EDUKASIA: Jurnal Pendidikan dan Pembelajaran
Vol. 7, 1 (January-June, 2026), pp. 333-344
ISSN: 2721-1150; EISSN: 2721-1169; DOI: 10.62775/edukasia.v7i1.2060

Development of Android-Based Learning Media for Islamic Cultural History to Improve Students' Learning Outcomes

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ARTICLE INFO

Keywords:

Android-Based Learning Media;
Islamic Cultural History;
Learning Outcomes;
Mobile Learning

Article history:

Received 2026-01-02
Revised 2026-03-05
Accepted 2026-04-19

ABSTRACT

The integration of digital technology in history education is still limited in many Islamic secondary schools, where learning is often dominated by text-based instruction that reduces student engagement and learning outcomes. This study aims to develop and evaluate Android-based learning media for Islamic Cultural History to improve student learning outcomes at Madrasah Aliyah Qamarul Huda Bagu. This research method uses a research and development (R&D) approach with the ADDIE model, followed by a quasi-experimental pre-test and post-test design to test the effectiveness of the learning. Data were collected through expert validation instruments, student response questionnaires, and achievement tests, and analyzed using descriptive statistics, normalized gain (N-gain), and comparative analysis of pre-test and post-test scores. The results indicate that the developed Android-based learning media is valid and practical, as confirmed by expert assessments and positive student responses. Furthermore, statistical analysis shows a significant increase in student learning outcomes after the media implementation, with the improvement in learning outcomes being in the moderate to high effectiveness category. These findings suggest that Android-based learning media can serve as an effective teaching tool that enhances conceptual understanding and active engagement in learning Islamic Cultural History.

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1. INTRODUCTION

Effective management of time and cost is universally acknowledged as a cornerstone of successful construction project delivery. In the field of civil infrastructure development, projects are typically constrained by limited resources, demanding strict adherence to schedule and cost frameworks to ensure optimal outcomes (*Kerzner, 2017*). From an ideal perspective, construction management techniques such as Critical Path Method (CPM), Program Evaluation and Review Technique (PERT),

Earned Value Management (EVM), and other integrated scheduling tools are designed to provide systematic frameworks for planning, monitoring, controlling, and adjusting project performance across the life cycle (PMI, 2021). When applied rigorously, these methods enable early identification of variances, facilitate corrective actions, and contribute to predictable delivery within budget and timeline commitments (Project Management Institute, 2021). In theory, the integration of these techniques should yield measurable improvements in schedule adherence and cost control outcomes that are critical for infrastructure projects including river embankments, flood control systems, and other water-related developments.

Despite these theoretical underpinnings, empirical observations from recent studies reveal persistent challenges in achieving ideal time and cost performance outcomes across construction contexts. For instance, evaluations of large dam construction projects using Earned Value Analysis have frequently shown schedule delays and cost overruns, with Schedule Performance Indices (SPI) and Cost Performance Indices (CPI) deviating significantly from planned values (Musyarofah et al., 2024). Similarly, projects combining structural reinforcement with complex hydrological requirements often encounter unforeseen obstacles such as delayed material deliveries, limited labor productivity, and logistic constraints factors that contribute to extended project durations and higher expenditures (Musyarofah et al., 2024). In flood control infrastructure specifically, delays in land acquisition and preparatory works have been empirically linked to deteriorated time and cost performance, indicating that site-specific socio-economic factors remain critical determinants of outcomes (Topan et al., 2025).

The application of construction management techniques in river embankment and flood control projects has been underscored in studies focusing on hydraulic infrastructure. For example, analyses of flood control and embankment reinforcement works show that risks associated with weather conditions, addendum costs, and changes to field conditions significantly affect both time and cost performance metrics (Yuliana & Rani, 2026). Some projects have adopted CPM and EVM methods to measure variances and forecast final cost and duration, yet these evaluations often highlight suboptimal performance, with corrective measures applied only reactively rather than proactively (Salsabila et al., 2024). Such findings suggest that even though construction management techniques are being utilized, their effectiveness in ensuring schedule and budget compliance varies widely across project types and contexts. This observation raises critical questions about the appropriateness of existing application models and the extent to which they address the unique operational dynamics of river embankment development projects.

River embankment projects in particular present a unique set of complexities that differentiate them from conventional building construction or transportation infrastructure works. Unlike standard horizontal construction projects, river embankment developments must respond to hydrologic variability, environmental permitting requirements, soil mechanics challenges, and potential flood incidents during execution. These factors impose dynamic risks and interdependent constraints that complicate time and cost performance predictability. However, despite these complexities, the construction management literature has traditionally focused on generalized project environments, with limited research dedicated specifically to river embankment scenarios (Syah Putra et al., 2024). Moreover, current empirical studies that do engage with such hydraulic projects often emphasize descriptive performance assessments without offering rigorous comparative evaluations of alternative management techniques or adaptive solutions that could mitigate observed inefficiencies.

The research gap becomes particularly evident when considering the lack of comprehensive analytical research that critically compares the efficacy of different construction management techniques (e.g., CPM vs. EVM vs. hybrid approaches) within the specific context of river embankment development. While prior studies have documented variances in SPI and CPI values, few have interrogated the underlying causal mechanisms such as risk management integration, real-time

monitoring, stakeholder communication flows, and adaptive decision frameworks—that determine why some techniques perform better than others in complex infrastructural settings. Additionally, there is limited evidence on how predictive scheduling models and cost forecasting tools can be effectively customized for embankment projects, which often involve cyclical environmental constraints and multi-phase construction sequencing. Consequently, existing literature exchanges descriptive findings for prescriptive insights, leaving practitioners with ambiguous guidance on optimal management strategies tailored to these project types.

Given this backdrop, it is necessary to formulate specific queries that can guide a focused investigation into time and cost performance under varying construction management paradigms. Therefore, this study seeks to address the following core questions: (1) How do different construction management techniques influence schedule adherence and budget control in river embankment projects, as measured by standard performance indices such as SPI and CPI? (2) To what extent do integrated risk management practices and real-time performance tracking contribute to improved outcomes in embankment development contexts? Operationally, this research will quantify time and cost variances against planned baselines using recognized performance metrics, and compare the relative effectiveness of selected techniques in moderating those variances throughout project execution.

The primary objective of this study is to evaluate time and cost performance in river embankment development projects through the application of various construction management techniques, and to determine which approaches yield superior performance results when faced with typical execution challenges. Secondary objectives include identifying key risk factors that influence project outcomes and proposing methodological adaptations to enhance management practices. By doing so, this research aims to generate actionable insights for project managers, policymakers, and industry stakeholders engaged in hydraulic infrastructure implementation.

2. METHODS

2.1. Design

This study employed a Research and Development (R&D) design integrated with a quasi-experimental approach. The R&D design was selected because the primary objective of the study was to develop an Android-based learning media for Islamic Cultural History and subsequently evaluate its effectiveness in improving students' learning outcomes. To ensure a systematic and theoretically grounded development process, the study adopted the ADDIE instructional design model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This model enables alignment among learning objectives, instructional content, media features, and assessment strategies. Furthermore, the effectiveness of the developed media was examined using a pretest–posttest quasi-experimental design, which is methodologically appropriate for educational settings where random assignment of participants is not feasible but empirical testing of learning outcomes is required.

2.2. Participants and Locus

The participants of this study were students of Madrasah Aliyah Qamarul Huda Bagu. The selection of participants was conducted using purposive sampling, ensuring that the subjects were relevant to the instructional context of Islamic Cultural History learning. This locus was chosen because it represents a typical madrasah setting where Islamic Cultural History is a compulsory subject and where the integration of Android-based learning media is pedagogically relevant. The object of the study comprised the developed Android-based learning media and students' cognitive learning outcomes.

2.3. Procedure of Development (ADDIE)

The development procedure followed the ADDIE model, which includes the following stages:

1. Analysis: Identification of students' learning needs, curriculum requirements, learning difficulties, and existing instructional media limitations in Islamic Cultural History learning.
2. Design: Preparation of learning objectives, content structure, interface layout, navigation flow, and assessment components tailored to Android-based learning.
3. Development: Creation of the Android application, integration of instructional materials, multimedia elements, and interactive features, followed by expert validation.
4. Implementation: Application of the developed media in classroom learning activities with selected students.
5. Evaluation: Assessment of media validity, practicality, and effectiveness through expert judgments, student responses, and learning outcome analysis.

This structured procedure ensured that the developed product was pedagogically sound and responsive to learners' needs.

2.4. Instruments

Several research instruments were utilized to ensure comprehensive data collection, including:

1. Achievement Tests, consisting of pretest and posttest items designed to measure students' conceptual understanding of Islamic Cultural History.
2. Expert Validation Questionnaires, used to evaluate content accuracy, instructional quality, and media usability.
3. Student Response Questionnaires, aimed at assessing practicality, ease of use, and user acceptance of the Android-based learning media.

The use of multiple instruments enhanced the validity of the study through triangulation.

2.5. Data Collection Techniques

Data were collected through a combination of testing and non-testing techniques. Achievement tests were administered before and after the implementation of the learning media to identify learning gains. Expert validation questionnaires were distributed to content and media experts during the development stage, while student response questionnaires were administered after implementation to capture learners' perceptions of the media's practicality and attractiveness.

2.6. Data Analysis Techniques

Data analysis was conducted using quantitative statistical techniques. Descriptive statistics were employed to summarize validation and response data in percentage form to determine media feasibility. Learning effectiveness was analyzed by comparing pretest and posttest scores using paired-sample statistical tests and normalized gain (N-gain) analysis to determine the magnitude of improvement in students' learning outcomes. This analytical approach allowed for a clear interpretation of the instructional impact of the developed Android-based learning media.

3. FINDINGS AND DISCUSSION

3.1. Findings

This study employed a Research and Development (R&D) approach guided by the ADDIE instructional design model, consisting of the Analysis, Design, Development, Implementation, and Evaluation stages. The findings are presented sequentially according to each ADDIE phase to ensure methodological coherence between the development process and the resulting instructional outcomes.

The research resulted in the successful development of an Android-based learning media for Islamic Cultural History that was systematically designed according to instructional principles and curriculum alignment. The development process produced a mobile application that integrates historical content, multimedia elements, interactive quizzes, and self-paced navigation. Expert validation results indicate that the media meets high standards of content validity, instructional quality, and technical feasibility. Content experts confirmed that the materials accurately represent core concepts of Islamic Cultural History and align with the learning objectives of Madrasah Aliyah, while media experts emphasized the coherence between interface design, navigation structure, and pedagogical flow.

3.1.1 Analysis Phase

The analysis stage focused on identifying instructional needs, learner characteristics, and contextual constraints in teaching Islamic Cultural History at Madrasah Aliyah Qamarul Huda Bagu. Preliminary observations and informal interviews with teachers indicated that learning activities were predominantly teacher-centered and relied heavily on textbooks and verbal explanation. Students experienced difficulties in understanding historical chronology, abstract concepts, and cause–effect relationships, which often resulted in low engagement and limited learning outcomes.

In addition, students demonstrated a high level of familiarity with Android-based mobile devices, which were already integrated into their daily activities but underutilized for instructional purposes. Curriculum analysis confirmed that Islamic Cultural History learning objectives require not only factual recall but also conceptual understanding and contextual interpretation. These findings justified the need for an Android-based learning medium that could transform abstract historical narratives into interactive and visually supported learning experiences aligned with curriculum demands.

3.1.2 Design Phase

Based on the needs analysis, the design phase focused on constructing a pedagogically sound blueprint for the Android-based learning media. Learning objectives were mapped directly to curriculum competencies of Islamic Cultural History at the Madrasah Aliyah level. Instructional content was structured into thematic modules arranged chronologically to support students' historical reasoning.

The media design incorporated multimedia learning principles, including the integration of text, images, animations, and interactive quizzes. Navigation was designed to be intuitive and self-paced, allowing students to control their learning flow. Formative assessments were embedded within each module to provide immediate feedback and reinforce conceptual understanding. At this stage, storyboards, interface layouts, and assessment designs were developed to ensure alignment between learning objectives, instructional strategies, and evaluation mechanisms.

3.1.3 Development Phase

During the development stage, the Android-based learning media was produced according to the approved design specifications. The application integrated instructional content, multimedia elements, interactive features, and assessment components into a cohesive learning environment. Following initial development, the product underwent expert validation to assess content accuracy, instructional quality, and technical feasibility.

The validation results indicate that the developed media achieved a high level of validity. Content experts confirmed that the historical materials accurately represented core concepts of Islamic Cultural History and were consistent with curriculum objectives. Media experts emphasized the coherence between interface design, navigation structure, and pedagogical flow. These findings demonstrate that

the product was not merely a digital version of printed materials, but a systematically designed instructional medium capable of supporting meaningful learning.

3.1.4 Implementation Phase

The validated Android-based learning media was implemented in classroom instruction at Madrasah Aliyah Qamarul Huda Bagu. During this phase, students used the application as part of the learning process, both individually and under teacher guidance. Student response questionnaires were administered to evaluate practicality, usability, and learner acceptance.

The results show that students perceived the media as easy to use, visually engaging, and supportive of independent learning. Students reported reduced difficulty in understanding historical content, particularly in relation to abstract concepts and chronological sequences. These findings indicate that the integration of multimedia elements and interactive features effectively transformed the learning process into a more student-centered experience. The high level of practicality confirms that the media can be feasibly adopted in real classroom contexts.

3.1.5 Evaluation Phase

The evaluation stage focused on measuring the effectiveness of the developed media in improving students' learning outcomes. A quasi-experimental pretest–posttest design was employed to assess changes in students' cognitive achievement after using the Android-based learning media. Statistical analysis reveals a significant increase in posttest scores compared to pretest scores, indicating improved mastery of historical concepts, chronological reasoning, and contextual understanding.

The normalized gain (N-gain) analysis places the learning improvement in the medium-to-high effectiveness category, suggesting that the observed gains were systematically attributable to the instructional intervention rather than incidental factors. These results provide empirical evidence that the developed media effectively enhances learning outcomes in Islamic Cultural History.

Table 1. Summary of Research Variables and Measurement Indicators

No	Variable	Indicator	Measurement Technique
1	Android-Based Learning Media	Content accuracy, instructional design, usability, interactivity	Expert validation questionnaire
2	Learning Process	Student engagement, learning motivation, ease of use	Student response questionnaire
3	Learning Outcomes	Concept mastery, historical understanding, test score improvement	Pretest–posttest achievement test
4	Media Effectiveness	Learning gain (N-gain), score difference	Statistical analysis
5	Variable	Indicator	Measurement Technique

Table 1 presents a concise overview of the main variables examined in this study, along with their respective indicators and measurement techniques. The Android-based learning media variable was evaluated through expert validation to ensure that the instructional content, media design, and technical usability met academic and pedagogical standards. This step was essential to establish the theoretical and instructional validity of the developed product before classroom implementation.

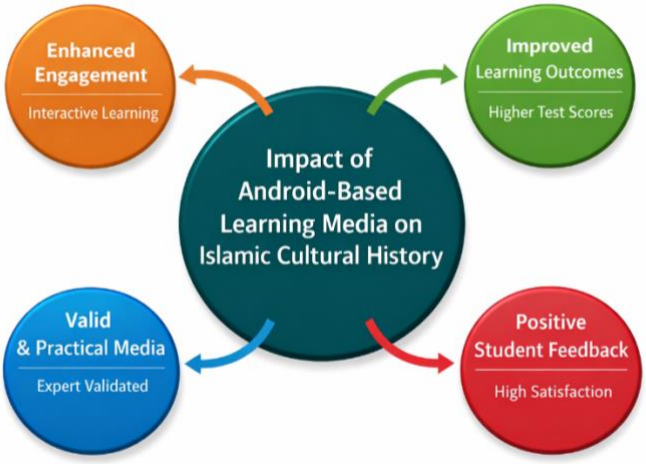

Figure 1. Impact of Android in Islamic History

The diagram illustrates the central role of Android-based learning media in enhancing Islamic Cultural History instruction. The interconnected circular elements show that increased student engagement, validated and practical media design, and positive student feedback collectively contribute to improved learning outcomes. This visual representation emphasizes that instructional effectiveness is achieved through the integration of pedagogical quality, usability, and learner-centered interaction.

3.2. Discussion

The findings of this study demonstrate that the application of the ADDIE model in developing Android-based learning media resulted in a valid, practical, and effective instructional product. Each ADDIE phase contributed substantively to the overall instructional quality and learning impact of the media.

The analysis phase ensured that the development process was grounded in authentic instructional needs and learner characteristics. By identifying students' difficulties with abstract historical content and recognizing their familiarity with mobile technology, the study established a strong rationale for mobile-based instructional innovation. This alignment between problem identification and solution design is a critical strength of the ADDIE-based R&D approach.

The design and development phases translated instructional objectives into a structured digital learning environment. The integration of multimedia elements and interactive quizzes supported cognitive processing by reducing abstraction and promoting active engagement. These findings align with multimedia learning principles, which emphasize that well-designed combinations of visual and verbal information enhance comprehension and retention. The expert validation results further confirm that pedagogical alignment and technical quality are essential prerequisites for effective digital learning media.

The development process resulted in an Android-based learning media for Islamic Cultural History that integrates historical narratives, interactive visuals, formative quizzes, and self-paced navigation features. The product was subjected to expert validation prior to classroom implementation to ensure content accuracy, pedagogical alignment, and technical feasibility. The validation results indicate that the media achieved a high level of theoretical and instructional validity. Content experts confirmed that the historical materials were consistent with the Madrasah Aliyah curriculum and accurately represented key concepts in Islamic Cultural History, while media experts emphasized the

coherence between instructional objectives, interface design, and user interaction. These findings suggest that the developed media does not merely digitize existing materials, but reconstructs learning content into a structured digital environment that supports conceptual understanding and cognitive engagement.

Following the validation stage, the media was implemented in the learning process at Madrasah Aliyah Qamarul Huda Bagu to examine its practical usability and instructional effectiveness. Student response analysis demonstrates a strong level of acceptance and perceived usefulness. Learners reported that the Android-based media facilitated independent learning, increased attention during instructional activities, and reduced cognitive overload commonly experienced in text-dominated history lessons. Importantly, students perceived the integration of multimedia elements such as images, animations, and interactive quizzes as enhancing comprehension rather than serving as mere visual embellishments. This finding is critical because it indicates that the media functioned as a cognitive support tool rather than a distraction, reinforcing its pedagogical practicality in real classroom conditions.

The effectiveness of the Android-based learning media was further examined through comparative analysis of students' learning outcomes before and after its implementation. Statistical analysis of pretest and posttest scores reveals a substantial improvement in students' cognitive achievement. The post-intervention scores were consistently higher than pre-intervention scores, indicating that students demonstrated stronger mastery of historical concepts, chronological reasoning, and contextual understanding after engaging with the media. The normalized gain (N-gain) analysis places this improvement in the medium-to-high effectiveness category, suggesting that the learning gains were not incidental but systematically attributable to the instructional intervention. This improvement reflects the media's capacity to transform abstract historical narratives into concrete and meaningful learning experiences.

During the implementation phase, student responses revealed that usability and pedagogical design play a decisive role in determining whether digital media can be meaningfully adopted in classroom practice. The positive student perceptions indicate that the media functioned not merely as a technological novelty, but as a genuine learning support tool. This reinforces the importance of practicality and learner acceptance as key indicators of instructional feasibility in educational technology research.

From a critical perspective, the observed learning gains can be interpreted as evidence of improved cognitive processing facilitated by multimedia learning principles embedded in the Android-based media. The structured sequencing of content, combined with interactive reinforcement through quizzes, appears to have supported both knowledge retention and conceptual transfer. Unlike conventional lecture-based instruction, which often positions students as passive recipients of information, the developed media promoted active engagement by allowing learners to control pacing, revisit materials, and immediately test their understanding. This shift in learning dynamics is significant, as it aligns with constructivist learning theory, where learners actively construct meaning through interaction with learning resources.

Moreover, the results suggest that the effectiveness of the media is closely linked to its contextual relevance. The integration of Islamic Cultural History content within a digital platform familiar to students' daily technology use enhanced motivational aspects of learning. Rather than perceiving history as a static and memorization-heavy subject, students engaged with it as an interactive and exploratory experience. This finding challenges the assumption that learning difficulties in historical subjects are primarily content-related; instead, it underscores the role of instructional media design in shaping students' learning outcomes.

The evaluation results provide strong evidence that the Android-based learning media significantly improved students' learning outcomes. The observed learning gains can be interpreted as the result of improved cognitive engagement facilitated by structured content sequencing, self-paced navigation, and immediate feedback. Unlike conventional teacher-centered instruction, which often positions students as passive recipients of historical narratives, the developed media promoted active and self-regulated learning. This shift reflects constructivist learning theory, in which learners actively construct knowledge through interaction with instructional resources.

Furthermore, the contextual relevance of the media contributed to its effectiveness. By embedding Islamic Cultural History content within a digital platform familiar to students' everyday experiences, the media enhanced motivation and engagement. This finding challenges the assumption that learning difficulties in history subjects are primarily content-related and highlights the role of instructional media design in shaping learning outcomes.

Overall, the results confirm that Android-based learning media developed through a systematic ADDIE-based R&D process can serve as an effective instructional strategy in Islamic secondary education. When grounded in sound instructional design principles and aligned with curriculum objectives, mobile learning media should be viewed not as supplementary tools, but as integral components of contemporary teaching and learning practices. Overall, the research findings demonstrate that the Android-based learning media developed in this study is valid, practical, and effective in improving students' learning outcomes in Islamic Cultural History at Madrasah Aliyah Qamarul Huda Bagu. The results confirm that technology integration, when grounded in sound instructional design and aligned with curriculum objectives, can produce measurable improvements in cognitive achievement. More importantly, these findings provide empirical support for the argument that mobile learning media should not be viewed as supplementary tools, but as integral components of contemporary instructional strategies in Islamic secondary education.

4. CONCLUSION

This study aimed to develop and evaluate an Android-based learning media for Islamic Cultural History using a Research and Development (R&D) approach guided by the ADDIE instructional design model. The findings demonstrate that the developed media is valid, practical, and effective in improving students' learning outcomes at the Madrasah Aliyah level. Expert validation confirmed that the instructional content, pedagogical structure, and technical design of the application met academic and instructional standards, ensuring alignment with curriculum objectives and learner needs. The implementation results indicate that the Android-based learning media positively influenced students' engagement and learning experiences. Students perceived the media as easy to use, visually engaging, and supportive of independent and self-paced learning. The integration of multimedia elements and interactive quizzes helped reduce the abstract nature of historical content and minimized reliance on rote memorization, thereby fostering deeper conceptual understanding of Islamic Cultural History.

Furthermore, the effectiveness analysis revealed a significant improvement in students' learning outcomes, as evidenced by higher posttest scores and medium-to-high normalized gain (N-gain) values. These results suggest that the observed learning gains were systematically attributable to the instructional intervention rather than incidental factors. The findings support the notion that well-designed Android-based learning media can enhance cognitive achievement by promoting active engagement, structured learning pathways, and immediate feedback.

Despite these positive outcomes, this study has several limitations. The research was conducted in a single educational institution with a limited sample size, which may restrict the generalizability of the findings. Additionally, the quasi-experimental design did not include a control group, limiting the strength of causal inference. Future research is therefore encouraged to involve larger and more diverse

samples, employ comparative or experimental designs, and explore the long-term impact of Android-based learning media on students' cognitive and affective development. Overall, this study provides empirical evidence that Android-based learning media developed through a systematic ADDIE-based R&D process can serve as an effective instructional strategy in Islamic secondary education. When grounded in sound instructional design principles and aligned with curricular goals, mobile learning media should be positioned not merely as supplementary tools, but as integral components of contemporary Islamic Cultural History instruction.

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