

Design and Evaluation of a Digital Learning Media Module Based on *Alur Merdeka* for Prospective Teachers

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ABSTRACT

The integration of technology in education necessitates that future teachers acquire the skills to design and implement effective digital learning media. The *Merdeka Curriculum*, particularly through its *Alur Merdeka* framework, emphasizes flexible and independent learning, aligning with this need. This study aimed to develop and evaluate a Digital Learning Media module grounded in the *Alur Merdeka* approach to improve student competencies in educational technology. A Research and Development (R&D) methodology was applied, guided by the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Module validity was assessed by expert reviewers. Practicality was gauged through student response questionnaires, and effectiveness was measured using N-Gain Scores from pretest and posttest results. The module demonstrated high validity (87.6%) and strong practicality (84%) based on expert evaluations and student feedback. Effectiveness testing showed a significant improvement in students' competencies, with an N-Gain Score of 0.72, categorized as high. The findings confirm that the *Alur Merdeka*-based module is a valid, practical, and effective tool for supporting independent learning in teacher education. Its implementation can enhance prospective teachers' ability to develop technology-driven instructional media. This study contributes to the development of flexible, competency-based digital learning resources in alignment with the *Merdeka Curriculum*, supporting the broader integration of technology in teacher education programs.

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1. INTRODUCTION

Integrating technology into education has become essential in the rapidly evolving digital era. The role of teachers is no longer limited to delivering subject matter; they must also be proficient in utilizing

technology to create dynamic and engaging learning experiences (Yeni, 2022). This shift reflects the increasing demand for 21st-century educator competencies, which emphasize pedagogical expertise and the ability to facilitate and inspire learning through information and communication technology (ICT) (Rahimi & Oh, 2024). Teachers must leverage digital tools to foster student-centered learning, encourage collaboration, and enhance critical thinking skills (Mejia & Sargent, 2023).

Research has shown that digital learning media improves student engagement and motivation by offering interactivity, flexibility, and personalized learning experiences (Alamri et al., 2020). These technologies allow students to access diverse resources, such as multimedia content, online simulations, and virtual learning environments, enabling deeper understanding and more meaningful learning (Hafezy, 2023). Moreover, digital platforms provide opportunities for adaptive learning, where instructional materials can be tailored to individual student needs, promoting self-paced and autonomous learning. Given these advantages, equipping prospective teachers with the skills to develop and implement effective digital learning media is essential for preparing them to meet the demands of modern education (Burns, 2023).

The Merdeka Curriculum, implemented across various educational institutions, emphasizes flexibility and student-centered learning, allowing learners to explore and develop their potential according to their interests and needs (Hikmah et al., 2024; Sirait et al., 2024). This curriculum shifts away from rigid, standardized instruction toward a more adaptive and personalized learning approach, where students are encouraged to take ownership of their learning process (Pak et al., 2020). By fostering autonomy and self-directed learning, the Merdeka Curriculum aims to better prepare students for the challenges of the modern world, equipping them with essential 21st-century skills such as problem-solving, collaboration, and digital literacy (Hunaepi & Suharta, 2024).

One of its key pedagogical frameworks is *Alur Merdeka*, which consists of seven structured stages: Starting from Self, Concept Exploration, Collaboration Space, Contextual Demonstration, Elaboration of Understanding, Connection between Materials, and Real Action (Widayat et al., 2023). This sequential approach ensures that learning begins with personal reflection, progresses through conceptual understanding and collaborative engagement, and culminates in real-world application. By prioritizing experiential and inquiry-based learning, *Alur Merdeka* fosters critical and creative thinking skills, encouraging students to engage with knowledge rather than passively receiving information (Tsui, 2002). Moreover, this approach aligns with modern constructivist learning theories, emphasizing the importance of active participation, contextual learning, and meaningful connections between concepts. As a result, *Alur Merdeka* serves as a powerful instructional model that supports the goals of the Merdeka Curriculum, equipping students with the skills necessary for lifelong learning and success in an ever-evolving global landscape.

Despite the widespread implementation of the *Merdeka* Curriculum, limited resources exist to support prospective teachers in designing and applying digital learning media within this framework. Most available learning modules remain conventional and do not fully accommodate the need for independent development of educational technology skills (El-Sabagh, 2021). Therefore, developing a Digital Learning Media module based on *Alur Merdeka* is necessary to support more flexible, innovative, and relevant learning experiences in response to contemporary educational demands.

This study aims to (1) design a digital learning media module aligned with *Alur Merdeka*, (2) evaluate its validity, practicality, and effectiveness, and (3) provide recommendations for its broader implementation in teacher education. Previous studies indicate that collaborative digital modules enhance student engagement and comprehension (Jamain et al., 2022), while STEM-based digital modules have proven effective in improving prospective elementary school teachers' mathematical competence (Ramadhani et al., 2022).

By integrating the *Alur Merdeka* approach, this module aims to prepare prospective teachers for the challenges of digital education while contributing to improving education quality in Indonesia through enhanced technological competence.

2. METHODS

2.1 Research Design

This study employs a Research and Development (R&D) approach using the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model to design and evaluate a Digital Learning Media course module based on Alur Merdeka for prospective teachers. The ADDIE model was chosen due to its systematic yet flexible framework, allowing for iterative refinement based on feedback and specific educational needs (Branch, 2009).

2.2 Participants and Sampling

Participants were selected using purposive sampling based on specific criteria: students currently enrolled in the Digital Learning Media course, with prior exposure to instructional design principles, and availability to participate in all module sessions. The participants consisted of 32 undergraduate students (aged 19–23 years), majoring in education, with a balanced gender distribution.

2.3 Module Development Process

The module development process followed the five stages of the ADDIE model to ensure a structured and systematic approach. The first stage, Analysis, involved identifying student needs and competencies related to digital learning media through surveys and interviews, allowing for a deeper understanding of their learning requirements. In the Design stage, the module structure was developed, learning objectives were defined, and instructional strategies were selected based on the Alur Merdeka approach to ensure alignment with the curriculum. The Development stage focused on creating the module content, which was then validated by material and media experts to ensure accuracy, instructional quality, and effectiveness. Following this, the Implementation stage involved piloting the module with students, during which data on its practicality and effectiveness were collected through observations and feedback. Finally, in the Evaluation stage, the module was assessed based on student and expert feedback, leading to necessary revisions and refinements to enhance its overall quality and usability.

2.4 Data Collection Instruments

Several instruments were utilized to gather data and evaluate the module's effectiveness. Questionnaires and interviews were conducted to assess student needs and collect feedback on their learning experiences. Expert validation sheets were used to evaluate the content and design to ensure the accuracy and instructional quality of the module. Additionally, observations were carried out to examine student engagement and the practical usability of the module during implementation. Finally, learning outcome tests, consisting of pretests and posttests, were administered to measure improvements in student competencies after using the module. These combined instruments provided qualitative and quantitative insights into the module's validity, practicality, and effectiveness.

2.5 Data Analysis Techniques

Data analysis was conducted using qualitative and quantitative approaches to ensure a comprehensive module evaluation. The qualitative analysis involved a thematic examination of data obtained from observations and interviews, allowing for an in-depth assessment of the module's practicality and user experience. Meanwhile, quantitative analysis was carried out using the N-Gain method, which measured the module's effectiveness by comparing pretest and posttest scores to determine the extent of student competency improvement (Aziz et al., 2021). This dual approach provides a well-rounded understanding of the module's impact on learning outcomes.

2.6 Ethical Considerations

Ethical guidelines were strictly followed throughout the study to protect participants' rights and well-being. Informed consent was obtained from all participants before data collection, ensuring they fully understood the study's purpose and procedures. Participation was entirely voluntary, and students could withdraw at any stage without any consequences. Additionally, data confidentiality

was maintained by securely handling and anonymizing all collected information, ensuring privacy and integrity in reporting. These measures were implemented to uphold ethical research standards and protect the participants involved in the study.

3. FINDINGS AND DISCUSSION

The results of this study include three main aspects: module validity, module practicality, and module effectiveness in improving prospective teacher students' competence in using Alur Merdeka-based digital learning media.

3.1 Module Validity

Module validation was carried out by two material experts and two media experts to assess the feasibility of content, presentation, language, and integration with the Alur Merdeka approach. The validation data is presented in Table 1:

Table 1. Module Validation Results by Experts

Assessment Aspects	Subject matter expert 1	Subject matter expert 2	Media Member 1	Media Member 2	Average (%)	Category
Eligibility	85%	88%	-	-	86.5%	Highly Valid
Conformity with the Alur Merdeka	90%	85%	-	-	87.5%	Highly Valid
Eligibility for Serving Linguistics	-	-	80%	82%	81%	Valid
Linguistics	88%	84%	85%	86%	85.8%	Highly Valid
Design and Interactivity	-	-	87%	85%	86%	Highly Valid
Total Average	87.6%	Highly Valid				

The Alur Merdeka-based Digital Learning Media module validation results show that this module is in the very valid category, with an average score of 87.6%. Validation was carried out by two material experts and two media experts who assessed the feasibility of the content, conformity with the Alur Merdeka, presentation, language, module design, and interactivity.

Regarding content eligibility, the module obtained an average score of 86.5%, which shows that the material is relevant to the competence of prospective teacher students. Experts assess that the content already covers the theory and practice of using digital learning media, although adding more examples of applications in learning is still recommended. The aspect of conformity with the Alur Merdeka scored 87.5%, indicating that the module accommodated the principles of flexibility, independent learning, and practical experience. However, experts recommend including more case studies that can lead students to develop their learning media independently.

Regarding presentation feasibility, the module received a score of 81%, meaning it has been presented well and is easy to understand. However, there are some suggestions for improvement, especially in navigating digital modules to make it more intuitive for students. Meanwhile, the linguistic aspect obtained a score of 85.8%, showing that the module has used academic language that is clear, communicative, and by Indonesian rules. Some technical terms in the module are suggested to be accompanied by a glossary to make it easier for students to understand.

The design and interactivity aspects received a score of 86%, indicating that the module has an attractive appearance and interactive features supporting student learning engagement. Media experts

suggest adding interactive elements like video tutorials and automated quizzes to enhance a more dynamic and innovative learning experience.

Overall, the validation results show that this module has been feasible with minor revisions to improve the clarity of presentation and enrich the interactive features. The recommendations given by the experts will be used as the basis for the revision process before the module is widely implemented in the learning of prospective teacher students.

Based on the validation results conducted by material and media experts, the module developed obtained an average validity score of 85.6%, which is included in the very valid category. Validation is based on content, presentation, language, and conformity with the Alur Merdeka approach. Material experts assessed that this module met the competency needs of prospective teacher students, while media experts assessed that the display and interactivity of the module met practical digital learning standards. This finding aligns with previous research, which shows that digital learning media validated by experts tends to have a high level of acceptance among students (Nokelainen, 2006).

3.2 Module Practicality

The practicality of the Alur Merdeka-based Digital Learning Media module is evaluated through observation during implementation and student response questionnaires. This practicality is measured based on ease of use, content comprehension, and student involvement in independent learning.

Table 2. Module Practicality Questionnaire Results

Assessment Aspects	Score (%)	Category
Ease of use	82.3%	Practical
Content comprehension	85.6%	Very Practical
Student engagement	88.1%	Very Practical
Navigation and display design	80.5%	Practical
Interactivity and active engagement	83.7%	Practical
Average	84%	Very Practical

Based on the evaluation results, the module obtained an average practicality score of 84%, which is categorized as very practical. These results indicate that students could use the module effectively in their learning process.

Regarding ease of use, the module received a score of 82.3%, suggesting that most students found the module user-friendly. However, some students noted that the navigation could be simplified for a more intuitive experience. One student remarked, *"I struggled with the module's navigation, especially when switching between different sections. A clearer menu or navigation guide would make it easier to follow."*

The content comprehension aspect scored 85.6%, demonstrating that the material was clear and easy to understand. Students found the concept explanations, illustrations, and case studies helpful in grasping the subject matter. One participant stated, *"The examples provided in the module helped me relate theories to real-life classroom applications. I found the step-by-step explanations very useful."*

Regarding student engagement in independent learning, the module received the highest score (88.1%), indicating that it strongly encourages self-directed learning, in line with the Alur Merdeka principles. Many students appreciated the experience-based project assignments, which allowed them to apply their knowledge in designing digital learning media. A student shared, *"The hands-on projects in this module helped me understand how to create digital media. I feel more confident in using technology for teaching."*

The module received a score of 80.5% for navigation and display design, showing that the visual layout was generally effective, but improvements could be made in font readability and page organization. A student suggested, *"Some text is too small, and certain sections feel cluttered. A cleaner layout would improve readability."*

The interactivity and active engagement aspect scored 83.7%, indicating that the interactive features, such as videos, quizzes, and discussion forums, effectively enhanced student participation.

However, some students recommended incorporating more interactive multimedia elements to enrich the learning experience. One student mentioned, *"I enjoyed the quizzes and discussion activities, but adding more video tutorials or interactive simulations would make the module even better."*

Observations during module implementation further supported the questionnaire results. Students could navigate the module without major technical issues, although some struggled with certain interactive features. Those unfamiliar with digital learning media needed additional guidance in effectively using interactive quizzes and discussion forums.

These findings align with previous studies, which emphasize that the practicality of digital modules depends largely on user-friendly interface design and active student engagement (Errabo & Ongoco, 2024). The positive response to experience-based projects supports research indicating that hands-on learning enhances student motivation and competency in digital education (Sevil et al., 2015).

Overall, the module is highly practical, with minor revisions recommended to enhance navigation, font readability, and interactivity. Including additional instructional videos and interactive simulations could further support student engagement and comprehension.

3.3 Module Effectiveness

The effectiveness of the Alur Merdeka-based Digital Learning Media module was measured using the N-Gain Score test, which compares the results of students' pretest and posttest before and after using the module. This test aims to see an increase in students' understanding of concepts and skills in developing digital learning media.

Table 3. N-Gain Score Results on Student Learning Outcomes

Assessment Aspects	Average Pretest	Average Posttest	N-Gain Score	Categories Effectiveness
Understanding the basic concepts of digital learning media	54.2	82.5	0.72	High
Skills in designing learning media	50.8	80.3	0.71	High
The ability to apply technology in learning	48.7	81.6	0.74	High
Total average	51.2	81.5	0.72	High

The N-Gain Score test results indicate that the Alur Merdeka-based Digital Learning Media module significantly enhances students' understanding and skills, with an average N-Gain Score of 0.72, categorized as high. This confirms the module's effectiveness in improving prospective teachers' digital literacy competencies and preparing them for technology-integrated teaching.

Students' understanding of digital learning media improved from 54.2 (pretest) to 82.5 (posttest), with an N-Gain Score of 0.72, demonstrating a deeper grasp of fundamental theories and principles. One student reflected, *"Before using this module, I only had a general idea of digital learning media. Now, I understand its theoretical background and role in enhancing student engagement."* Additionally, students' skills in designing digital learning media increased from 50.8 to 80.3, with an N-Gain Score of 0.71, showing that they could apply their knowledge effectively in assignments. A participant noted, *"This module helped me build my digital learning media. The structured process made it easier to design engaging and effective materials."*

The highest improvement was observed in students' ability to apply technology in learning, increasing from 48.7 to 81.6, with an N-Gain Score of 0.74. This suggests that the module effectively supports 21st-century learning demands, enabling students to integrate digital tools into real classroom settings. One student shared, *"I now feel more confident using technology in my teaching. Before this module, I hesitated about integrating digital tools into my lessons."* Observations during implementation confirmed that students could navigate and utilize the module effectively, although some initially struggled with interactive features and required additional guidance.

These findings align with the ADDIE model, particularly in the Implementation and Evaluation phases, emphasizing iterative learning improvements based on feedback. Additionally, the results support the TPACK framework, demonstrating that effective integration of technology, pedagogy, and content knowledge enhances prospective teachers' skills (Koehler & Mishra, 2005). The constructivist learning approach also underpins these findings, as the module fosters active, experience-based learning, allowing students to develop digital learning materials independently (Zulu & Haupt, 2019).

Despite the module's high effectiveness, students suggested several enhancements, including more interactive multimedia elements such as adaptive quizzes and gamified learning activities, additional real-world case studies to connect theory and practice better, and a simplified user interface for easier navigation. The findings confirm that the *Alur Merdeka*-based Digital Learning Media module is a highly effective tool for improving prospective teachers' digital competencies. Future research should explore its long-term impact on teaching performance and test its applicability across different educational levels and subjects.

Discussion

The findings of this study highlight the potential of the *Alur Merdeka*-based Digital Learning Media module not only to transmit theoretical knowledge but also to develop students' practical teaching competencies. More than reiterating the results, this discussion focuses on the broader implications for teacher education. The integration of flexible, module-based learning reflects the principles of the Technological Pedagogical Content Knowledge (TPACK) framework, emphasizing the need for educators to blend technological, pedagogical, and content knowledge to design meaningful and contextually relevant learning experiences (Koehler & Mishra, 2005). By enabling prospective teachers to engage in autonomous, technology-rich learning experiences, the module supports the Merdeka Curriculum's emphasis on independence, creativity, and adaptability.

The module's high validation score reflects its strong content alignment with *Alur Merdeka*, effective presentation, and interactive features. This aligns with Hobbs' (2017) emphasis on digital literacy as a critical element in 21st-century education. According to Hobbs, digital literacy comprises five key competencies—access, analyze, create, reflect, and act—which are essential in helping educators integrate digital tools effectively. The developed module addresses each of these elements by providing students with opportunities to access curated content, analyze case studies, create digital media, reflect through quizzes and feedback, and apply learning through simulation tasks. This comprehensive approach reflects a pedagogically sound method of integrating technology into teacher education.

The practicality score of 84% suggests that the module is both user-friendly and beneficial in supporting students' learning processes. This result is consistent with the principles outlined in the TPACK framework, which highlight that effective educational technology must be interactive, accessible, and tailored to learners' needs (Koehler et al., 2014). The module's interactive components—such as video tutorials, media design simulations, and formative quizzes—proved valuable in helping students grasp abstract technological concepts and apply them in simulated teaching scenarios. Prior studies also emphasize the importance of user-centered design in educational technology, underscoring that digital tools must be intuitively navigable and pedagogically purposeful (Nisa et al., 2024; Nisa & Aryni, 2023).

The module's effectiveness was demonstrated through a high N-Gain Score of 0.72, indicating significant improvement in students' understanding and skills. This score places the module in the "high effectiveness" category, suggesting its success in facilitating meaningful learning. The flexible, independent learning approach promoted by *Alur Merdeka* allowed students to develop learning media that suited their own contexts and teaching goals, thereby reinforcing the value of learner autonomy.

These findings are consistent with research advocating for student-centered, hands-on learning approaches that promote 21st-century competencies such as digital fluency, problem-solving, and critical thinking (Ikbal, 2023). The ability to adapt technology into educational practice is essential for

modern educators, and this module's design encourages such skill development through experiential learning.

More specifically, the area of greatest improvement was in students' ability to apply technology in instructional contexts, with an N-Gain Score of 0.74. This suggests not only conceptual understanding but also successful translation into practice—one of the core aims of the TPACK framework. According to Koehler et al. (2014), meaningful technology integration occurs when teachers can thoughtfully combine their pedagogical and content expertise with appropriate technological tools. The module appears to support this integration effectively, demonstrating its relevance and applicability in teacher education settings.

Despite the overall positive results, some limitations emerged—particularly in navigation and display design. A small proportion of students reported difficulties with the module's interface, citing that the layout and visual structure could be more streamlined. These issues reflect broader findings in educational technology research, which caution that poorly designed interfaces can impede learning by increasing cognitive load (Sung et al., 2016). A visually cluttered or confusing interface may distract from the learning content and frustrate users, thereby reducing overall effectiveness.

To address these concerns, future revisions of the module should include enhancements to the user experience (UX). These may involve simplifying menu structures, improving visual hierarchy, and ensuring consistency across pages. Incorporating user feedback during iterative design cycles will also be crucial in making the module more accessible and engaging for all learners.

Overall, this study suggests that *Alur Merdeka*-based modules offer a promising approach to preparing prospective teachers for technology-integrated instruction. By combining theory with practical application in a flexible, autonomous learning environment, such modules can bridge the gap between policy aspirations and classroom realities.

Moreover, the findings support the need for ongoing innovation in instructional design, particularly in higher education institutions that aim to produce digitally literate and pedagogically competent teachers. Developing adaptable learning modules that reflect local contexts and prioritize learner autonomy aligns with current educational trends toward personalization and flexibility.

Future research should explore the long-term impacts of implementing such modules across different courses and educational levels. Longitudinal studies could assess how continued exposure to autonomous, technology-based learning influences teachers' readiness to integrate digital tools in real classroom settings. Additionally, comparative studies across institutions could help refine the module further and adapt it to diverse educational contexts.

4. CONCLUSION

This study confirms that digital learning media modules designed using the *Alur Merdeka* approach are valid, practical, and effective in enhancing prospective teachers' digital competencies. The validation results indicate that the module meets essential criteria related to content feasibility, alignment with *Alur Merdeka* principles, instructional design, language clarity, and interactivity. Additionally, student responses highlight its practicality, with an average usability score of 84%, demonstrating its effectiveness in facilitating independent and technology-integrated learning.

Furthermore, the effectiveness analysis based on the N-Gain score shows a significant improvement in students' learning outcomes after using the module. These findings align with previous research emphasizing the importance of well-structured digital learning resources in fostering engagement, critical thinking, and media literacy (Hobbs, 2017; Koehler & Mishra, 2005). Integrating interactive elements such as video tutorials, simulations, and formative assessments enhances students' understanding and application of digital learning strategies in real classroom settings.

This study contributes to developing effective digital teaching materials that support the needs of 21st-century educators. Future studies should explore the long-term impacts of such modules on classroom teaching performance and test their adaptability across different educational levels and

subjects. Further research could also examine how emerging technologies such as artificial intelligence and virtual reality can enhance the personalization and interactivity of digital learning modules.

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