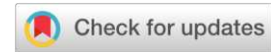


Development of a web-based learning application for a trigonometry course with integrated Islamic values



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Abstract

Trigonometry instruction in mathematics education is often perceived as abstract and insufficiently interactive, with limited integration of Islamic values. This study aimed to develop and implement a web-based trigonometry learning application integrating Islamic values as a supplementary learning resource. The application integrates instructional materials, interactive quizzes, educational games, and assignments to support student learning. This study employed a Research and Development (R&D) approach using the ADDIE model. Data were collected through lecturer interviews, needs-assessment questionnaires, expert validation, and student-response questionnaires. The application was validated by five experts, comprising two mathematics content experts, one Islamic studies expert, and two media experts, using validation instruments based on a Likert scale. Expert validation indicated that the application was highly feasible, with scores of 93.75% from mathematics content experts, 91.67% from the Islamic studies expert, and 94.50% from media experts. In addition, responses from 21 first-semester students yielded a score of 88.57%, categorized as “Very Positive.” These findings indicate that the developed application met the established feasibility criteria and received positive student responses, supporting its potential use as a supplementary learning resource for trigonometry instruction.

Keywords: ADDIE; educational game; Islamic values; trigonometry; web application

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Introduction

Mathematics education in Islamic higher education institutions plays a strategic role in preparing prospective mathematics teachers who are not only cognitively competent but also possess strong moral character grounded in Islamic values. Trigonometry is one of the fundamental courses in Mathematics Education study programs; however, it is often perceived as difficult because of its abstract nature and its limited connection to everyday life and Islamic values (Anggoro & Yunianta, 2018). In the Mathematics Education Study Program at *Institut Agama Islam Negeri* (IAIN) Langsa, the Trigonometry course is offered in the first semester to strengthen students' understanding of fundamental mathematical concepts before they undertake more advanced courses. Challenges in learning trigonometry are not unique to the Indonesian educational context. Arhin and Hokor (2021) reported that students continued to experience difficulties in understanding information, transforming problems, carrying out mathematical procedures, and presenting final answers when solving trigonometric problems. Similarly, Dhungana et al. (2023) found that trigonometry was perceived as abstract and challenging because it required students to connect conceptual and procedural understanding with their application in problem-solving situations. These findings indicate that difficulties in learning trigonometry have also received considerable attention in international mathematics education research.

Preliminary observations and interviews with the lecturer responsible for the Trigonometry course in the Mathematics Education Study Program at IAIN Langsa revealed that students continued to experience difficulties in understanding the concepts of sine, cosine, tangent, trigonometric identities, and their applications in word problems and mathematical modelling. The learning resources used in the course were still predominantly limited to textbooks and selected journal articles, while interactive web-based learning media had not yet been optimally utilised. Furthermore, the available learning materials had not integrated Islamic values and contexts, such as the relationship between trigonometric concepts and the determination of the Qibla direction, prayer times, and Islamic astronomy. Consequently, students lacked integrated learning resources connecting trigonometric concepts with academic content, everyday applications, and Islamic contexts.

Students in the Mathematics Education Study Program at IAIN Langsa frequently encounter difficulties in learning trigonometry because the subject is abstract and requires a strong ability to understand mathematical representations, relationships among concepts, and spatial reasoning. Previous studies have shown that the main difficulties in learning trigonometry involve understanding fundamental concepts, interpreting word problems, and connecting formulas with real-world contexts (Arhin & Hokor, 2021; Dhungana et al., 2023). These challenges have become increasingly apparent in online and blended learning environments during the post-pandemic period, in which direct interaction with lecturers and opportunities to visualise mathematical concepts may be limited (Hidayat et al., 2023). Therefore, learning media are needed that not only present materials digitally but also assist students in visualising concepts, practising independently, receiving feedback, and understanding the application of trigonometry in relevant contexts.

Advances in information technology have encouraged the development of interactive web-based learning media. Web-based applications enable learning materials, visualisations, interactive quizzes, educational games, and assignments to be integrated into a single learning environment that can be accessed more flexibly. The development of web-based media and digital applications for trigonometry learning has demonstrated potential to support students' conceptual understanding and critical-thinking skills (Abdullah & Yunianta, 2018; Rahayu & Irawan, 2020; Sholihah et al., 2023). From an international perspective, Engelbrecht and Borba (2024) explained that developments in digital technology have transformed learning resources, learning spaces, and patterns of interaction in mathematics education. Weigand et al. (2024) further emphasised that digital technologies can be utilised in mathematics teaching, learning, and assessment. Nevertheless, the use of technology does not automatically result in better learning, as its success depends on the alignment among the technology, learning content, instructional strategies, assigned tasks, and user characteristics. Cevikbas et al. (2023) similarly indicated that digital technologies provide various opportunities for mathematics learning and mathematical modelling, although their implementation continues to involve pedagogical and technical challenges.

Nevertheless, most previous studies on the development of trigonometry learning media have focused on secondary education. The media developed in these studies have also tended to present learning components separately, such as learning materials, videos, visualisations, exercises, or digital assessments. Based on the literature reviewed, few studies have developed a web-based learning application that integrates learning materials, automatically scored quizzes, story-based educational games, independent assignments, and contextual applications into a comprehensive learning system. Another limitation concerns the use of game elements in digital learning media, which often emphasises visual appeal or score-based rewards, while their relationship with the learning content, contextual framework, and instructional objectives is not always designed as a pedagogically coherent whole. Therefore, the inclusion of digital features alone is insufficient to demonstrate novelty when those features are not meaningfully interconnected within the instructional design.

The integration of Islamic values into mathematics learning, particularly in the Trigonometry course, is increasingly relevant within Islamic higher education institutions. Trigonometry is related to various Islamic practices and fields of knowledge, including the determination of the Qibla direction, prayer times, and Islamic astronomy. Previous studies have indicated that integrating Islamic values into mathematics learning can help connect mathematical knowledge with real-life contexts and support the development of students' religious character (Ahmad & Tasni, 2020; Ummah et al., 2019; Inganah et al., 2023; Kusnadi et al., 2022). This approach is consistent with the holistic nature of Islamic education, which regards scientific knowledge and religious values as interconnected rather than separate domains. From an international mathematics education perspective, culturally responsive learning also emphasises the importance of connecting mathematical concepts with students' experiences, identities, and social environments to make learning more meaningful (Suh & Calabrese, 2025). However, Inganah et al. (2023) reported that prospective mathematics teachers still required further understanding and concrete examples of how Islamic values could

be integrated into mathematics instruction. Therefore, the integration of Islamic values into the developed web-based learning application is not limited to Islamic symbols, terminology, or visual elements but is embedded in the learning contexts, stories, exercises, educational games, and applications of trigonometric concepts.

Although several studies have examined the development of trigonometry learning media and the integration of Islamic values, a research gap remains. Moreover, existing studies have predominantly focused on secondary education rather than prospective mathematics teachers in Islamic higher education. However, these components have generally been developed or examined separately. Previous research has also predominantly been conducted at the secondary-school level and has not specifically focused on prospective mathematics teachers in Islamic higher education institutions. Furthermore, existing web-based applications for trigonometry learning have rarely integrated learning materials, automatically scored quizzes, Islamic story-based educational games, independent assignments, and the application of trigonometry in Islamic contexts as a unified learning system (Ramadhan et al., 2024). Therefore, the research gap does not merely concern the limited availability of web-based applications or trigonometry materials containing Islamic elements, but rather the lack of comprehensive integration of these components within a platform specifically designed to address the learning needs of prospective mathematics teachers in Islamic higher education.

The distinctive contribution of this study lies in the development of a web-based learning application for the Trigonometry course that comprehensively integrates Islamic values. This integration is realised through the interconnection of trigonometry learning materials, interactive quizzes with automated scoring, Islamic story-based educational games, independent assignments, and the application of trigonometric concepts in various everyday contexts. Thus, web technology, interactivity, trigonometry content, and Islamic values are not presented as separate components but are designed as an interconnected learning environment. This integrated approach distinguishes the developed application from previous learning media, which have generally presented digital materials, exercises, or Islamic elements only partially.

Accordingly, this study aims to develop a web-based learning application for the Trigonometry course with integrated Islamic values and to evaluate the product's feasibility and students' responses as application users. This study is not intended to examine the effectiveness of the application in improving learning outcomes because it does not employ an experimental design, pre-test and post-test measurements, or a comparison group. The contribution of this study lies in the development of supplementary learning media for the Trigonometry course that comprehensively integrate web technology and Islamic values, as well as in the provision of preliminary empirical evidence regarding the feasibility of the product and users' responses to the developed application.

Method

This study employed a research and development (R&D) methodology based on the ADDIE model, comprising five stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009). The ADDIE model was chosen due to its systematic structure, flexibility, and widespread application in the development of technology-based learning media, particularly in mathematics education. This R&D study employed descriptive quantitative analysis to evaluate product feasibility and student responses.

In the Analysis phase, needs were identified through semi-structured interviews with three lecturers teaching the Trigonometry course, as well as the distribution of a needs assessment questionnaire to all first-semester students ($n = 21$). The interviews explored students' learning difficulties, the teaching materials currently in use, and lecturers' expectations for web-based learning media integrated with Islamic values. The needs questionnaire consisted of 15 statement items measured on a five-point Likert scale, which were divided into three main categories: (a) students' difficulties in learning trigonometry (4 items), (b) the conditions and limitations of the currently used teaching materials (3 items), and (c) students' expectations toward web-based interactive teaching materials with the integration of Islamic values (8 items). The questionnaire was developed from an instrument blueprint aligned with the study objectives, followed by item construction and expert review to ensure content relevance and readability.

The Design phase involved developing the overall application blueprint. This phase included the design of the system architecture (flowcharts and use case diagrams), user interface and user experience (UI/UX) using Figma, the integration of Islamic values (Qur'anic verses, hadiths, and examples of trigonometry applications in acts of worship), as well as the development of interactive quiz features, educational games, and assignment modules. In addition, validation instruments for the design were developed during this phase.

In the Development phase, the design was translated into a functional web application using HTML5, CSS3, JavaScript, the Bootstrap 5 framework, and a MySQL database. The coding process was carried out iteratively, incorporating both unit testing and integration testing. Upon completion of the application, validation was conducted by a panel of experts comprising two mathematics subject matter experts, one Islamic studies expert, and two media experts. Among these five validators, three were from IAIN Langsa and two were from Universitas Samudra. All validators hold at least a master's degree in their respective fields, possess more than five years of teaching experience at the university level, and have relevant expertise in curriculum development, Islamic education, or educational technology. The validation process utilized a Likert-scale-based evaluation sheet. Revisions were made based on the experts' feedback prior to conducting the pilot tests.

The Implementation phase was conducted in two stages: a limited-scale pilot test involving eight students and a large-scale pilot test involving 21 first-semester students in the 2025/2026 academic year. These pilot tests took place in the lecture halls of the IAIN Langsa. Students were provided with access to the application via a web link, along with user guides to facilitate its use.

Both formative and summative evaluations were conducted using data from expert validation and student-response questionnaires. The data were analysed using descriptive quantitative methods, specifically through percentage calculations:

$$P_x = \frac{\text{Total Score Obtained}}{\text{Maximum Score}} \times 100\%$$

Data were categorised using Riduwan (2015) criteria, as shown in Table 1.

Table 1. Feasibility categories (Adapted from Riduwan, 2015)

Score in Percent	Feasibility Category
$0\% \leq P_x \leq 20\%$	Highly Infeasible
$20\% < P_x \leq 40\%$	Infeasible
$40\% < P_x \leq 60\%$	Moderately Feasible
$60\% < P_x \leq 80\%$	Feasible
$80\% < P_x \leq 100\%$	Highly Feasible

Based on Table 1, web-based teaching materials are considered feasible for use when they obtain an assessment score above 60%. This percentage corresponds to the “Feasible” category $60\% < P_x \leq 80\%$ or the “Highly Feasible” category $80\% < P_x \leq 100\%$. Teaching materials that obtain an assessment score of 60% or lower have not yet met the minimum feasibility criterion and therefore require revision based on the validators’ comments and recommendations before being implemented in the learning process. The student response data are then analysed based on questionnaire results and categorised into five levels, as presented in Table 2.

Table 2. Student response criteria (Adapted from Riduwan, 2015)

Score in Percent	Category
$0\% \leq P_x \leq 20\%$	Very Negative
$20\% < P_x \leq 40\%$	Negative
$40\% < P_x \leq 60\%$	Moderate Positive
$60\% < P_x \leq 80\%$	Positive
$80\% < P_x \leq 100\%$	Very Positive

Based on Table 2, student responses to the web-based teaching materials are considered positive when they obtain a percentage score above 60%. This percentage corresponds to the “Positive” category $60\% < P_x \leq 80\%$ or the “Very Positive” category $80\% < P_x \leq 100\%$. Student responses with a percentage score of 60% or lower have not yet met the minimum criterion for a positive response; therefore, the teaching materials should be revised and improved based on the students’ feedback before being used more broadly in the learning process. All stages of the research adhered to ethical standards by obtaining permission from the mathematics education program and ensuring the confidentiality of respondents’ data.

Results

The development outcome of this study is a web-based trigonometry learning application with an Islamic theme. The results at each stage of the ADDIE model are described as follows.

Analysis

In this stage, the researcher conducted in-depth interviews with three lecturers teaching the Trigonometry course in the Mathematics Education Program at IAIN Langsa and distributed a needs assessment questionnaire to 21 first-semester students. The interview findings indicated that students experienced considerable difficulties in understanding fundamental trigonometry concepts, particularly in identifying angle relationships, mastering trigonometric identities, and applying these concepts to word problems and mathematical modelling. In addition, the lecturers reported that the instructional materials currently used were still conventional (e.g., textbooks and PowerPoint slides), which have not effectively enhanced students' interest and understanding. The results of the student needs survey further showed that 82.14% of respondents preferred web-based, interactive learning media that are readily accessible via smartphones or laptops and integrate Islamic values. This integration is expected to make the learning process more meaningful and relevant to their daily lives as prospective teachers in Islamic schools.

Design

The design phase involved developing the overall architecture of the web application using Figma. The design comprised four integrated main features: (1) instructional content pages presenting explanations of trigonometric concepts accompanied by relevant Qur'anic verses and hadiths (e.g., Surah An-Najm: 1–2 in relation to the concepts of angles and Qiblah direction), (2) interactive quizzes equipped with automatic feedback and solution explanations, (3) an educational game based on an Islamic narrative (Trigono Quest, in which students solve trigonometric problems to determine the Qiblah direction during a simulated Hajj journey), and (4) self-assignment modules that can be submitted and assessed digitally.

The interface design is responsive and incorporates an Islamic aesthetic, characterized by elements such as calligraphy, green and gold colour schemes, and user-friendly navigation. The overall design was preliminarily validated by the course instructor before proceeding to the development phase.

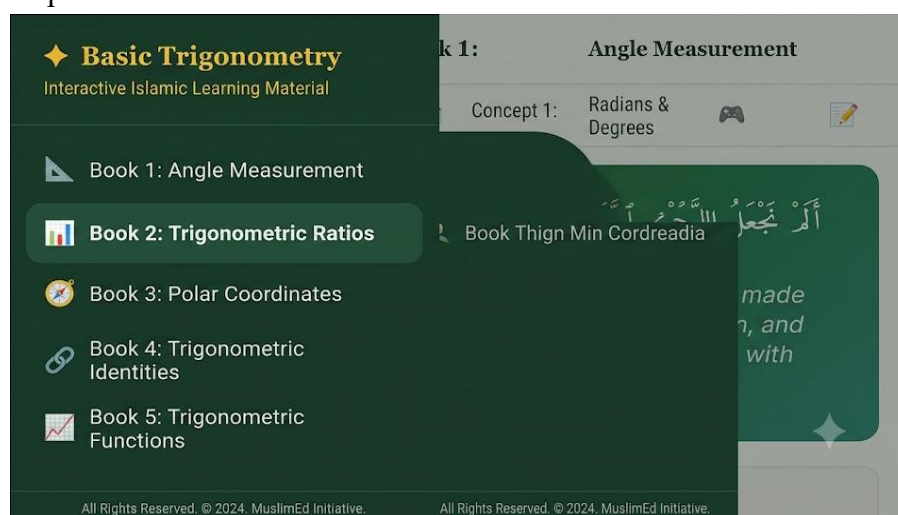


Figure 1. Initial design of instructional materials

Development

In the Development phase, the application was developed based on several relevant learning theories. This study adopted the Cognitive Theory of Multimedia Learning (Mayer, 2009), which emphasizes the principles of multimedia design to reduce students' cognitive load. Consequently, the visualization of trigonometric concepts was presented interactively without overburdening working memory. In addition, this study was also grounded in Constructivist Theory (Piaget, 1954; Vygotsky, 1978), whereby students are encouraged to actively construct their own knowledge through interactive quizzes, educational games, and independent assignments.

The development process utilized modern web technologies, including HTML5, CSS3, JavaScript, Bootstrap 5, and a MySQL database. The application was built as a responsive web-based platform to ensure accessibility across various devices. An Islamic ambiance was incorporated through the use of subtle calligraphic backgrounds, the integration of relevant Qur'anic verses within each lesson, and contextual examples of trigonometric applications, such as determining prayer times and the direction of the Qiblah.

The quiz and game features were developed using programming logic that enables automatic assessment and the systematic storage of students' learning outcomes. This Basic Trigonometry web-based learning application was developed in a structured manner with an Islamic contextual approach. The platform provides comprehensive learning materials covering Angle Measurement, Trigonometric Ratios, Polar Coordinates, Trigonometric Identities, and Trigonometric Functions. Each chapter features four main integrated and responsive functions: a Material tab initiated with the *Basmala* and concise conceptual explanations; an interactive Quiz tab with automated feedback; an essay-based Digital Assignment tab linking mathematical concepts to Islamic history and values (such as the application of polar coordinates in Muslim maritime navigation); and a Game tab offering a timed task (Speed Challenge) to interactively enhance students' conceptual conversion skills.

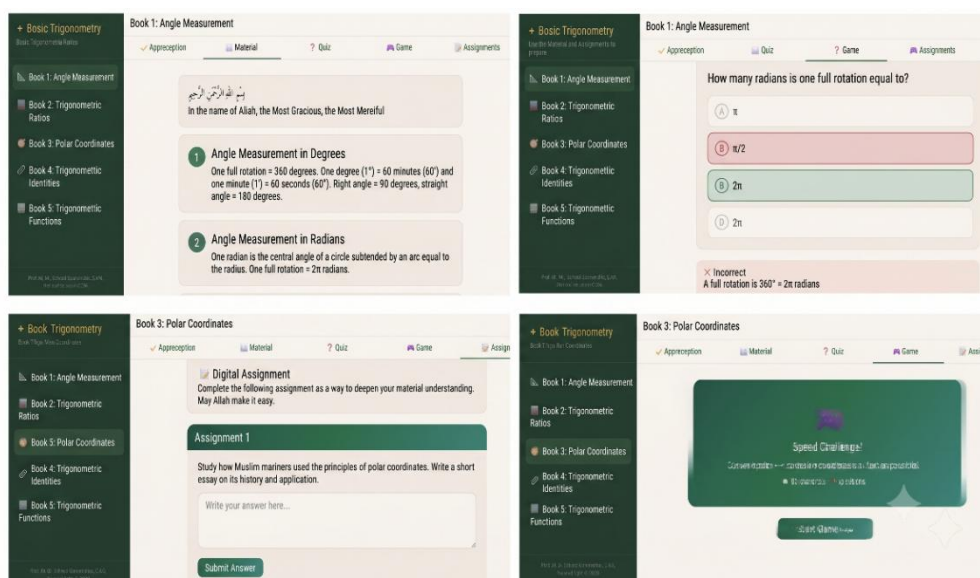


Figure 2. Results of instructional material development

The application was evaluated by five experts: two mathematics subject matter experts, one Islamic studies expert, and two media experts. The validation results indicated a very high average score, demonstrating that the application met the established quality criteria. All experts provided recommendations for minor revisions, which were promptly addressed prior to the pilot testing phase. The detailed validation results are presented in the following table.

Table 3. Validation results by mathematics subject matter experts

Aspect	Validator 1	Validator 2	Average Score	Percentage	Category
Content Suitability	24	24	24.0	96.00%	Highly Acceptable
Conceptual Understanding	28	29	28.5	95.00%	Highly Acceptable
Language Eligibility & Clarity	23	23	23.0	92.00%	Highly Acceptable
Presentation & Learning Flow	19	19	19.0	95.00%	Highly Acceptable
Total Average	94	95	94.5	93.75%	Highly Acceptable

Based on Table 3, the developed web-based interactive learning material was declared highly feasible and comprehensively met the required subject matter standards. The high achievement in the content suitability aspect indicates that the presented trigonometric content aligns with the learning outcomes and is mathematically accurate. These findings indicate that the mathematical content met the established feasibility criteria for subsequent implementation.

Table 4. Validation results by Islamic studies expert

Aspect	Validator	Percentage	Category
Suitability of Islamic Values Integration	28	93.33%	Highly Acceptable
Accuracy and Relevance of Islamic Sources	27	90.00%	Highly Acceptable
Harmony between Mathematics and Islamic Values	27	90.00%	Highly Acceptable
Language & Presentation of Islamic Content	28	93.33%	Highly Acceptable
Total Average	110	91.67%	Highly Acceptable

Based on Table 4, the developed web-based interactive teaching material successfully incorporates Islamic values into trigonometry instruction. The strong agreement across all evaluated aspects confirms that the integrated Islamic sources are accurate, contextually relevant, and presented in clear language. Furthermore, this integration establishes a natural alignment between mathematical concepts and Islamic values without compromising the depth of the core trigonometry content. Overall, these findings indicate that the teaching material effectively integrates Islamic values, making it highly suitable for classroom implementation.

Table 5. Validation results by media experts

Aspect	Validator 1	Validator 2	Average Score	Percentage	Category
Media Design & Visual Appeal	24	23	23.5	94.00%	Highly Acceptable

Aspect	Validator 1	Validator 2	Average Score	Percentage	Category
User Interface & Ease of Use	24	24	24.0	96.00%	Highly Acceptable
Interactivity & Technical Aspects	23	23	23.0	92.00%	Highly Acceptable
Overall Presentation Suitability	24	24	24.0	96.00%	Highly Acceptable
Total Average	95	94	94.5	94.50%	Highly Acceptable

Based on Table 5, the developed web-based interactive teaching material meets high visual, technical, and usability standards. The strong alignment in user interface and presentation suitability confirms that the layout design is clear and easy to understand, visual elements are functional, and navigation is user-friendly. Furthermore, the high ratings in interactivity and technical aspects suggest that the digital features function seamlessly, helping students learn independently without technical confusion. Overall, these findings indicate that the media is well-built and highly suitable for implementation in trigonometry instruction.

A limited-scale trial was conducted with 8 students. The survey results showed a response rate of 87.60% with the “Very Positive” rating. Students stated that the educational game features were very engaging and helped them understand trigonometric concepts in a more enjoyable way.

Implementation

The implementation phase involved 21 first-semester students from the Mathematics Education Program at IAIN Langsa, conducted during their Trigonometry course. The application was utilized across four sessions. Overall, the student response survey yielded a score of 88.57%, categorized as “Very Positive.” The highest-rated indicators were ease of use (91.07%), the aesthetic appeal of the Islamic-themed interface (91.67%), and its benefits in understanding trigonometric concepts (87.50%).

Evaluation

During the evaluation phase, the entire development process and the results of the pilot testing were systematically assessed. The expert validation involving five experts revealed a high level of feasibility, with the Mathematics Subject Matter Expert scoring 93.75%, the Islamic Studies Expert scoring 91.67%, and the Media Expert scoring 94.50%, placing the overall category in the Very Feasible level. Additionally, the implementation trial conducted with 21 first-semester students from the Mathematics Education Program at IAIN Langsa yielded highly positive responses, with an average score of 88.57% (categorized as “Very Positive”). These findings indicate that the web-based interactive teaching materials with integrated Islamic values received a high level of feasibility and acceptance from both experts and students.

Discussion

The results of this study indicate that the development of web-based interactive instructional materials for the Trigonometry course, integrated with Islamic values, was highly successful. The expert-validation results indicate that the application met the established feasibility, particularly in terms of the suitability of mathematical content (93.75%), the integration of Islamic values (91.67%), and media quality (94.50%). This success can be attributed to deliberate design decisions that emphasized interactive visualizations of trigonometric concepts, user-friendly navigation, and a harmonious and contextual presentation of Islamic values. The high expert validation scores across these three aspects confirm that the developed teaching materials comprehensively meet the principles of content feasibility, presentation quality, and instructional media standards.

Student responses were also highly positive, with an average score of 88.57%. The indicators of ease of use (91.07%) and the aesthetic appeal of the Islamic nuances in the display (91.67%) emerged as the primary strengths of the developed teaching material. The positive student responses may be associated with the application's integration of interactive features and culturally relevant Islamic contexts. Rather than presenting Islamic values as decorative elements, the application embeds them within learning tasks, examples, and educational games. This design may increase contextual relevance for students in Islamic higher education. These findings indicate that the integration of Islamic values is not merely supplementary but serves a significant pedagogical function in enhancing students' sense of connection with the trigonometry material. Students reported that the presentation of material alongside relevant Islamic values made the teaching material more engaging and accessible. This result strengthens the findings of Inganah et al. (2023) on the integration of Islamic values, mathematics, and career readiness competencies among prospective teachers in Islamic higher education institutions, as well as Sari et al. (2023) regarding the development of teaching materials integrated with Islamic values in mathematics education.

In terms of integrating Islamic values, Kartika and Sari (2024), and Siswanti and Agustin (2025) emphasize that incorporating Islamic principles into trigonometry course materials not only enhances students' conceptual understanding but also strengthens their religious character. Similarly, Inganah et al. (2023), in a study conducted at an Islamic university, found that prospective mathematics teachers who received instruction integrated with Islamic values demonstrated improved career readiness. Furthermore, Nurafni et al. (2020), through a local wisdom-based approach to teaching trigonometry, reported a notable increase in students' learning motivation.

Amrulloh et al. (2022), in their development of Maple-based media for visualizing trigonometric function graphs, and Rahayu et al. (2023), using GeoGebra, demonstrated that software-based interactive media significantly enhance students' conceptual understanding. Additionally, Sholihah et al. (2023) and Ma'sum et al. (2018) highlight that web-based media and educational games can increase students' interest and facilitate the learning of trigonometry.

Overall, the application developed in this study offers advantages over previous research by fully integrating instructional materials, automated interactive quizzes, Islamic-themed educational games, and digital assignments into a single responsive web platform. This comprehensive approach addresses the gaps identified by Hidayat et al. (2023) and Ramadhan et al. (2024), as well as Sari et al. (2024) and Faadhilah et al. (2024), regarding the need for more holistic, contextual, and Islamic value-based trigonometry learning media at the university level. Furthermore, these findings align with recent studies on digital mathematics education, which demonstrate that integrating interactive web tools and gamified learning elements significantly enhances student engagement and material accessibility (Larico et al., 2026; Nguyen, 2025).

This study has several limitations. First, its instructional effectiveness was not examined using learning-outcome measures, pretest–posttest comparisons, or a control group. Second, the relatively small sample was drawn from a single study program at one institution, limiting the generalizability of the findings. Accordingly, the results should be interpreted as evidence of product feasibility and user acceptance rather than instructional effectiveness. Future studies should employ larger and more diverse samples and experimental or quasi-experimental designs to evaluate learning outcomes.

Conclusion

This study developed and implemented a web-based trigonometry learning application with an Islamic nuance, integrating instructional materials, interactive quizzes, educational games, and independent assignments. Based on validation results from mathematics subject-matter experts (93.75%), Islamic studies experts (91.67%), and media experts (94.50%), along with student feedback (88.57%), the application met the established feasibility criteria and has received a highly positive response from students in the Mathematics Education Program at IAIN Langsa.

The application presents trigonometric concepts interactively while integrating Islamic values in a contextual manner, and students responded positively to these features. Furthermore, The findings further suggest that the ADDIE model provided a systematic framework for developing and refining the web-based application.

Based on these findings, the following recommendations are proposed: (1) The application may be used as a supplementary learning resource while its instructional effectiveness is further evaluated.; (2) Future developers are advised to incorporate features for analyzing student learning outcomes and to expand the range of difficulty levels within the educational games; (3) Further research should examine the effectiveness of the application in improving learning outcomes and mathematical reasoning using experimental or quasi-experimental designs with pretest and posttest measures; (4) Additionally, similar applications could be developed for other areas of mathematics, such as calculus, statistics, or geometry, while maintaining an Islamic perspective.

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Declarations

- Conflicts of Interest : The authors declare no conflict of interest regarding the publication of this manuscript.
- Generative AI Statement : Generative AI tools, including ChatGPT, Gemini, and Grammarly, were utilized in a limited and supportive capacity to assist with preliminary idea development and language refinement. All aspects of the research conceptualization, data analysis, interpretation of findings, and literature synthesis were conducted independently by the authors. The entire process was critically verified to ensure high standards of scientific rigor, accuracy, and academic integrity.
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References

- Abdullah, F. S., & Yunianta, T. N. H. (2018). Pengembangan media pembelajaran matematika Trigo Fun berbasis game edukasi menggunakan Adobe Animate pada materi trigonometri [Development of Trigo Fun mathematics learning media based on educational games using Adobe Animate on trigonometry material]. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, 7(3), 434–443.
- Ahmad, H., & Tasni, N. (2020). Integrasi Alquran pada mata kuliah trigonometri [Integration of the Quran in trigonometry courses]. *Jurnal Pendidikan Matematika*, 14(1), 25–38.
- Anggoro, I. F., & Yunianta, T. N. H. (2018). Development of learning media website-based for trigonometry. *Math Didactic: Jurnal Pendidikan Matematika*, 4(Dies Natalis XXXII), 253–260.
- Arhin, J., & Hokor, E. K. (2021). Analysis of high school students' errors in solving trigonometry problems. *Journal of Mathematics and Science Teacher*, 1(1), 1–16. <https://doi.org/10.29333/jmst/11306>
- Branch, R. M. (2009). *Instructional Design: The ADDIE approach*. Springer. <https://doi.org/10.1007/978-0-387-09506-6>
- Cevikbas, M., Greefrath, G., & Siller, H.-S. (2023). Advantages and challenges of using digital technologies in mathematical modelling education – a descriptive systematic literature review. *Frontiers in Education*, 8(April), 1–17.

- <https://doi.org/10.3389/feduc.2023.1142556>
- Dhungana, S., Pant, B. P., & Dahal, N. (2023). Students' experience in learning trigonometry in high school mathematics: A phenomenological study. *Mathematics Teaching Research Journal Golden Fall*, 15(4), 184–201.
- Engelbrecht, J., & Borba, M. C. (2024). Recent developments in using digital technology in mathematics education. *ZDM – Mathematics Education*, 56(2), 281–292. <https://doi.org/10.1007/s11858-023-01530-2>
- Hidayat, W., Rohaiti, E. E., Hamidah, I., & Putri, R. I. I. (2023). How can android-based trigonometry learning improve the math learning process? *Frontiers in Education*, January, 1–13. <https://doi.org/10.3389/feduc.2022.1101161>
- Inganah, S., Rizki, N., Muhammad, S., Farooq, Y., & Susanti, N. (2023). Integration of Islamic values, mathematics, and career readiness competencies of prospective teachers in Islamic universities. *Delta-Phi: Jurnal Pendidikan Matematika*, 1, 11–14. <https://doi.org/10.61650/dpjpm.v1i1.31>
- Jana, H. W., & Michal, T. (2024). Mathematics teaching, learning, and assessment in the digital age. *ZDM–Mathematics Education*, 56, 525–541.
- Kartika, A., & Sari, J. (2024). Integrasi nilai-nilai Islam dalam pembelajaran matematika pada materi trigonometri [Integration of Islamic values in mathematics learning on trigonometry topics]. *Jurnal Inovasi Global*, 2(3), 520–527. <https://doi.org/10.58344/jig.v2i3.81>
- Khulus, Al Afidatul, Hanif Amrulloh, A. R., & Hernisawati, H. (2022). Pengembangan media pembelajaran berbantuan Aplikasi Maple pada materi grafik fungsi trigonometri [Development of learning media assisted by Maple application on trigonometric function graphs]. *Jurnal Pendidikan Matematika RAFA*, 8(1), 81–92. <https://jurnal.radenfatah.ac.id/index.php/jpmrafa/article/view/11116>
- Kusnadi, D., Islam, A., & Bima, M. (2022). Integrasi nilai-nilai Islam dalam membelajarkan matematika sebagai bentuk penguatan karakter [Integration of Islamic values in teaching mathematics as a form of character strengthening]. *Jurnal Eduscience (JES)*, 9(1), 152–167.
- Larico, D. V., Alexa, M., Gutierrez, B., Talavera-mendoza, F., Hugo, F., & Paucar, R. (2026). Digital applications in mathematics learning for secondary school students: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, 22(1), em2768. <https://doi.org/10.29333/ejmste/17760>
- Ma'sum, Romdoni, M. Y., & Hermanto, R. (2018). Game edukasi trigonometri berbasis web untuk media pembelajaran [Web-based trigonometry educational game for learning media]. *Saintek, Jurnal Ilmiah Sains dan Teknologi*, 1(2), 92–105.
- Mayer, R. E. (2009). *Multimedia Learning (2nd ed.)*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511811678>
- Nguyen, D. T. (2025). The evolving landscape of AI integration in mathematics education: A systematic review of trends (2015-2025). *Eurasia Journal of Mathematics, Science and Technology Education*, 21(10), em2714. <https://doi.org/10.29333/ejmste/17078>
- Nurafni, A., Pujiastuti, H., & Mutaqin, A. (2020). Pengembangan bahan ajar trigonometri berbasis kearifan lokal [Development of trigonometry learning materials based on local wisdom]. *Journal of Medives: Journal of Mathematics Education IKIP Veteran Semarang*, 4(1), 71–80. <https://doi.org/10.31331/medivesveteran.v4i1.978>
- Piaget, J. W. F. (1954). *The construction of reality in the child*. Basic Book.
- Rahayu, M., Fricticarani, A., Humaeroh, M., Aropiq, P. R., Septiani, T., & Bangsa, U. B. (2023). Penggunaan software Geogebra untuk meningkatkan pemahaman dalam materi fungsi trigonometri pada jenjang SMA [Use of Geogebra software to improve understanding of trigonometric function topics at the senior high school level]. *Cendikia*,

- 17(1), 136–151. <https://doi.org/10.30957/cendekia.v17i1.840>
- Rahayu, W., & Irawan, A. (2020). Rancangan aplikasi pembelajaran rumus trigonometri berbasis Android [Design of an Android-based trigonometry formula learning application]. *Jurnal Kajian Pendidikan Matematika*, 6(1), 49–56.
- Ramadhan, Y. A., Sobiruddin, D., & Dwirahayu, G. (2024). Pengembangan media pembelajaran berbasis website dengan pendekatan RME pada materi trigonometri [Development of website-based learning media with an RME approach on trigonometry material]. *Fibonacci: Jurnal Pendidikan Matematika dan Matematika*, 10(1), 39–50.
- Riduwan. (2015). *Skala pengukuran variabel-variabel penelitian [Research variable measurement scales]*. Alfabeta.
- Sari, D. R., Halimah, S., Akmal, W., & Carolina, E. (2023). Pengembangan bahan ajar terintegrasi nilai-nilai Islam pada pembelajaran matematika pendahuluan [Development of learning materials integrated with Islamic values in introductory mathematics learning]. *Jurnal Multidisiplin Ilmu*, 2(2), 179–187.
- Sholihah, U., Masfiah, S., Negeri, I., Ali, S., Tulungagung, R., & App, E. (2023). The Learning Media Development Based on Benime and Edmodo at Trigonometry Subjects to Improve Students' Learning Interest. *Jurnal Matematika dan Pembelajaran*, 11(1), 71-88. <https://doi.org/10.24252/mapan.2023v11n1a5>
- Siswati, F. E., & Agustin, R. D. (2025). Pengembangan video interaktif pada pembelajaran matematika materi SPLDV [Development of interactive videos in mathematics learning on linear equation systems in two variables topics]. *Jurnal Ilmiah Matematika Realistik*, 6(1), 8–15. <https://doi.org/10.33365/ji-mr.v6i1.236>
- Suh, J. M., & Calabrese, S. C. (2025). Culturally responsive mathematics engagement through a family - inspired mathematizing routine. *Educational Studies in Mathematics*, 0123456789. <https://doi.org/10.1007/s10649-025-10411-2>
- Ummah, E. D. R., Solichah, N. L., Purnomo, M. A., & Siti Lailiyah, N. K. (2019). The development of learning module trigonometry equation material integrated Islamic values to improve students learning outcomes Mathematics Education, Faculty of Teacher and Training, UIN Sunan Ampel. *Matematika dan Pembelajaran*, 7(1), 70–80.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.