

Development of Hybrid Learning Media Integrating Android and Web Platforms with an Adaptive Learning Approach

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Abstrac

This study aimed to develop hybrid learning media based on Android and web platforms using an adaptive learning approach for the Basic Programming course. The study employed a Research and Development (R&D) method with the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages. The participants were 36 eleventh-grade students from the Software Engineering and Informatics, Networking & Application Systems programs at a vocational high school in Padang, Indonesia. Data were

collected through observations, semi-structured interviews with basic programming teachers and student representatives, expert validation questionnaires, and student response questionnaires. The results showed that the developed media achieved validity scores of 92.4% from media experts and 90.8% from subject matter experts, both categorized as highly valid. Student responses reached 89.7%, indicating a very positive acceptance level. The adaptive learning features enabled personalized delivery of learning materials and exercises based on students' abilities. Therefore, the developed hybrid learning media is considered feasible and effective for supporting personalized learning in vocational education. The implications of this study suggest that integrating dual-platform adaptive paths provides vocational schools with a practical digital framework to successfully mitigate diverse student learning paces in technical ICT curricula.

Keywords

Adaptive Learning, Android-Based Learning, Hybrid Learning, Learning Media, Web-Based Learning

I. Introduction

Digital transformation has brought significant changes to the education sector, particularly in the utilization of technology to support learning processes that are more flexible, interactive, and learning centre. The rapid advancement of information technology has encouraged the development of various innovative learning media that enable students to acquire more effective learning experiences aligned with the demands of 21st-century education. Digital technology is no longer viewed merely as a supplementary tool in education; rather, it has become an essential component in enhancing the quality of both teaching and learning outcomes (Kerimbayev et al., 2023; Llorente & Izquierdo-Álvarez, 2024).

In vocational education, particularly in vocational high schools specializing in Information Technology, educational technology plays a strategic role in supporting students' competency development. Study programs such as Software Engineering and Information Systems, Networking, and Applications require students to master computational thinking, programming skills, and problem-solving abilities through learning activities that extend beyond classroom instruction and encourage independent learning. Therefore, learning media that provide flexible access to learning resources while promoting interactive and continuous learning experiences are highly needed (Saputri & Fransisca, 2023b; SAPUTRI et al., 2024).

Technological advancement has also accelerated the implementation of e-learning and blended learning as alternative instructional approaches capable of integrating face-to-face and online learning environments. Research conducted by ((Fransisca & Yunus, 2021) demonstrated that the use of e-learning within a blended learning model possesses a high level of practicality and effectively supports the learning process. Similarly, (Fransisca, 2017) reported that the implementation of e-learning in Digital Simulation courses at vocational high schools received positive responses from students because it enabled them to access learning materials anytime and anywhere.

Despite these benefits, conventional learning media applied in vocational classrooms often rely on a one-size-fits-all delivery. This uniform teaching paradigm creates a critical core problem: high-achieving students face disengagement due to a lack of instructional challenge, while lower-paced students rapidly fall behind, ultimately leading to severe gaps in essential programming competencies. Therefore, identifying these individual gaps early and offering automated, tailored recommendations is paramount to ensuring equitable learning outcomes. Within the same classroom, some students can comprehend learning materials quickly, while others require additional time and supplementary

learning resources. Such disparities often result in unequal competency achievement and subsequently affect students' learning outcomes.

To address this issue, learning approaches that can adapt instructional content to individual learner characteristics and abilities are required. One of the emerging approaches in digital education is adaptive learning. This approach enables learning systems to provide different materials, exercises, and assessments based on learners' performance and achievement levels. Adaptive learning aligns with the principles of learner-centered education by offering personalized learning experiences tailored to individual needs.

In addition to adaptive learning, the concept of hybrid learning has gained increasing attention across various educational levels. Hybrid learning combines the advantages of face-to-face instruction with technology-enhanced learning environments, allowing students to participate in both synchronous and asynchronous learning activities. A literature review conducted by (Permata Saputri et al., 2025) revealed that blended and hybrid learning approaches have significant potential to improve learning flexibility, student engagement, and competency achievement in Informatics education.

Numerous previous studies have developed Android-based and web-based learning media. (Yunus & Fransisca, 2020) developed an Android-based learning application and found that it was valid for use as a digital learning medium. Similarly, (Sutiasih & Saputri, 2019) reported that Android-based mobile learning improved learning accessibility and promoted students' independent learning. Furthermore, (Saputri & Fransisca, 2023a) found that Android-based learning media positively influenced students' learning activities and understanding in Digital Simulation courses.

However, a review of the existing literature reveals several research gaps. First, most previous studies have focused on developing

Android-based or web-based learning media separately. Second, the implementation of adaptive learning in programming education at vocational high schools remains relatively limited. Third, previous studies have rarely integrated automatic content recommendation features based on students' learning abilities together with real-time learning analytics dashboards that enable teachers to monitor students' progress effectively. Meanwhile, integrated and learner-centered educational innovation has become one of the major priorities in contemporary educational development (Fitriati et al., 2025; Soedjatmiko et al., 2023).

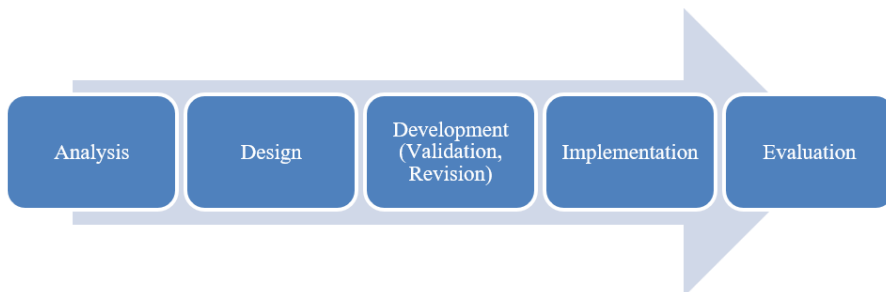
Based on these challenges, this study develops a hybrid learning media integrating Android and web platforms with an adaptive learning approach for the Fundamentals of Programming course. The novelty of this study lies in the integration of Android and web platforms into a single hybrid learning ecosystem supported by an adaptive learning mechanism based on pre-test results, automated learning material recommendations tailored to students' competency levels, and a learning progress monitoring dashboard accessible to teachers. The developed system is expected to provide a more personalized, flexible, and effective learning experience in supporting Information Technology education at vocational high schools.

Although previous studies have developed Android-based learning media, web-based learning systems, and hybrid learning models, most of them have primarily focused on providing general learning content without adequately addressing differences in students' learning abilities. Furthermore, the implementation of adaptive learning in vocational programming education remains limited, particularly studies that integrate Android and web platforms within a unified learning ecosystem. Therefore, this study offers a novel contribution through the development of hybrid learning media that integrates Android and web platforms with an adaptive learning approach to personalize students' learning experiences. The developed system not only provides learning access through

multiple devices but also identifies students' initial competencies through pre-tests, automatically recommends learning materials and exercises based on learning achievement, and provides a learning analytics dashboard that enables teachers to implement timely instructional interventions. This innovation was implemented in the Fundamentals of Programming course involving students enrolled in the Software Engineering and Information Systems, Networking, and Applications programs at vocational high schools in Padang. Consequently, this study contributes not only to the development of digital learning media but also to the advancement of a more adaptive, personalized, and vocationally relevant learning model for Information Technology education (Oliveira & De Souza, 2022).

II. Method

This study employed the ADDIE development model (Branch, 2009), encompassing five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. These phases



were implemented systematically to ensure that the developed learning media aligned with user requirements and satisfied established educational quality and feasibility standards. The research procedure is presented in Figure 1.

Figure 1. Learning Media Development Process Based on the ADDIE Model

The analysis phase involved identifying user needs and student characteristics to establish the requirements for the proposed learning media. The design phase resulted in the development of the system architecture, user interface, and adaptive learning framework. During the development phase, an Android application and a web-based platform were produced and subsequently evaluated through expert validation involving media and subject matter specialists. After revisions were made based on the experts' recommendations, the developed product was implemented with students and underwent evaluation to determine its educational feasibility and user acceptance.

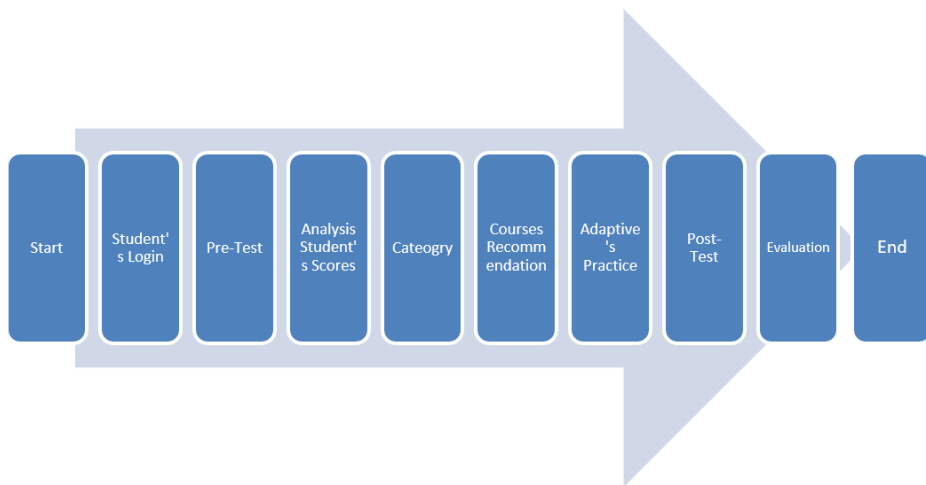


Figure 2. Flowchart Adaptive Learning

In this study, the adaptive learning approach was designed to tailor instructional materials to students' initial competency levels. The adaptation process was based on pre-test results, which were used to classify students into different learning ability groups. This classification enabled the system to provide learning materials and activities that were aligned with each student's level of understanding and learning needs.

III. Result and Discussion

Result

This study resulted in the development of hybrid learning media integrating Android and web platforms with an adaptive learning approach for the Fundamentals of Programming course. The developed product consists of an Android application that enables

students to access learning materials, practice exercises, and assessments, as well as a web-based platform that allows teachers to manage instructional content and monitor students' learning progress.

The main features of the learning media include interactive learning modules, instructional videos, pre-tests, post-tests, an adaptive learning-based content recommendation system, interactive exercises, and a learning progress monitoring dashboard. The implementation of the adaptive learning approach enables the system to personalize learning materials according to students' initial competency levels, as determined through pre-test results.

Media Expert Validation Results

Media validation was conducted by two media experts who evaluated the product in terms of user interface design, navigation, interactivity, system functionality, and application compatibility.

Table 1. Media Expert Validation Results

No.	Evaluation Aspect	Percentage (%)	Category
1	User Interface Design	94.2	Highly Valid
2	Navigation	91.7	Highly Valid
3	Interactivity	93.5	Highly Valid
4	System Functionality	92.8	Highly Valid
5	Application Compatibility	89.8	Highly Valid
	Average	92.4	Highly Valid

As presented in Table 1, all evaluated aspects achieved the category of Highly Valid. User interface design obtained the highest score (94.2%), while application compatibility received the lowest score (89.8%). These findings indicate that the developed learning media demonstrates excellent design quality and system functionality.

Subject Matter Expert Validation Results

Content validation was performed by two subject matter experts who assessed the alignment of the learning materials with learning outcomes, content accuracy, language appropriateness, content presentation, and learning assessment.

Table 2. Subject Matter Expert Validation Results

No.	Evaluation Aspect	Percentage (%)	Category
1	Content Relevance	92.5	Highly Valid
2	Content Accuracy	91.8	Highly Valid
3	Language Appropriateness	89.3	Highly Valid
4	Content Presentation	90.7	Highly Valid
5	Learning Assessment	89.7	Highly Valid
	Average	90.8	Highly Valid

The validation results indicate that the developed learning materials are well aligned with the curriculum and learning outcomes of the Fundamentals of Programming course. The validators also confirmed that the materials are clearly presented, easy to understand, and supportive of the learning process in vocational high schools.

Student Response Results

The product was tested with 36 eleventh-grade students enrolled in the Software Engineering and Information Systems, Networking, and Applications programs at a vocational high school in Padang.

Table 3. Student Response Results

No.	Evaluation Aspect	Percentage (%)	Category
1	Ease of Use	91.2	Excellent
2	Media Appearance	90.4	Excellent
3	Learning Benefits	89.6	Excellent
4	Learning Motivation	88.7	Excellent
5	User Satisfaction	88.6	Excellent
	Average	89.7	Excellent

Based on the questionnaire results, students expressed highly positive responses toward the developed learning media. Ease of use achieved the highest score (91.2%), indicating that students were able to operate the system conveniently and effectively.

Summary of Product Feasibility Results

Table 4. Summary of Product Feasibility Results

Evaluation Component	Percentage (%)	Category
Media Expert Validation	92.4	Highly Valid
Subject Matter Expert Validation	90.8	Highly Valid
Student Responses	89.7	Excellent
Overall Average	90.97	Highly Valid

The summary results indicate that the developed learning media achieved an overall average score of 90.97%, placing it within the Highly Valid category. Therefore, the hybrid learning media integrating Android and web platforms with an adaptive learning approach is considered feasible and suitable for use in the Fundamentals of Programming course in vocational high schools.

Discussion

The findings of this study indicate that the hybrid learning media integrating Android and web platforms with an adaptive learning approach achieved a high level of feasibility. The high media expert validation score suggests that the developed product fulfills the essential principles of effective digital learning media design, including visual presentation, navigation, interactivity, and system functionality. This finding is consistent with the study conducted by (Fransisca, 2017), which reported that learning media with well-designed interfaces and interactive features can enhance students' learning experiences.

The subject matter expert validation score of 90.8% indicates that the instructional content is well aligned with the learning outcomes of the Fundamentals of Programming course and the characteristics of vocational high school students. The systematic organization of learning materials, supported by interactive exercises, enables students to construct their understanding progressively. This finding is consistent with constructivist learning theory, which emphasizes that knowledge is actively constructed through learning experiences and interactions with the learning environment (Piaget, 1977; Vygotsky, 1978). In the context of this study, students were not merely passive recipients of information but actively engaged with learning activities and assessments provided by the system.

One of the major contributions of this study is the implementation of an adaptive learning approach. This approach

enables the system to personalize learning materials and exercises according to students' initial competency levels as identified through pre-test results. Such a mechanism aligns with the concept of personalized learning, which places learners' needs, abilities, and characteristics at the center of the learning process (Sumathy & Navamani, 2024). Through differentiated learning recommendations for each competency level, students receive learning experiences that are more relevant and responsive to their individual learning needs.

The findings support the study conducted by (Wulandari et al., 2024), which demonstrated that adaptive learning can enhance students' learning experiences by providing instructional content that matches their individual abilities. Furthermore, the results are in agreement with the findings of (Essa et al., 2023), who reported that adaptive learning systems can improve student engagement and academic performance by offering personalized learning pathways compared to conventional instructional approaches.

The student response score of 89.7% indicates that the developed learning media was highly accepted by users. This positive response was largely influenced by the accessibility of the Android-based application, which enabled students to learn anytime and anywhere. This finding supports the study by (Saputri & Fransisca, 2023b), which concluded that Android-based learning media can enhance learning flexibility and promote students' independent learning.

From the perspective of vocational education, the developed learning media demonstrates strong relevance to the characteristics of vocational high school learning environments. Programs such as Software Engineering and Information Systems, Networking, and Applications require students to develop practical competencies through continuous practice and timely feedback. The integration of Android and web platforms provides broader access to learning resources, while teachers can monitor students' progress in real time through the learning monitoring dashboard. These findings support the view that digital transformation in vocational education can improve instructional effectiveness and better prepare students for technology-driven workplaces (Oliveira & De Souza, 2022).

Compared with previous studies that primarily focused on developing Android-based or web-based learning media independently, this study offers a novel contribution through the integration of both platforms within a single hybrid learning ecosystem supported by an adaptive learning approach. In addition, the inclusion of a learning progress monitoring dashboard provides teachers with valuable support for evaluation

and instructional decision-making. Therefore, the developed product functions not only as a medium for delivering instructional content but also as an adaptive and personalized learning system that addresses the demands of 21st-century vocational education.

IV. Conclusion

This study successfully developed a hybrid learning media integrating Android and web platforms with an adaptive learning approach for the Fundamentals of Programming course. The developed system was implemented for students enrolled in the Software Engineering and Information Systems, Networking, and Applications programs at vocational high schools in Padang. The learning media integrates an Android application for student learning activities and a web-based platform for content management, learning assessment, and integrated monitoring of students' learning progress.

The findings indicate that the developed learning media achieved a high level of feasibility. Media expert validation obtained a score of 92.4%, subject matter expert validation reached 90.8%, and student responses achieved 89.7%. These results demonstrate that the developed product fulfills the criteria of media quality, content appropriateness, usability, and user needs within the learning process. Therefore, the learning media can be classified as highly valid and suitable for supporting the teaching and learning of Fundamentals of Programming in vocational high schools.

Overall, the findings suggest that the Android and web-based hybrid learning media with an adaptive learning approach has strong potential to serve as an innovative instructional solution for improving the quality of programming education in vocational high schools, particularly in study programs related to Information Technology.

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