

Enhancing Mathematics Learning Through eMI-PERLU: An Interactive E-Module on Perimeter and Area

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Abstract: *Mathematics remains one of the most challenging subjects for lower secondary students in Malaysia, particularly in geometry topics such as perimeter and area. Traditional instructional methods often fail to address students' misconceptions and declining engagement. This study aimed to develop and evaluate eMI-PERLU, an interactive e-module designed to support Form One students' mastery of perimeter and area by incorporating visual, interactive, and self-paced learning features. A Development Research Design (DRD) guided by the ADDIE model was employed. The population consisted of 266 Form One students at Sekolah Menengah Kebangsaan Tandek, Kota Marudu, Sabah, from which 40 were selected using convenience sampling. Research instruments included expert validity questionnaires and student usability questionnaires, both based on a four-point Likert scale. Data analysis involved Content Validity Index (CVI), expert agreement percentages, Cronbach's Alpha for reliability, and descriptive statistics for usability. Findings indicated excellent validity, with a CVI score of 1.00 and expert agreement at 96.43%. The e-module also demonstrated good reliability (Cronbach's Alpha = 0.848). Usability analysis revealed high ratings for usefulness ($M = 3.69$, $SD = 0.47$), ease of use ($M = 3.70$, $SD = 0.49$), and satisfaction ($M = 3.76$, $SD = 0.46$). Overall, eMI-PERLU is a valid, reliable, and user-friendly resource that enhances student engagement and conceptual understanding. The study contributes to advancing interactive mathematics education and offers implications for teachers, students, and policymakers within the Malaysian education system.*

Keywords: ADDIE Model; Interactive E-Module; Perimeter and Area; Usability Evaluation; Mathematics Education

1. Introduction

Mathematics is widely recognized as a foundation for critical thinking, problem-solving, and logical reasoning skills. Despite its importance, many students perceive mathematics as difficult and less appealing, which often results in low motivation and poor performance (Khasanah & Purwaningrum, 2023). Geometry, particularly the topic of perimeter and area, introduced in Form One, continues to present challenges. Students commonly demonstrate misconceptions such as assuming that changes in perimeter directly affect area, or confusing

units of length with units of area (De Sousa et al., 2020; Abadi & Amir, 2022). These difficulties highlight the need for instructional strategies that clarify concepts and sustain engagement.

The Malaysian education system has changed significantly with the introduction of Malaysia Education Blueprint 2013 to 2025 (MOE, 2013). This plan focuses on important 21st-century skills like creativity, critical thinking, collaboration, and communication. One key strategy is integrating information and communication technology (ICT) into teaching. E-learning plays a big role in meeting international educational needs (Rajikal & Hamzah, 2020; Israil & Ahmad, 2023). However, even with the increasing focus on ICT, the traditional "chalk and talk" method still prevails in many classrooms. This limits chances for active student participation (Poobalan & Mahmud, 2022; Osman, 2023). This gap shows the need for innovative teaching and learning resources that use digital materials to improve understanding and motivation.

One of the potential solutions to tackle this problem is the implementation of e-modules. They combine multimedia components including films, animations, and quizzes with flexibility for self-paced learning (Azkiya et al., 2022; Fujiarti et al., 2024). When compared to static or printed materials, research continuously demonstrates that interactive modules enhance student engagement and improve information retention (Hamid & Alberida, 2021; Herlina & Abidin, 2024). Few studies have looked at the use of e-modules in mathematics in Malaysia, particularly at the lower secondary level, despite the fact that they have been studied internationally in science and language instruction (Chan et al., 2020; Fitzpatrick et al., 2021). The teaching of geometry is one area where this gap is most noticeable because basic concepts like area and perimeter serve as the foundation for more complex mathematical reasoning but have not yet received widespread attention from digital advances.

Innovative, student-centered methods are even more urgent now that the Ujian Penilaian Sekolah Rendah (UPSR) has been abolished and classroom-based evaluations, or Pentaksiran Bilik Darjah (PBD), have been fully implemented. Concerns over the preparedness of pupils starting secondary school, many of whom still struggle with fundamental arithmetic and geometry concepts, and discrepancies in teacher-led assessments have been brought up by these reforms (Ariffin & Arumugham, 2021; Borhman & Karim, 2023). Teaching resources must maintain students' desire and interest while also making mathematical concepts clear to close these gaps.

This research presents eMI-PERLU, an interactive e-module for the Form One topics of area and perimeter that was created using Canva. The e-module includes concise notes, guided examples, interactive activities, and multimedia features. It is based on constructivist learning theory and developed using the ADDIE instructional design method. eMI-PERLU aims to eliminate common errors, encourage self-directed learning, and create a more engaging classroom experience by adding interactivity throughout.

This study aims to address the following two research questions:

RQ1: Does eMI-PERLU for perimeter and area demonstrate a satisfactory level of validity based on expert evaluation?

RQ2: Does eMI-PERLU have satisfactory usability according to student perceptions in terms of usefulness, ease of use, and user satisfaction?

2. Methodology

2.1 Research Design

The main design of this study uses a quantitative and descriptive method to investigate how an interactive e-module can improve understanding and mastery of perimeter and area among Form One students, based on evidence. A survey method collected data from participants. To ensure reliability, test the theory, and find relationships between variables, data must be measured and gathered from respondents (Nordin & Hassan, 2019). This design was chosen as a quantitative study to assess how usable the interactive e-module is. The study follows a development research framework and uses the ADDIE model as the basis for creating the interactive e-module on perimeter and area for Form One students. This model includes five stages: Analysis, Design, Development, Implementation, and Evaluation. These stages provide a clear and flexible framework for developing structured materials (Branch, 2009).

2.2 Population, Sample, and Sampling Technique

The selected group includes Form One students from Sekolah Menengah Kebangsaan (SMK) Tandek in Kota Marudu, Sabah. Form One students were chosen because they learn about perimeter and area at this stage. The total number of Form One students at SMK Tandek is 266. From this group, 40 students were selected using convenience sampling. This method was chosen because it allows researchers to reach respondents who are easily available and relevant to the study (Mweshi & Sakyi, 2020). Although the sample size is small, it is sufficient to provide initial insights into the usability of the e-module, given the logistical limits of the research.

2.3 Research Instruments

Two main instruments were used in this study. The first was a validity assessment questionnaire filled out by three math experts. They evaluated both the face and content validity of the interactive e-module. The Content Validity Index (CVI) was calculated to find out how much agreement there was among the experts (Davis, 1992). This instrument included seven items for face validity and eight items for content validity. The second instrument was a usability questionnaire given to forty student participants. This evaluated the usability of the interactive e-module. It measured three aspects: usefulness, with seven items; ease of use, with six items; and user satisfaction, with five items. Responses were recorded on a four-point Likert scale that ranged from “Strongly Disagree” to “Strongly Agree.” To check reliability, Cronbach’s Alpha was used, with values above 0.70 seen as acceptable signs of internal consistency (Nawi et al., 2020).

2.4 Research Procedure Using ADDIE

Phase 1: Analysis

In the analysis phase, the researchers started by identifying the common misconceptions that Form One students often face when learning about perimeter and area (De Sousa et al., 2020; Abadi & Amir, 2022). They reviewed the *Dokumen Standard Kurikulum dan Pentaksiran* (DSKP) to ensure it matched the national curriculum. Furthermore, the research team also gathered insights from teacher interviews and classroom observations. These highlighted several key challenges: a heavy reliance on traditional teaching methods, a lack of interactive learning materials, and generally low levels of student motivation (Poobalan & Mahmud, 2022; Osman, 2023).

Phase 2: Design

During the design phase, the researchers drafted a detailed blueprint for the e-module, and Canva is used as the primary platform. The e-module was then systematically organized to include concise notes, worked examples, practice questions, interactive quizzes, and multimedia features such as animations and videos. Its instructional strategies were based on constructivist learning principles, which encourage students to actively construct their understanding through engagement with interactive learning tasks (Piaget, 1970; Vygotsky, 1978).

Phase 3: Development

In the development phase, the content of the e-module was developed and digitized using Canva templates. Attention was given to ensuring that the materials were clear, visually engaging, and accessible to Form One students. Interactive elements were incorporated to keep learners actively involved. Experts' feedback was later used to refine and improve the content of the e-module. These expert evaluations measured face and content validity, in which validity was analyzed through percentage of expert agreement and CVI values, with $CVI \geq 0.80$ considered satisfactory (Polit & Beck, 2006).

Phase 4: Implementation

The implementation phase involved a pilot study involving a group of 30 respondents, a different group of respondents from those who will participate in the usability test, but with similar characteristics. The respondents accessed the e-module using either smartphones or laptops. The e-module was used both in class and as a self-learning resource, giving students the flexibility to engage with the materials at their own pace.

Table 1: Reliability of the instrument: Cronbach's Alpha value of the usability questionnaire

Number of Items	Cronbach's Alpha Value	Reliability Level
18	0.848	Good

This stage is important to check the reliability of the instruments that will be used in the study. As shown in Table 1, the reliability test produced a Cronbach's Alpha value of 0.848, which falls within the "good" range of 0.80 to 0.90 (Nawi et al., 2020). This result confirms the internal consistency of the usability questionnaire and its suitability for evaluating the e-module. The pilot test also confirmed the reliability of the instrument using Cronbach's Alpha.

Phase 5: Evaluation

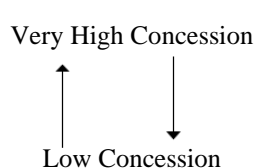
In the final phase of this model, the evaluation phase assessed the effectiveness of the e-module, where student feedback provided insights into usability, with mean and standard deviation scores analyzed across the constructs of usefulness, ease of use, and satisfaction. In this phase, 40 respondents were involved in the usability test.

Quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 30. Usability scores were analyzed descriptively using mean and standard deviation, with interpretation based on Riduwan (2012) for mean scores (see Table 2) and Ramlee (1999) for standard deviation consensus levels (see Table 3).

Table 2: Interpretation of Mean Score

Mean score	Interpretation
1.00-1.50	Less related
1.51-2.50	Low
2.51-3.50	Intermediate
3.51-4.00	High

Table 3: Interpretation Standard Deviation and Concession Responded

Standard Deviation Value	Interpretation	Concession Responded
0.00-0.25	Less related	Very High Concession  Low Concession
0.26-0.50	Low	
0.51-0.75	Intermediate	
0.76-1.00	High	
Higher than 1.00	Very High	

3. Results and Discussion

3.1 Module Validity

Three experts evaluated the validity of eMI-PERLU. As shown in Table 4, the average expert agreement percentage for face validity was 96.43%, which exceeds the recommended threshold of 70 % (Tuckman & Waheed, 1981; Nordin, 1995). Table 5 further indicates that content validity recorded a perfect CVI of 1.00, meaning that all experts agreed on the relevance of every item (Davis, 1992).

Table 4: Face validity value of the interactive e-module for perimeter and area

Expert No.	Expert Score	Maximum Score	Expert Agreement Percentage (%)	Level
1	28	28	100	Very relevant
2	25	28	89.29	Very relevant
3	28	28	100	Very relevant
Average expert agreement percentage			96.43	Very relevant

Table 5: Content validity value for Each Item (I-CVI) and Overall Scale Content Validity (CVI) of the eMI-PERLU

Item	Expert 1	Expert 2	Expert 3	I-CVI
Question 1	1	1	1	1
Question 2	1	1	1	1
Question 3	1	1	1	1
Question 4	1	1	1	1
Question 5	1	1	1	1
Question 6	1	1	1	1
Question 7	1	1	1	1
Question 8	1	1	1	1
CVI				1

These findings confirm that eMI-PERLU is aligned with curriculum objectives and conceptually accurate. This result is consistent with Bakar et al. (2024) and Mokhtar and Aman (2017), who emphasized that modules with high content validity contribute to meaningful learning. The inclusion of clear notes, examples, and quizzes reflects sound instructional design

practices and supports constructivist approaches, where learners actively engage with content rather than passively receiving information (Piaget, 1970; Vygotsky, 1978).

Overall, the validity findings provide evidence to answer RQ1, confirming that eMI-PERLU achieves a satisfactory level of validity based on expert evaluation.

3.2 Usability Evaluation

The usability of *eMI-PERLU* was evaluated using three constructs: usefulness, ease of use, and satisfaction. The analysis results are shown in Table 6, where all mean values were above 3.50, with standard deviations below 0.50, indicating strong consensus among respondents (Riduwan, 2012; Ramlee, 1999).

Table 6: Mean and standard deviation values for each construct

Construct	Number of Items	Mean Value	Standard Deviation Value	Level
Usability of the eMI-PERLU	7	3.69	0.47	Strongly Agree
Ease of Use	6	3.70	0.49	Strongly Agree
User Satisfaction	5	3.76	0.46	Strongly Agree

Usefulness

Table 7 presents the detailed analysis for usefulness where all mean values were above 3.50, with standard deviations 0.50 and below. Students reported that the e-module helped them understand concepts more clearly, sparked their interest, and made classroom activities more productive (M = 3.85). These findings echo Idayanti et al. (2023), who found that interactive e-modules enhance engagement and productivity in mathematics lessons.

Table 7: Mean and standard deviation values for construct usability of the eMI-PERLU

No.	Criteria	Mean Score	Standard Deviation
1.	eMI-PERLU provides an experience that helps me in the learning process for the topic of Perimeter and Area in Form One	3.68	0.47
2.	eMI-PERLU is very useful for me to understand the concepts in the topic of Perimeter and Area in Form One.	3.63	0.49
3.	eMI-PERLU makes me interested in learning the topic of Perimeter and Area in Form One.	3.77	0.48
4.	eMI-PERLU makes it easier for me to understand the topic of Perimeter and Area in Form One.	3.65	0.48
5.	eMI-PERLU makes classroom activities productive.	3.85	0.43
6.	eMI-PERLU makes classroom activities effective.	3.60	0.50
7.	eMI-PERLU meets my needs.	3.67	0.47
Overall Mean and Standard Deviation		3.69	0.47

Ease of Use

Table 8 indicates that students found the e-module easy to use, with clear instructions and quizzes that supported learning. The accessibility of the e-module was supported by Canva's user-friendly platform, which required only minimal technical skills from students. This finding is consistent with Delita et al. (2022), who stated that Canva's design features make navigation simple and effective as learning modules. In addition, Hamid and Alberida (2021) also emphasized that a user-friendly design is essential for effective online learning as overly complex interfaces can prevent learners from fully engaging with the content.

Table 8: Mean and standard deviation values for the construct ease of use of the eMI-PERLU

No.	Criteria	Mean Score	Standard Deviation
1.	eMI-PERLU is easy to use.	3.68	0.47
2.	eMI-PERLU has clear and understandable instructions.	3.75	0.49
3.	eMI-PERLU helps me memorize and recall the topic of Perimeter and Area in Form One.	3.75	0.49
4.	eMI-PERLU is user-friendly.	3.63	0.49
5.	The questions or quizzes in eMI-PERLU are easy to solve.	3.75	0.49
6.	eMI-PERLU is successfully used in learning the topic of Perimeter and Area in Form One.	3.65	0.48
Overall Mean and Standard Deviation		3.70	0.49

User Satisfaction

As for user satisfaction, the analysis results indicate that students found the e-module to be genuinely exciting and enjoyable, see Table 9. They reported that eMI-PERLU boosted their interest in mathematics and helped them solve problems in an efficient way. These outcomes are in line with the study by Sukma Ayu Nur Safitri et al. (2022), which shows that interactive digital courses may keep students' attention and greatly increase student satisfaction.

Table 9: Mean and standard deviation values for user satisfaction of use of the eMI-PERLU

No.	Criteria	Mean Score	Standard Deviation
1.	I enjoy using eMI-PERLU.	3.75	0.49
2.	I find that eMI-PERLU functions well.	3.70	0.46
3.	I can solve questions and quizzes on the topic of Perimeter and Area in Form One based on the notes in eMI-PERLU.	3.80	0.41
4.	I can increase my interest in learning the topic of Perimeter and Area in Form One using eMI-PERLU.	3.75	0.49
5.	I am excited when learning using eMI-PERLU.	3.80	0.46
Overall Mean and Standard Deviation		3.76	0.46

Overall, because of its practicality, ease of use, and sense of fulfillment it generated during the learning process, students viewed eMI-PERLU as highly usable, according to the usability evaluation's results, which strongly corroborate RQ2.

3.3 Discussion of Findings

The analysis results show that eMI-PERLU is a useful and legitimate teaching and learning material. According to the high usability ratings, interactive digital modules or e-modules can be a significant factor in attracting student interest and resolving common mathematical misconceptions, two issues that have been extensively discussed in the literature (De Sousa et al., 2020; Abadi & Amir, 2022).

This study also emphasizes the benefit of integrating websites like Canva into math education. This study adds to the body of research by showcasing the potential of e-modules in teaching geometry at the lower secondary level, whereas previous studies have mostly focused on their usage in science and language education (Chan et al., 2020; Fitzpatrick et al., 2021). According to the findings, interactive e-modules can help the *Pentaksiran Bilik Darjah* (PBD) framework by offering adaptable, student-focused materials that let students advance at their own speed (Ariffin & Arumugham, 2021).

More generally, the study's findings align with the Malaysia Education Blueprint 2013–2025's transformation goals, which prioritize the development of higher-order thinking abilities, digital literacy, and autonomous learning. In this sense, eMI-PERLU serves to forward the goals of Malaysia's education reform program in addition to addressing the current issues in math classrooms.

4. Conclusion

The purpose of this study was to develop and assess the usability of eMI-PERLU, an interactive e-module designed to improve Form One students' teaching and learning of area and perimeter. The e-module, which was created using the ADDIE instructional design paradigm, was tested with 40 students at Sabah's SMK Tandek. According to expert reviews, the results show strong validity, with a flawless CVI score of 1.00 and a face validity agreement of 96.43%. The trustworthiness of the usability tool was further proved by its Cronbach's Alpha rating of 0.848, which indicates strong internal consistency. These findings were supported by student response, which gave the program good marks for overall satisfaction, usefulness, and convenience of use. Taken together, the evidence confirms that eMI-PERLU is both valid and effective in deepening students' understanding of geometry concepts.

The study contributes meaningfully to the field of developmental research in mathematics education. For students, the e-module supports self-paced learning, allowing them to revisit more challenging topics and making mathematics more engaging. For teachers, it offers a readily available supplementary resource that complements conventional teaching methods and encourages more student-centered practices. At the policy level, this work highlights the value of digital learning resources in advancing the goals of the Malaysia Education Blueprint 2013–2025, particularly in integrating technology, promoting independent learning, and cultivating twenty-first-century skills. By aligning with these objectives, interactive e-modules such as eMI-PERLU can make a substantial contribution to the quality and equity of mathematics education across the nation.

The study is not without its limitations. The small sample size, drawn from a single rural school, limits the generalizability of the findings. In addition, the e-module addresses only the topics of perimeter and area. These constraints point to the need for further research before wider claims can be made.

In order to provide a more comprehensive view of the e-module's efficacy in various circumstances, future research could expand the scope by incorporating a wider and more varied spectrum of schools and students. It would be very beneficial to do longitudinal research to evaluate the sustainability of the observed learning gains. To evaluate adaptability, the eMI-PERLU design concepts could potentially be applied to other mathematical fields like probability, statistics, or algebra. Incorporating cutting-edge technology like augmented reality or gamification could improve the e-module's attractiveness and interaction in subsequent revisions.

In summary, eMI-PERLU's creation and assessment demonstrate the revolutionary potential of interactive e-modules for Malaysian mathematics education. This program helps dispel common misconceptions, encourages student involvement, and supports flexible learning methods by combining succinct material, multimedia features, and interactive assignments. Although further investigation is necessary to broaden its scope and evaluate its enduring influence, this study offers a solid basis for promoting digital innovation in mathematics

education. In the conclusion, eMI-PERLU shows how digital learning may make mathematics more approachable, relevant, and interesting for students today.

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Conflict of Interest Statement

The authors of this work state that they have no conflicts of interest with relation to its publication.

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