained the primary basis for item-level interpretation. The Module Feedback Survey evaluated students' perceptions of the MOOC-supported learning experience across three dimensions, namely platform, content, and instructor support, as shown in Table II.

TABLE I. ENTRANCE AND EXIT SURVEY QUESTIONS

Category	Item	Statement	Related CLO
Entrance and Exit Survey	A1	I can analyse power switching device characteristics and converter operating principles.	CLO1
	A2	I can calculate key electrical quantities in converters using circuit analysis.	CLO2
	A3	I can design power electronic converters to meet specific technical specifications.	CLO3

TABLE II . MODULE FEEDBACK SURVEY QUESTIONS

Category	Item	Statement
Platform	B1	The platform is easy to navigate.
	B2	The platform is accessible on all my learning devices.
	B3	The platform's design and usability encourage me to seek information
Content	C1	The module instructions are clear and easy to understand.
	C2	The chapter notes align with the course learning outcomes.
	C3	The learning activities align with the course learning outcomes.
	C4	The module videos enhance my understanding of the course content.
	C5	The module assessments align with the course learning outcomes.
	C6	The overall learning materials are satisfactory.
Instructor	D1	The instructor demonstrated enthusiasm for the course.
	D2	The instructor was dynamic and energetic.
	D3	The instructor made the lessons engaging and enjoyable.
	D4	The instructor's presentation style maintained my interest.
	D5	The instructor provided fair opportunities for questions and consultation.
	D6	The instructor's consultations deepened my understanding of the course.

The survey instruments were developed based on the objectives of the study and the course learning outcomes of EPO510. The Entrance Survey and Exit Survey were constructed to reflect students' perceived competency in relation to CLO1, CLO2, and CLO3, while the Module Feedback Survey was designed to assess key aspects of the MOOC-supported course experience. To establish content validity, the survey items were reviewed by subject-matter experts with experience in Power Electronics, engineering education, and online teaching and learning. A total of three subject-matter experts participated in the content validation process, representing expertise in Power Electronics, engineering education, and online teaching and learning. They reviewed the survey items for relevance, clarity, wording, and alignment with the study objectives and course learning outcomes. Based on their feedback, minor revisions were made to improve item clarity and alignment before the instruments were finalized. All surveys employed a five-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Cronbach's alpha [18] was used to assess the internal consistency of the survey instruments. Cronbach's alpha evaluates the extent to which items within an instrument consistently measure the same underlying construct. It was calculated as shown in Eq. (1).

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_t^2}\right) \quad (1)$$

where k is the number of items, σ_i^2 is the variance of item i, and σ_t^2 is the total score variance. An alpha value of 0.70 or higher was considered to indicate acceptable internal consistency.

A paired-samples t-test [19] was then conducted to examine whether the difference between the Entrance Survey and Exit Survey scores was statistically significant. The paired-samples t-test was selected because the Entrance and Exit Survey responses were obtained from the same students at two different points in time, resulting in matched observations. The test statistic was calculated as shown in Eq. (2).

$$t = \frac{\bar{d}}{\left(\frac{S_d}{\sqrt{n}}\right)} \quad (2)$$

where $\bar{d}$ is the mean of the paired differences, s_d is the standard deviation of the paired differences, and n is the number of paired observations.

The null hypothesis assumed no significant difference between the mean Entrance and Exit Survey scores, while the alternative hypothesis assumed a significant difference. Statistical significance was determined at $p < 0.05$. In addition to statistical significance, Cohen's d_z was calculated using Eq. (3) to quantify the magnitude of the pre-post difference.

$$d_z = \frac{\bar{d}}{S_d} \quad (3)$$

Prior to the statistical analyses, the assumptions of the paired-samples t-test were checked by examining the normality of the paired difference scores and the presence of extreme outliers.

Pearson correlation analysis [20, 21] was also performed to examine the strength and direction of the relationship between the survey-based measures, namely self-perceived competency and Module Feedback Survey scores, and overall final course performance, calculated using Eq. (4).

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}} \quad (4)$$

where x_i and y_i represent the individual survey-based scores and final course marks, $\bar{x}$ and $\bar{y}$ denote their respective sample

means, and n is the total number of students. For Pearson correlation analysis, linearity, approximate normality, and potential outliers were examined prior to the analysis.

III. Results and Discussion

A. Reliability of the instruments

Table III presents the reliability of the instruments used in this study.

TABLE III . Reliability of the Instruments

Instrument / Dimension	Number of Items	Cronbach's Alpha	Interpretation
Entrance Survey	3	0.974	Excellent
Exit Survey	3	0.961	Excellent
Module Feedback Survey	15	0.936	Excellent
Platform	3	0.933	Excellent
Content	6	0.840	Good
Instructor	6	0.930	Excellent

Note: Cronbach's alpha values were interpreted as follows: ≥0.90 = Excellent; 0.80–0.89 = Good; 0.70–0.79 = Acceptable; 0.60–0.69 = Questionable; 0.50–0.59 = Poor; <0.50 = Unacceptable.

The Entrance Survey recorded a Cronbach's alpha value of 0.974, while the Exit Survey obtained 0.961, indicating excellent internal consistency for both instruments. The Module Feedback Survey also demonstrated strong reliability, with an overall alpha value of 0.936. At the dimension level, the Platform and Instructor subscales recorded alpha values of 0.933 and 0.930, respectively, which indicate excellent reliability. The Content dimension recorded the lowest Cronbach's alpha value among the subscales at 0.840, although it remained within the good and acceptable range for this study. This indicates that the dimension was sufficiently reliable, while still offering room for improvement in future implementations to strengthen item consistency. Overall, these findings confirm that the instruments were reliable and suitable for evaluating students' self-perceived competency and their experience with the MOOC-supported blended-learning implementation of EPO510.

B. Students' self-perceived competency in EPO510

Table IV presents the comparison of students' self-perceived competency before and after the implementation of the MOOC-supported blended-learning approach in EPO510. A paired-samples t-test was conducted to examine the difference between the pre-course and post-course assessments across the three course learning outcomes using a 5-point Likert scale. At the beginning of the course, the overall mean score was 1.61 (SD = 0.75), indicating a very low level of self-perceived competency. At the end of the course, the overall mean increased markedly to 4.28 (SD = 0.68), indicating a very high level of self-perceived competency. At the item level, the mean score for A1 increased from 1.57 (SD = 0.77) to 4.33 (SD = 0.66), A2 from 1.67 (SD = 0.76) to 4.27 (SD = 0.74) and A3 from 1.60 (SD = 0.77) to 4.23 (SD = 0.73). The paired-samples t-test further showed that the increase in the overall mean score from 1.61 to 4.28 was statistically significant, $t(29) = 13.58$, $p < 0.001$, with a large effect size (Cohen's dz = 2.48). Significant differences were also found for A1, $t(29) = 14.57$, $p < 0.001$, A2, $t(29) = 11.95$, $p < 0.001$ and A3, $t(29) = 13.14$, $p < 0.001$.

The slightly lower standard deviation values in the post-course assessment also suggest that students' competency levels became more consistent by the end of the course. Overall, these findings indicate a substantial improvement in students' self-perceived competency in relation to CLO1, CLO2 and CLO3 following the implementation of the MOOC-supported blended-learning approach.

TABLE IV . Students' Self-Perceived Competency In Relation To Course Learning Outcomes In EPO510

Item	Related CLO	Entrance Mean (SD)	Exit Mean (SD)	Mean Difference	t-value	p-value	Cohen's d_z
A1	CLO1	1.57 (0.77)	4.33 (0.66)	2.76	14.57	< 0.001	2.66
A2	CLO2	1.67 (0.76)	4.27 (0.74)	2.60	11.95	< 0.001	2.18
A3	CLO3	1.60 (0.77)	4.23 (0.73)	2.63	13.14	< 0.001	2.40
Overall Mean		**1.61 (0.75)**	**4.28 (0.68)**	**2.67**	**13.58**	**< 0.001**	**2.48**

Note: Entrance Survey = pre-course self-perceived competency; Exit Survey = post-course self-perceived competency; $p < 0.05$ indicates statistical significance.

C. Students' Evaluation of the MOOC-Supported Course

Table V presents students' evaluation of the MOOC-supported course based on the Module Feedback Survey. The responses in Table V were analysed using descriptive statistics, in which mean scores were computed for each item, dimension and the overall Module Feedback Survey, and then interpreted using the predefined Likert-scale categories. The overall mean score was 4.22, indicating a very positive evaluation of the MOOC-supported learning experience. Among the three dimensions, Platform recorded the highest mean score of 4.38, followed by Instructor with 4.23 and Content with 4.12. At the item level, the highest-rated items were B1, "The platform is easy to navigate," and B3, "The platform's design and usability encourage me to seek information," both with a mean score of 4.40. Other highly rated items included B2, D2 and D5, each with a mean of 4.33. The lowest-rated item was C4, "The module videos enhance my understanding of the course content," with a mean score of 3.87, although it still fell within the high category. This lower rating may be attributed to the nature of some Power Electronics topics, which require repeated circuit analysis, waveform interpretation, and problem-solving practice, leading students to rely more on notes, exercises, or instructor guidance. Overall, these findings indicate that students responded positively to the MOOC-

supported course while suggesting that the video component could be further improved in future implementations.

TABLE V . STUDENTS' EVALUATION OF THE MOOC-SUPPORTED COURSE

Category	Item	Statement	Mean	Interpre-tation
Platform	B1	The platform is easy to navigate.	4.40	Very High
	B2	The platform is accessible on all my learning devices.	4.33	Very High
	B3	The platform's design and usability encourage me to seek information	4.40	Very High
		Dimension mean	4.38	Very High
Content	C1	The module instructions are clear and easy to understand.	4.33	Very High
	C2	The chapter notes align with the course learning outcomes.	4.20	High
	C3	The learning activities align with the course learning outcomes.	4.20	High
	C4	The module videos enhance my understanding of the course content.	3.87	High
	C5	The module assessments align with the course learning outcomes.	4.07	High
	C6	The overall learning materials are satisfactory.	4.07	High
		Dimension mean	4.12	High
Instructor	D1	The instructor demonstrated enthusiasm for the course.	4.13	High
	D2	The instructor was dynamic and energetic.	4.33	Very High
	D3	The instructor made the lessons engaging and enjoyable.	4.27	Very High
	D4	The instructor's presentation style maintained my interest.	4.20	High
	D5	The instructor provided fair opportunities for questions and consultation.	4.33	Very High
	D6	The instructor's consultations deepened my understanding of the course.	4.13	High
		Dimension mean	4.23	Very High
		Overall mean	**4.22**	**Very High**

Note: Mean scores were classified as follows: 1.00–1.80 = Very Low, 1.81–2.60 = Low, 2.61–3.40 = Moderate, 3.41–4.20 = High, and 4.21–5.00 = Very High

D. Students' Official Final Course Results

Table VI presents the official final course results for EPO510 based on students' performance in relation to the three course learning outcomes. The total allocated marks for CLO1, CLO2, and CLO3, derived from the test, assignment, and final examination components, were 80, 80, and 30 marks, respectively. The mean scores obtained by the 30 students were 42.29, 50.25, and 25.50 marks for CLO1, CLO2, and CLO3, respectively. Accordingly, the mean percentages for CLO1, CLO2, and CLO3 were 52.86%, 62.82%, and 85.00%, respectively. The overall mean score was 118.04 out of 190 marks, which corresponds to an overall final course performance of 62.13%. The findings show that student performance varied across the three course learning outcomes. Among the three CLOs, the highest mean percentage was achieved for CLO3, while CLO1 recorded the lowest performance. This suggests that students demonstrated stronger performance in the design-related outcome than in the more analytical aspects of the course. The lower achievement in CLO1 and CLO2 may reflect the greater complexity of analysing converter operating principles and calculating circuit parameters, both of which require deeper conceptual understanding and stronger analytical skills. Although CLO3 represents a higher cognitive level in Bloom's Taxonomy, it was assessed through an assignment completed within a specified submission period, providing a less time-constrained assessment environment than conventional tests or examinations. This allowed students greater opportunity to review relevant materials, perform calculations, and refine their design solutions before submission. In contrast, the assessment of CLO1 and CLO2 involved more time-constrained tasks requiring immediate conceptual interpretation and circuit analysis. Overall, the results show that students achieved different levels of performance across the course learning outcomes, with the strongest achievement observed in CLO3.

TABLE VI . STUDENTS' OFFICIAL FINAL COURSE RESULTS

Course learning outcome	Full marks	Mean score	Mean percentage (%)
CLO1	80	42.29	52.86
CLO2	80	50.25	62.82
CLO3	30	25.50	85.00
Overall performance	**190**	**118.04**	**62.13**

Note: Based on the actual grading marks obtained by the students in the group, comprising Tests, Assignment, and Final Examination.

E. Relationship Between Survey Measures and Overall Final Course Performance

Table VII presents the relationship between the survey-based measures and students' overall final course performance.

TABLE VII . RELATIONSHIP BETWEEN SURVEY MEASURES AND OVERALL ASSESSMENT PERFORMANCE

Variable	r	p-value	Interpretation
Exit Survey mean vs overall assessment performance	0.054	0.779	Very weak, not significant
Module Feedback mean vs overall assessment performance	0.168	0.374	Very weak, not significant
Platform vs overall assessment performance	-0.056	0.769	Very weak, not significant
Content vs overall assessment performance	0.163	0.389	Very weak, not significant
Instructor vs overall assessment performance	0.241	0.199	Weak, not significant

Note: Correlation interpretation: 0.00–0.19 = Very weak; 0.20–0.39 = Weak; 0.40–0.59 = Moderate; 0.60–0.79 = Strong; 0.80–1.00 = Very strong.

In this analysis, r represents the correlation coefficient, which indicates the direction and strength of the relationship between two variables, while the p-value indicates whether the

relationship is statistically significant. The results showed weak and non-significant relationships between the Exit Survey mean and overall final course performance, r = 0.054, p = 0.779, and between the overall Module Feedback mean and overall final course performance, r = 0.168, p = 0.374. At the dimension level, Platform showed a very weak negative relationship with overall final course performance, r = -0.056, p = 0.769, while Content and Instructor showed weak positive relationships of r = 0.163, p = 0.389 and r = 0.241, p = 0.199, respectively. These findings suggest that although students reported higher self-perceived competency and evaluated the MOOC positively, these perceptions were not strongly associated with their actual course performance. This indicates that perceived competency, satisfaction with the MOOC, and measured academic performance may represent different but related aspects of the learning experience. This may be explained by the different nature of perception-based and performance-based measures. Self-perceived competency and MOOC evaluation reflect students' confidence and learning experience, whereas final course performance is determined through formal assessments involving analytical, computational, and design tasks. Consequently, positive perceptions of the learning environment may not necessarily correspond to higher academic performance. This interpretation is consistent with previous research indicating that perceived learning and actual performance may not necessarily align [22].

In MOOCs, perceived learning and satisfaction may also be influenced by course design, learning support, motivation, and engagement [12, 13]. The relatively small sample may also have limited the ability to detect statistically significant relationships. Overall, these findings highlight the importance of considering both perception-based and performance-based measures when evaluating MOOC-supported learning. The significant increase in students' self-perceived competency following the MOOC-supported blended-learning implementation, together with their positive evaluation of the platform, content, and instructor support, is consistent with a beneficial role of the MOOC in supporting the learning experience. However, as the study involved a single class without a control or comparison group, the observed improvement cannot be attributed solely to the MOOC.

IV. Conclusion

This study evaluated the development and implementation of a MOOC-supported blended-learning approach for the EPO510 Power Electronics course. The findings showed that students' self-perceived competency improved significantly from the beginning to the end of the course, indicating higher perceived understanding of the selected course learning outcomes following the MOOC-supported blended-learning implementation. In addition, students evaluated the MOOC positively in terms of platform, content, and instructor support, with the platform dimension recording the highest mean score. The official final course results further showed that students achieved different levels of performance across the course learning outcomes, with the highest performance recorded for CLO3. However, the relationships between the survey-based measures and overall final course performance were weak and not statistically significant. Overall, the findings suggest that the EPO510 MOOC served as a structured digital support platform for blended learning and was associated with higher self-perceived competency and a positive learning experience. However, these findings should be interpreted within the limitations of the study design, particularly the small sample and absence of a control or comparison group. Its main contribution lies in providing an integrated evaluation of students' perceived competency, learning experience, and CLO-based course performance in Power Electronics. Nevertheless, the lower performance observed in certain learning outcomes and the non-significant relationship between perception-based measures and academic performance suggest that a positive learning experience does not always translate into stronger assessment achievement. The study is limited by its small sample of 30 students from a single EPO510 class at one institution, the absence of a control or comparison group, and the reliance on self-reported competency measures. Therefore, the observed improvement cannot be attributed solely to the MOOC or generalized beyond the study context. Future studies should involve larger samples across multiple cohorts or institutions, include appropriate comparison groups, and incorporate direct measures of competency together with MOOC engagement data. Future improvements may also focus on strengthening learning videos and analytical topic support to further enhance student learning and course outcome achievement.

Acknowledgment

The authors would like to express their utmost gratitude to the Institute of Continuing Education and Professional Studies (iCEPS), Universiti Teknologi MARA, Shah Alam, for providing the UFUTURE platform used in the development of the Power Electronics (EPO510) MOOC. The authors also extend their sincere appreciation to members of the Faculty of Electrical Engineering, Universiti Teknologi MARA, Shah Alam, for their valuable support and assistance. Finally, the authors would like to thank all individuals who contributed, directly or indirectly, to the completion of this study.

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