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Development of an Android-Based Interactive E-Module Using the Problem-Based Learning Method

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Abstract

The rapid growth of digital technology has created significant opportunities for innovation in educational practices, including the use of Android-based e-modules as self-directed learning media. In the context of Vocational Education, particularly the Motorcycle Engineering expertise program, there is a strong need for interactive learning materials that can enhance the conceptual understanding and cognitive abilities of students. This study aims to develop an Android-based interactive e-module using the Problem-Based Learning (PBL) model for the topic of motorcycle workshop management elements, and to examine its validity, practicality, and effectiveness. The research employed the ADDIE research and development model with participation from media experts, material experts, teachers, and Grade XI TSM students at SMK Cordova Margoyoso. Research instruments included expert validation sheets, practicality questionnaires, and pre-test and post-test assessments. The findings indicate that the e-module is valid, with a media expert validation score of 3.7 (91%) and a material expert score of 3.6 (91%). The e-module was also considered practical based on student evaluations. In addition, it proved effective in improving cognitive abilities, as shown by an N-Gain score of 64% (moderately effective category) and a T-test significance value of 0.000 < 0.05. In conclusion, the Android-based interactive e-module developed using the PBL model meets the criteria of validity, practicality, and effectiveness as a learning medium.

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INTRODUCTION

Advances in technology today are developing rapidly and have a significant influence on many aspects of human life. Technological progress also affects developments in the field of education. Various opportunities for learning innovation have emerged, including the use of Android as a platform for independent learning. In the learning process, students do not interact only with the teacher. They also engage with a wide range of learning resources that can be used to support the achievement of learning objectives (Malina et al., 2021). A good learning medium is a tool or technology that supports and improves the learning process (Jafnihirda et al., 2023). These developments also influence the creation of teaching materials, which increasingly rely on available technological advancements.

An e-module is a digital learning module composed of text, images, or video produced through a computer and accessible through mobile phones or computers (Tita, N. W, Mustika, 2022). An e-module is designed as an independent learning resource to help learners achieve specific learning goals. It is arranged systematically in small units of study and presented in electronic form, incorporating audio, video, animation, and navigation features that enable more interactive learning (Nurmayanti et al., 2017).

Technological developments in the present era require learning media that can improve both the quality of the learning process and student learning outcomes. Current technology also enables students and teachers to engage in learning activities even when they are not in the same physical location (Sa idah et al., 2024). The use of e-modules can be a strategy to support independent learning, allowing students to access a wider range of learning resources. Through e-modules, students can study more optimally and develop better thinking skills (Pendidikan et al., 2024).

Learning with e-modules involves more than simply reading materials. Students are also required to engage in activities such as observing videos and completing available exercises. This provides greater room for independent learning and encourages the development of their abilities (Manzil et al., 2022).

According to Kumalasari and Eilmelda (2022, p. 43), e-modules offer a variety of content including material explanations, practice questions, images, and videos that support learning, particularly in the subject of light vehicle engineering. For example, animations in e-modules can clarify the workings of workshop management systems that are difficult to explain through text alone. E-modules also provide several advantages including: (1) increasing learner motivation, (2) allowing teaching materials to be adjusted to academic levels, (3) offering flexible use, and (4) providing supporting audio-visual and motion animation features.

Based on observations at SMK Cordova Margoyoso on July 08, 2024, several findings were identified. Learning resources used in the classroom were still limited and relied mainly on teacher and student textbooks provided by the government. Additional teaching materials to support the learning process were not yet available. As a result, students were less interactive during lessons and quickly became bored, often seeking other activities during class. Differences in student understanding also influenced learning outcomes, which were not optimal. To support active and engaging learning, appropriate teaching materials are needed to help students understand the content and achieve learning objectives (Hanifah and Hidayah, 2024).

In vocational education, particularly in the Motorcycle Engineering expertise program, learning media are required that can support deep conceptual understanding and improve student cognitive abilities. One of the topics that demands strong cognitive comprehension is the elements of motorcycle workshop management, which involve technical, managerial, and procedural aspects that must be fully understood.

To ensure the effective use of e-modules, an instructional model is needed that can develop student thinking skills. One such model is Problem Based Learning (PBL), which positions students at the center of the learning process through the presentation of real problems. According to Bamban et al., (2022), Problem Based Learning challenges students to think critically in solving existing problems. Problem

Based Learning is an instructional approach that uses real world problems as a context for students to learn critical thinking and problem-solving skills (Collins et al., 2021). The use of PBL can encourage students to think critically and can be strengthened through the use of suitable learning resources such as e-modules (Rohmatulloh et al., 2023).

METHODOLOGY

This study employed a research and development approach. The research followed the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The Analysis stage involved identifying student needs, challenges in the learning process, and the suitability of the material to be developed. The Design stage included creating the layout for the Android-based interactive e-module. The Development stage involved constructing the e-module based on the layout that had been designed. The Implementation stage consisted of testing the e-module with media experts, material experts, teachers, and students to evaluate its validity, practicality, and effectiveness. The Evaluation stage involved obtaining feedback and suggestions, which were used as the basis for refining the product so that it can be used optimally.

This study was conducted at SMK Cordova Margoyoso Pati. The research subjects included media experts, material experts, teachers, and Grade XI TSM students. The instruments used in this study included observation sheets, interview sheets, questionnaires, and pre-test and post-test forms. Data collection was carried out through trials in both the experimental and control classes using pre-tests and post-tests, as well as feasibility, practicality, and effectiveness assessments completed by experts, teachers, and students through questionnaires. The development of this Android-based e-module using the Problem Based Learning method aimed to improve the cognitive abilities of TSM students in the topic of motorcycle workshop management.

Data collection employed several instruments designed to gather information, feedback, and student learning outcomes related to the use of the Android-based interactive e-module. These instruments assessed feasibility, practicality, and effectiveness within the learning process for elements of motorcycle workshop management. Feasibility was evaluated using expert validation sheets to ensure that the e-module met standards related to content, appearance, and media functionality. Practicality data were collected through responses from teachers and students after using the e-module during the learning activities. These responses were converted into quantitative data to facilitate analysis and interpretation.

RESULTS AND DISCUSSION

Results

The development of the Android-based interactive e-module using the Problem Based Learning method produced several key results regarding its feasibility, practicality, and effectiveness in improving student cognitive abilities.

Feasibility of the E-Module

The feasibility test indicated that the developed e-module is suitable for use in the learning process. Feasibility assessments covered several aspects including cover design elements, cover layout and composition, typography, content design, content writing quality, and content layout. Validation by media experts produced an average score of 3.7 with a percentage of 91%, which falls into the feasible category.

Aiken V analysis produced an average value of 0.890, categorized as feasible. The intraclass correlation coefficient reached an average of 0.768, which is considered good. Validation by material experts produced an average score of 3.6, categorized as very feasible, with a percentage of 91%. Aiken V analysis produced a value of 0.874, categorized as feasible, and the intraclass correlation coefficient produced a value of 0.750. These results indicate that the Android-based interactive e-module using the Problem Based Learning method is feasible for use in learning the topic of motorcycle workshop management.

Practicality of the E-Module

The practicality validity test using the point biserial correlation showed that all items were valid because the calculated r value exceeded the table value of 0.632. Reliability testing using KR 20 produced a value of 0.783, categorized as good. The reproducibility coefficient produced a value of 0.93, which exceeds the minimum requirement and therefore confirms that the e-module is practical for use. The practicality percentage reached 93%, categorized as very practical. These findings confirm that the developed e-module is practical for use as a learning resource.

Effectiveness of the E-Module

The effectiveness test was conducted using the Shapiro Wilk normality test, which showed that the pre-test and post-test data for Grade XI TSM students had significance values greater than 0.05. The homogeneity test showed that the based on mean value was 0.559, which exceeded the minimum threshold of 0.05, indicating that the data were homogeneous.

Table 1. N Gain Test Results

Data from SPSS N Gain Percent		
	Control	**Experimental**
Mean	31.33	63.82
Minimum	0	16.67
Maximum	66.67	100
Percentage	31%	64%
Category	Not Effective	Moderately Effective

The control group obtained an average N gain score of 31%, categorized as not effective. The experimental group obtained an average of 64%, categorized as moderately effective. This indicates a significant improvement in learning outcomes after the use of the interactive e-module.

Table 2. T Test Results

Group Statistics					
	Class	N	Mean	Std. Deviation	Std. Error Mean
Posttest Results	Posttest Control	36	31.33	18.092	3.015
	Posttest Experimental	36	63.82	26.292	4.382

The T Test results show that the control class scored 31.33 and the experimental class scored 63.82, indicating that the e-module is effective for use in the learning process.

The overall development results show that the e-module meets feasibility standards based on expert validation, which includes evaluations of subject matter quality, design, and interactivity. These aspects received ratings ranging from good to very good. Therefore, the developed e-module is deemed appropriate for use as a learning resource in vocational education settings and for future research applications.

The e-module consists of the following components:

1. Cover
2. Introduction
3. Problem Based Learning
4. Concept Map
5. Learning Outcomes and Objectives
6. Workshop Management Material
7. Summative Assessment
8. Summary
9. References

DISCUSSION

The findings of this study indicate that developing an Android-based interactive e-module using the Problem Based Learning (PBL) method has a significant impact on improving the cognitive abilities of students in the topic of motorcycle workshop management. This conclusion is supported by the difference between the pre-test and post-test results of the control and experimental classes. The control class obtained an average score of 71, while the experimental class achieved a much higher average score of 87. The N Gain results indicate that the control class achieved 31%, which falls into the not effective category, while the experimental class reached 64%, which is categorized as moderately effective. The Independent Sample T Test further strengthens these findings, with a significance value of 0.000 < 0.05, indicating that the

improvement between the two groups is statistically significant. These results are consistent with the findings of Septiana et al. (2019), who reported that the use of e-modules has a more positive influence on student understanding and competency achievement compared to groups that do not receive similar treatment.

Observations in the control class show that during conventional learning, students appeared less motivated and tended to be passive. Students in the control group mainly listened to teacher explanations without actively engaging in discussions or problem-solving activities. The monotonous learning process and limited instructional media, which consisted only of printed textbooks and PowerPoint slides, led some students to feel bored. In contrast, students in the experimental class showed strong enthusiasm in using the Android-based e-module. They reported that the interactive e-module was helpful because it could be accessed anytime and anywhere through their devices, and because it included case-based material, practice questions, and appealing visual illustrations. The ease of use allowed students to study independently using the available features.

Interviews with subject teachers also revealed positive responses to the developed e-module. Teachers stated that the e-module supported the learning process by increasing student independence. They also emphasized that the integration of the PBL approach in the e-module encouraged students to think critically, find solutions, and engage in peer discussions. This perspective aligns with the research findings, which show significant improvement in the cognitive domain, particularly in students understanding of motorcycle workshop management concepts.

Despite the many advantages of the interactive Android-based e-module, several limitations were identified. One challenge is the need for internet access when opening the e-module. This sometimes becomes an obstacle for students who do not always have mobile data or who live in areas with unstable internet signals. This dependence on internet access may disrupt learning in certain situations, such as when students study at home with weak signals or when many users are connected to the network at the same time. However, most students reported that this issue did not significantly hinder their learning because they were able to look for alternative connections, use school Wi-Fi, or download materials when the network was available so that they could continue studying offline.

Although these challenges exist, the overall benefits of the Android-based interactive e-module remain dominant. Observations show that students using the e-module appear more active, enthusiastic, and engaged in the learning process. They do not only read the material but also interact with various features such as practice questions, visual illustrations, simulations, and contextual cases included in the module. These findings align with Saparini et al. (2023), who emphasized that the use of technology-based learning media can increase student motivation by providing more interactive and contextual learning experiences.

Increased student engagement is evident from the fact that students using the e-module are more enthusiastic and actively involved compared to those in the control class who experienced traditional lecture-based instruction. This is supported by Fanani and Astuti (2024), who stated that Android based e-modules offer learning flexibility because they can be accessed anytime and anywhere, allowing students to become more autonomous and responsible for their learning process. Students are no longer passive recipients of information but instead explore the material actively using interactive features. Meanwhile, the teacher shifts into a facilitator who guides students when necessary. Therefore, although internet access remains a limitation, the benefits of the Android-based interactive e-module have a broader positive impact on improving learning quality, increasing student motivation, and fostering better learning independence.

Overall, the e-module successfully addresses the three key aspects of instructional material development in this study, namely feasibility, practicality, and effectiveness.

CONCLUSION

Overall, this study concludes that the Android-based interactive e-module integrated with the Problem Based Learning (PBL) approach is a valid, practical, and effective learning medium for improving instruction in the topic of motorcycle workshop management. The use of this e-module led to a significant improvement in the cognitive abilities of students. The experimental class achieved an average score of 87, which was substantially higher than the control class average of 71. This improvement falls into the moderately effective category with an N Gain value of 64%, in contrast to the control class which showed a not effective N Gain of 31%. Statistical testing ($p < 0.05$) confirms that this improvement in learning outcomes is significant.

The PBL based e-module successfully created a more active and enthusiastic learning environment. Students reported that the module was helpful due to its flexible access through Android devices, case-based material, practice questions, and engaging visual elements. Teachers also acknowledged that the e-module enhanced student independence and promoted critical thinking and collaborative problem solving through the PBL approach. The only minor limitation identified was the need for a stable internet connection. However, this issue was manageable, as students could rely on alternative networks or school Wi-Fi, or download materials for offline use.

In conclusion, this study affirms that interactive and contextually designed technology-based learning media can enhance student motivation, improve competency achievement, and support independent learning.

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