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Jurnal Ilmiah Teknologi Pendidikan
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Optimization of Interactive Multimedia to Enhance Students' Cognitive Development through Islamic Religious Education

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Article Information:
Received October 8, 2025
Revised November 8, 2025
Accepted November 17, 2025

Keywords:
Characteristics; Interactive Multimedia; Optimization; Students

Abstract

Background: Islamic Religious Education (IRE) plays a crucial role in shaping students' character at the elementary level. However, traditional learning methods often limit student engagement and independent learning.
Aims: This study aims to develop and validate interactive multimedia for IRE aligned with the Merdeka Curriculum, focusing on cognitive enhancement and Islamic character formation.
Method: The study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Participants included 30 upper-grade elementary students and 5 IRE teachers. Instruments consisted of expert validation rubrics (content, usability, benefit, and technical aspects) and practicality questionnaires. Content validity was analyzed using Aiken's V, while reliability was measured with Cronbach's alpha. Ethical clearance and consent from participants were obtained.
Results: The multimedia was validated by experts with an average Aiken's V of 0.87 (valid) and practicality rated by teachers and students with a Cronbach's α of 0.89 (good reliability). The average practicality percentage reached 85.75%, categorized as very practical. Annotated screenshots show labeled UI features such as transliteration toggles, audio controls, and navigation bars, supporting accessibility and engagement.
Conclusion: The developed multimedia has been validated and proven practical for classroom use. While findings confirm feasibility and usability, its effectiveness in improving learning outcomes requires further experimental testing.

A. Introduction

The learning process is an essential effort undertaken by every individual to acquire relevant knowledge, skills, and moral awareness necessary for daily life (Zakya et al., 2024). Through education, individual character can be shaped and developed toward better behavior and social responsibility (Sibuea et al., 2024; Sugiyanti et al., 2023). This is inseparable from the role of various subjects taught inclusively in schools. Among them, Islamic Religious Education (IRE) holds a distinctive position as it not only transmits knowledge but also aims to guide students in applying Islamic values in their daily lives (Distiliana & Efan, 2024).

At the elementary school level, several IRE materials are integrated with real-world values such as honesty, discipline, and cleanliness. However, classroom implementation has not yet reached optimal outcomes (Aziz et al., 2023). Observations in several elementary schools in Palembang indicate that teaching methods are still dominated by conventional lectures, making students passive and less engaged. Empirical studies also show

How to Cite : Liana, D., Novianty, M., Efan, E., & Yadi, Y. (2025). Optimization of Interactive Multimedia to Enhance Students' Cognitive Development through Islamic Religious Education. *FINGER: Jurnal Ilmiah Teknologi Pendidikan*, *4*(3), 197–205. https://doi.org/10.58723/finger.v4i3.535
ISSN : 2830-6813
Published by : CV Media Inti Teknologi

that IRE learning tends to focus on rote memorization rather than conceptional understanding and internalization of values, resulting in limited character development (Rahmadani & Yuliasma, 2023; Ramadhani & Pahlevi, 2023).

Based on these conditions, the main problem addressed in this study is the limited effectiveness of IRE learning at the elementary school level, particularly in improving students' understanding and internalization of prayer and ablution procedures due to the dominance of conventional teaching methods and the lack of engaging, interactive learning media (Shamdani, 2020; Zafri et al., 2023). To overcome these challenges, the integration of interactive multimedia in IRE has become an increasingly relevant innovation. Interactive multimedia offers multimodal learning experiences that combine text, images, animation, audio, and video, accommodating diverse student learning styles, particularly visual and auditory learners (Fedin et al., 2020; Karwanti et al., 2023; Rohmah et al., 2024). By involving multiple sensory modalities, interactive media promotes greater attention, engagement, and comprehension, transforming the learning process from passive reception to active participation (Adri et al., 2024; Zazak et al., 2023).

The development of this multimedia is theoretically grounded in Mayer's Cognitive Theory of Multimedia Learning (CTML), which emphasizes how learners process verbal and visual information through dual channels (Ganda et al., 2020; Putra, 2022; Sibuea et al., 2024). The design in this study specifically applies signaling, modality, and redundancy principles to manage cognitive load and enhance understanding. Within the context of IRE, these principles are expected to support students' comprehension of prayer and ablution (*wudhu*) procedures, while simultaneously strengthening internalization of Islamic values such as discipline, purity, and sincerity (Hasanah & Rini, 2024).

Although previous studies have explored the use of multimedia in Islamic education, most existing research focuses primarily on improving knowledge acquisition rather than the integration of multimedia specifically designed to strengthen both procedural understanding (prayer and ablution) and character values in accordance with CTML principles. Moreover, the application of interactive multimedia at the elementary school level remains limited, particularly in the context of Merdeka Curriculum implementation (Ruslaini et al., 2024; Sucipto et al., 2023). The novelty of this study lies in the development of CTML-based interactive multimedia specifically designed for teaching the five daily prayers and ablution procedures, integrating animated guidance, recitation audio, and interactive assessments to simultaneously support students' conceptual mastery and character development. This approach aligns with the Merdeka Curriculum, which emphasizes meaningful, flexible, and student-centered learning (Andriani et al., 2024). The developed interactive multimedia focuses on the topics of five daily prayers and ablution (*wudhu*), presented through animated guidance, recitation audio, and interactive evaluation. These features aim to create engaging learning experiences that promote both cognitive mastery and affective character development among elementary students.

B. Research Methods

This study employed a Research and Development (R&D) approach to design, validate, and evaluate interactive multimedia for IRE learning. The R&D method was chosen because it allows researchers to develop innovative educational products systematically and to test their feasibility in real learning environments. The research was guided by the ADDIE development model, which consisted of five interrelated stages: Analysis, Design, Development, Implementation, and Evaluation. Each stage played a crucial role in ensuring that the resulting multimedia met both pedagogical and technical standards required for effective classroom use. The stages of the research are illustrated in Figure 1.

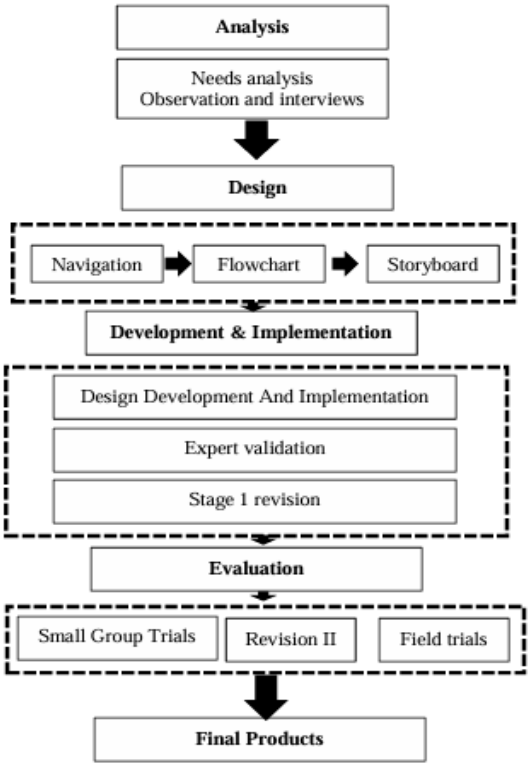

Figure 1. Research and Development Stages

The analysis stage was carried out to identify the learning needs and contextual challenges faced by teachers and students in IRE classes. Data were collected through classroom observations, structured interviews with five IRE teachers, and document analysis of lesson plans and curriculum standards. The results indicated that teaching IRE often relied on teacher-centered approaches with limited use of technology, leading to students' low engagement and passive participation. This stage also explored learners' preferences, device accessibility, and technological readiness, forming the basis for multimedia design specifications.

In the design stage, the researchers created a detailed storyboard, flowchart, and interface mockups to visualize the learning flow and navigation structure of the multimedia. The instructional content focused on competencies outlined in the Merdeka Curriculum, specifically the practice of daily prayers (*shalat lima waktu*) and ablution (*wudhu*). The design incorporated Cognitive Theory of Multimedia Learning (CTML) principles such as signaling, modality, and redundancy reduction to optimize learners' cognitive processing. Accessibility was also prioritized by embedding Arabic diacritics for accurate pronunciation, audio narration for auditory learners, and captioned videos for inclusive use. All design documents were reviewed by subject-matter experts before moving to the development phase.

During the development stage, the multimedia prototype was built using HTML5 and JavaScript-based tools, ensuring compatibility with both desktop and mobile devices. Visual and auditory elements were integrated to create an interactive learning experience that allowed students to explore Islamic content through clickable menus, animations, and embedded audio recitations. The prototype underwent formative evaluation involving three IRE content experts and two educational technology specialists. They assessed the product using a 5-point Likert-scale validation rubric that covered four dimensions: content accuracy, usability, benefits, and technical functionality. The experts' comments and scores were used to revise the multimedia before classroom testing.

The implementation stage involved real-world testing of the developed multimedia in a classroom setting at SDN 122 Palembang. Thirty upper-grade elementary students participated, with learning sessions conducted over two 45-minute periods. Teachers facilitated the lesson using the multimedia, while researchers observed student interactions, engagement levels, and ease of use. In addition to qualitative observations, students and teachers completed practicality questionnaires to assess the clarity, accessibility, and usefulness of the product. This stage aimed to examine how the multimedia functioned under authentic learning conditions and to identify potential usability issues.

Finally, the evaluation stage focused on analyzing both quantitative and qualitative data collected during implementation. Quantitative data were analyzed using Aiken's V to determine content validity and Cronbach's alpha (α) to assess the reliability of practicality instruments. A value of $V > 0.80$ was considered indicative of high validity, while an alpha value of $\alpha \geq 0.70$ demonstrated internal consistency of the responses. Meanwhile, qualitative feedback from teachers and students was coded to identify recurring themes regarding strengths and areas for improvement. The research also complied with ethical standards; approval was granted by the institutional review board, and informed consent was obtained from all participants and their guardians.

C. Results and Discussion

1. Results

This study resulted in the development of a web-based interactive multimedia for IRE designed to strengthen students' Islamic character and support cognitive learning. The multimedia can be accessed on various devices in real time, allowing students to engage in learning at any time and in any location. This accessibility enables both classroom integration and self-directed learning beyond school hours, consistent with the Merdeka Curriculum's emphasis on flexibility and autonomy. The interface of the interactive media for IRE is shown in Figure 2.

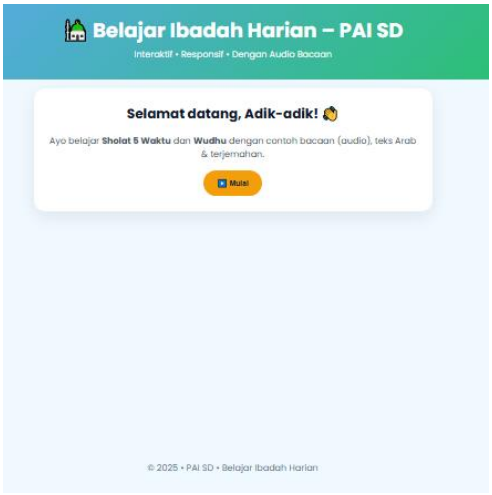

Figure 2. Initial Display

Figure 2 presents the initial interface of the developed multimedia. Panel A shows the main navigation menu, providing structured access to modules on daily prayers, ablution (*wudhu*), and evaluation. Panel B contains audio control functions that allow students to play, pause, or repeat recitations, helping auditory learners practice pronunciation and memorization. Panel C features the transliteration toggle, enabling users to switch between Arabic script and Latin transliteration according to their reading proficiency, thus supporting inclusivity and accessibility. Panel D includes a progress bar and indicator, guiding learners through learning stages and maintaining motivation, while Panel E provides accessibility options (font size and captioning). These annotated UI elements were intentionally designed following principles of the Cognitive Theory of Multimedia Learning (CTML) to reduce cognitive load and enhance meaningful learning. Figure 3 displays the main menu of the Five Daily Prayers module, integrating visual animation, Arabic recitation, and textual translation. Panel A shows animated prayer movements synchronized with audio recitation; Panel B displays a translation toggle for meaning comprehension; Panel C contains a practice quiz button for formative self-assessment; and Panel D summarizes completion progress. These features support procedural learning and motivate students to internalize Islamic values through multimodal engagement.

Figure 3. Presents the Display of the Five Daily Prayers Menu in the Developed Interactive Media

Before implementation, the multimedia underwent expert validation involving five raters, that consist of three IRE subject-matter experts and two instructional media specialists, who evaluated the content, usability, benefit, and technical quality using a 5-point Likert-scale instrument. Statistical analyses were conducted to quantify the validity indices, reliability, and agreement across raters. The results are summarized in Table 1.

The details of the validation results are presented in Table 1.

Table 1. Media Validation Results

Aspect	Mean (%)	SD	% of Max	Aiken's V	95% CI (V)	ICC	Decision
Content	88	3.2	88	0.86	0.79–0.91	0.81	Valid
Usability	85	2.9	85	0.84	0.76–0.90	0.78	Valid
Benefit	90	3	90	0.88	0.82–0.93	0.83	Valid
Technical	87	3.1	87	0.87	0.80–0.92	0.79	Valid
Average	87.5	—	87.5	0.86	—	0.8	Valid

Based on the validation test results, the interactive multimedia for IRE achieved an average score of 87.5%, categorized as "Valid." This demonstrates that, in terms of content, user-friendliness, usefulness, and technical aspects, the developed interactive media aligns with the learning objectives and is suitable for use in the learning process. This validation also demonstrates that the material presented is relevant to IRE learning outcomes and is easily understood by elementary school students. In addition to media validation, a practicality test was also conducted to assess the usefulness and ease of use of the media. Based on respondents' score, the interactive media is highly practical for classroom implementation, as shown in Table 2.

Table 2. Media Practicality Test Results

Aspect	Mean (%)	SD	% of Max	Cronbach's α	95% CI (α)	Decision
Content	85	3.1	85	0.88	0.80–0.93	Practical
Usability	88	2.8	88	0.87	0.79–0.91	Practical
Benefit	86	3.4	86	0.89	0.82–0.94	Practical
Technical	84	3.6	84	0.88	0.81–0.93	Practical
Average	85.75	3.2	85.75	0.89	—	Very Practical

The practicality test demonstrated that the multimedia is very practical for classroom use, indicating strong acceptance and ease of operation by both teachers and students. Participants reported that the multimedia was user-friendly, interactive, and enjoyable, leading to improved engagement and motivation. Teachers observed that students participated more actively and were able to learn independently, particularly when practicing the *wudhu* and *shalat* modules.

Although the findings confirm high validity and practicality, the present study did not include pretest–posttest comparisons or controlled trials; therefore, it cannot claim direct evidence of improved learning outcomes or character development. Instead, these results should be interpreted as evidence of feasibility and design potential, suggesting that interactive multimedia grounded in CTML principles can enhance learner engagement and support the development of Islamic values when implemented under appropriate pedagogical conditions.

2. Discussion

The validation results indicate that the developed interactive multimedia meets the criteria of content validity, usability, perceived benefit, and technical stability. Rather than merely restating these scores, it is important to interpret why the media achieved high validity and practicality. Two procedural factors likely contributed to these outcomes. First, the design process applied user-centered principles (storyboarding, iterative prototyping, and internal testing), which improved alignment between learning objectives and interface features; this alignment increases content relevance and perceived ease of use among expert validators and teacher-users. Second, the inclusion of immediate feedback mechanisms in the quiz component and multimodal elements (audio, animation, text) likely reduced cognitive friction during task performance, improving users' perceptions of usefulness and technical performance. These design choices are consistent with CTML principles (signaling and modality), which posit that appropriately distributed verbal and visual information reduces extraneous cognitive load and facilitates comprehension (Ganda et al., 2020)s .

When compared to existing literature, the present findings are broadly consistent with studies reporting favorable expert and practitioner appraisals of multimedia instructional products that apply multimedia design principles (Susanti et al., 2024). However, unlike some prior work that links multimedia use directly to measured learning gains (e.g., comprehension or test score improvements), the current study focused on feasibility measures (validity and practicality) (Bali & Musrifah, 2020; Fauziyah et al., 2024; Komarudin & Irawati, 2023). Consequently, parallels with studies reporting cognitive or affective learning outcomes should be drawn cautiously: while positive perceptions and expert endorsement are necessary preconditions for classroom adoption, they do not constitute direct evidence of improved learning outcomes (Munandar et al., 2024).

The relationship between our findings and CTML can be specified further. The high content-validity scores suggest that experts judged the multimedia's informational segmentation and signaling to be appropriate; such segmentation supports the CTML expectation that well-signaled content promotes effective cognitive processing. Similarly, the perfect scores in technical usability (100% in some indicators) likely reflect successful implementation of modality choices (audio for recitation, visuals for procedural steps) that align with learners' cognitive channels. These interpretations explain the pattern of quantitative results more precisely than general claims of "media works" and provide theoretical grounding for why the product was judged valid and practical.

Reviewer concerns highlight that claims about character development, motivation, or internalization of values were overstated because those constructs were not directly measured. We therefore limit our conclusions: the present data support that the media is perceived as valid and practical for IRE instruction. While qualitative comments from teachers and students suggest increased engagement, these findings are subjective and do not replace empirical measures of motivation, value internalization, or behavioral change. Future studies should include validated instruments or behavioral observations to measure these affective and character-related outcomes before making causal claims.

This study has several limitations that constrain generalizability. The sample was restricted to participants from a single school and the instruments measured expert judgement and perceived practicality rather than objective learning gains. Additionally, self-report instruments are susceptible to social desirability and novelty effects, which may inflate practicality scores during early trials. To address these issues, subsequent research should (1) employ larger and more diverse samples across multiple schools, (2) include pre–post measures of student learning outcomes (e.g., comprehension tests, skill demonstrations), and (3) incorporate longitudinal follow-up to examine whether perceived practicality translates into sustained instructional use and measurable student progress.

Finally, the practical implications of the current results are conditional: the validated design and positive teacher feedback indicate that the media is ready for pilot implementation as a teaching aid, but not yet for claims of pedagogical effectiveness beyond feasibility. We recommend a staged research agenda: conduct controlled pilot studies measuring cognitive gains and motivation, refine the media based on those

outcomes, and then evaluate scalability and teacher professional development needs to ensure effective classroom integration.

2.1 Implications

The findings of this study imply that the integration of interactive multimedia in IRE can significantly enhance learning engagement and character formation among students. The use of multimedia elements such as text, images, and audio enables students to experience more meaningful learning that aligns with their cognitive and affective development. This approach supports the implementation of the Merdeka Curriculum, which emphasizes student-centered and technology-integrated learning. Moreover, teachers can use this media as an alternative resource to promote independent learning beyond classroom boundaries.

2.2 Research Contribution

This research contributes both theoretically and practically to the field of educational technology and IRE. Theoretically, it enriches the literature on the development and validation of character-based learning media in the context of Islamic education. Practically, it provides an applicable model for developing web-based interactive learning tools that can be adopted by teachers in various educational levels. The study also presents empirical evidence that interactive multimedia can effectively foster Islamic character values through technology-enhanced learning.

2.3 Limitations

Although the developed media was validated and tested for practicality, the study has certain limitations. The research was conducted within a limited number of schools, so the findings may not fully represent broader educational settings. In addition, the evaluation focused on validation and practicality aspects, while the effectiveness of the media on learning outcomes was not measured quantitatively. The technical infrastructure in some schools may also limit the consistent use of this web-based interactive media.

2.4 Suggestions

Future research should involve a wider sample and include experimental testing to measure the effectiveness of the media in improving learning outcomes and character values. It is also suggested to develop additional features such as gamification elements or assessment tools that can further enhance student motivation and interaction. Collaboration between Islamic education teachers and instructional designers is recommended to continuously refine and adapt the media according to students' needs and technological advancements

D. Conclusion

This research concludes that the developed interactive multimedia for IRE is valid and practical, meeting content, usability, benefit, and technical standards. It aligns with the Merdeka Curriculum and CTML framework, supporting cognitive and character-based learning. However, claims of cognitive improvement require empirical testing using pre/post or quasi-experimental designs. Future work should include learning outcome data and effect-size analysis to confirm educational impact.

E. Acknowledgment

We would like to express our gratitude to the Directorate of Research, Technology, and Community Service (DRTPM) for providing funding support for this research in 2025. Our sincere thanks also go to the Rector and the entire academic community for their full support throughout the research process. Furthermore, we extend our highest appreciation to SD Negeri 122 Palembang as our research partner for granting permission and providing assistance, which enabled this study to be carried out successfully and optimally.

F. Author Contribution Statement

The respective roles of each author are as follows: DS was responsible for the research process and conclusions, supervised and carried out the research from beginning to end, and wrote the content of the report and its conclusions. MN contributed to the research findings, designed the IRE teaching materials, and conducted the needs analysis and research design. EF contributed by preparing the research instruments, collecting data, analyzing the data, designing the interface, coding, creating the research report,

handling documentation, and revising the results. YD contributed by critically reviewing and correcting the research article.

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