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Designing Digital Mathematics Learning Media Integrated with Islamic Values to Support Mathematical Literacy in Madrasah Aliyah: A Needs Analysis Study

Emmy Saelan[1], Andi Mulawakkan Firdaus[2], Nasrun[3]

[1]Master of Mathematics Education, Postgraduate Program, University of Muhammadiyah Makassar, Indonesia.

Corresponding Author: Andi Mulawakkan Firdaus

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ABSTRACT

Mathematical literacy has become a central competence in contemporary mathematics education, emphasizing the ability to interpret, formulate, and apply mathematics in real-life contexts. However, many classrooms still rely on procedural teaching approaches and learning materials that provide limited opportunities for contextual reasoning. In faith-based educational settings such as Madrasah Aliyah, the challenge is compounded by the limited integration of Islamic values within mathematics learning resources. This study investigates the learning conditions and instructional needs related to mathematical literacy in a Madrasah Aliyah context. Using a needs-analysis approach, data were collected through classroom observations, teacher interviews, student questionnaires, and textbook analysis. The participants included mathematics teachers and students in a selected Madrasah Aliyah. Qualitative and descriptive quantitative analyses were used to identify gaps between expected mathematical literacy competencies and actual classroom practices. The findings reveal three major issues: (1) classroom instruction remains predominantly teacher-centered and procedural, (2) existing textbooks are perceived as abstract, text-heavy, and weakly connected to real-life contexts, and (3) Islamic values are largely absent from the mathematics learning materials used in the classroom. These conditions indicate the need for more contextual, engaging, and culturally relevant learning resources. The study concludes that the development of digital mathematics learning media integrating Islamic values can provide a promising direction for supporting mathematical literacy in Madrasah settings. Such media have the potential to combine contextual problems, interactive representations, and value-based learning experiences that align with both mathematical literacy goals and the educational mission of Madrasah institutions.

Keywords: mathematical literacy; digital learning media; Islamic values integration; mathematics education; contextual learning.

INTRODUCTION

Mathematical literacy has become one of the most important orientations in contemporary mathematics education because it positions mathematics not merely as a collection of formulas and procedures, but as a means of interpreting reality, solving problems, and participating responsibly in society. In the literature,

mathematical literacy is broadly understood as the capacity to use, interpret, formulate, and communicate mathematics in ways that are meaningful for daily life, work, and citizenship, thereby extending mathematics beyond classroom routines into authentic human activity (Oktiningrum et al., 2016; Supianti et al., 2022; Harisman et al., 2023; Sepriliani et al., 2022). This conception emphasizes that mathematically literate learners are not only able to calculate accurately, but also able to reason in context, construct representations, model situations, interpret evidence, and make justified decisions in relation to practical and social issues (Turidho et al., 2021; Venkat & Winter, 2015; Guo & Della, 2023; Прохорова et al., 2024). In this sense, mathematical literacy is closely aligned with broader traditions of numeracy and quantitative literacy that view mathematics as a functional and civic competence needed for informed participation in a data-driven world (Firdaus et al, 2020).

The urgency of mathematical literacy is even more pronounced in 21st-century education, where individuals are constantly confronted with quantitative information in public discourse, media, health, finance, and technology. A mathematically literate citizen is expected to evaluate statistical claims, interpret risk, judge the credibility of numerical information, and participate thoughtfully in democratic and social decision making (Jablonka & Bergsten, 2021; Mirandah, 2025). For this reason, mathematical literacy is repeatedly described as a central competence for authentic problem solving across disciplines, including STEM, financial literacy, and health literacy, while also supporting critical thinking, modelling, data literacy, computational thinking, and metacognitive reflection (Ghani et al., 2021; Liao & Liang, 2024; Yulianto, 2025; Beccuti, 2024). From this perspective, mathematical literacy is not an optional enrichment, but a foundational educational goal that helps students translate mathematics into meaningful action in the real world rather than merely reproduce school-based procedures (Turidho et al., 2021; Firdaus et al, 2023).

This conceptual orientation has been strongly shaped by international assessments, especially the Programme for International Student Assessment (PISA), which defines mathematical literacy as the ability to formulate, employ, and interpret mathematics in contexts relevant to students' lives as active citizens in a technological society (Spangenberg, 2012; Ekawati et al., 2020; Warner & Lim, 2019; Colonnese, 2020). PISA highlights three closely related processes, formulating real situations mathematically, employing mathematical concepts and procedures, and interpreting results back into context, thus foregrounding mathematizing, representation, reasoning, and communication as core dimensions of literacy (Turidho et al., 2021; Warner & Lim, 2019; Colonnese, 2020; Burkhardt, 2017). These dimensions are operationalized through context-rich tasks that ask students to read information in authentic situations, construct mathematical models, justify conclusions, and explain their reasoning using mathematical language and tools (Lengnik, 2005; Takaria et al., 2020). Yet this international emphasis also exposes an enduring problem: many secondary school students still struggle to engage productively with contextual mathematical problems, particularly when they are asked to move from real situations into formal mathematical representations.

A substantial body of research shows that students often encounter difficulty at the stage of mathematization. They may be able to perform calculations after a suitable model has been provided, but they frequently struggle to identify relevant quantities, determine relationships among variables, select useful representations, and justify how a contextual situation should be expressed mathematically (Turidho et al., 2021; Warner & Lim, 2019; Colonnese, 2020). Studies on PISA-like tasks in a range of contexts, including sports, sailing,

elections, and pandemic-related data, repeatedly report that students' responses tend to weaken when a task requires contextual interpretation, data reasoning, or argumentation rather than direct procedural execution (Efriani et al., 2019; Ekawati et al., 2020; Muñiz-Rodríguez et al., 2020). These difficulties are intensified by language demands, unfamiliar contexts, and the need to interpret data or uncertainty in real-life settings, all of which may increase cognitive load and create inequitable barriers for learners with differing prior experiences, discourse familiarity, or cultural access to the contexts used in the task (Bohlmann & Benölken, 2020; Beccuti, 2024; Jablonka & Bergsten, 2021).

The problem is not located only in the students' performance, but also in the nature of instruction and learning resources that shape classroom experiences. Research has consistently warned that teacher-centered and procedure-oriented instruction may limit students' opportunities to develop broader mathematical literacy because such instruction tends to privilege transmission of formulas over discussion, modelling, sense-making, and contextual reasoning (Colonnese, 2020; Bennison et al., 2020; Soboleva et al., 2020; Beccuti, 2024). When mathematics classrooms are dominated by teacher explanation and repetitive exercises, students may learn to imitate procedures without learning to formulate problems, interpret evidence, or communicate mathematical ideas in context (Colonnese, 2020). This concern is further connected to equity, because teacher-centered practice that ignores linguistic diversity, prior knowledge, and contextual relevance can exacerbate disparities in participation and achievement, especially when learners are expected to demonstrate literacy competencies that have not been explicitly cultivated in instruction (Firdaus, 2023). In addition, abstract and decontextualized teaching materials may further weaken students' engagement, because they fail to connect mathematical ideas to everyday life, social meaning, and the lived realities of learners (Liu et al., 2025; Fitriana et al., 2021).

To address these problems, previous studies have explored a range of approaches that strengthen mathematical literacy through contextualized task design, local adaptation of international frameworks, and design-based validation. Many researchers have developed PISA-like tasks using local, social, and culturally meaningful contexts, including Asian Games, football, sailing, elections, COVID-19, and Indonesian local settings, in order to make mathematical reasoning more authentic and accessible to learners (Ekawati et al., 2020; Warner & Lim, 2019; Muñiz-Rodríguez et al., 2020; Susanta et al., 2023). These studies demonstrate that design research cycles, such as preliminary analysis, expert review, one-to-one evaluation, small-group testing, and field testing, are important for ensuring validity, practicality, linguistic clarity, and cultural appropriateness in mathematical literacy tasks (Turidho et al., 2021; Colonnese, 2020; Beccuti, 2024). At the same time, measurement-oriented work has emphasized the need for psychometric rigor, including rubric alignment, Rasch modelling, and cross-context fairness, so that mathematical literacy can be assessed meaningfully and equitably across different populations and settings (Kollosche & Meyerhöfer, 2021; Colonnese, 2020).

Beyond contextual task design, another important line of research has examined the roles of digital learning media and interactive teaching materials in promoting mathematical understanding and engagement. Digital resources can provide dynamic visualizations, simulations, manipulatives, immediate feedback, and multimodal representations that help learners explore mathematical ideas more actively and conceptually than static print materials often permit (Hwang & Ham, 2021; Hamidah, 2025). Interactive materials are also associated with richer mathematization, representation, and argumentation because they encourage students to test ideas, receive feedback, and

revise reasoning in more iterative ways (Sistyawati et al., 2023; Sepriliani et al., 2022; Susanta et al., 2022; Setianingsih et al., 2025). Recent studies further indicate that digital and game-based learning environments can support differentiated and inclusive participation when designed with attention to accessibility, linguistic clarity, and cultural relevance, although poor design may also reproduce inequities rather than reduce them (Soboleva et al., 2020; Murtafiah et al., 2021; Putra et al., 2023; Hamidah et al., 2025). Because of this, teachers' capacity to choose, adapt, and design meaningful digital resources has become another important concern in the literature on professional development and numeracy-oriented pedagogy (Hou, 2024; Khalo et al., 2022; Baumgartner et al., 2021; Mariani et al., 2022).

A further strand of scholarship is especially relevant to faith-based schooling: the integration of cultural and Islamic values into mathematics education. In Islamic educational contexts, mathematics learning can become more meaningful when it is connected to learners' ethical, social, and religious experiences through contexts such as zakat, waqf, Islamic finance, fair distribution, and other forms of values-based quantitative reasoning (Edo et al., 2013; Kusumawati et al., 2023; Harisman et al., 2023). Research on culturally grounded and ethnomathematical approaches suggests that students benefit when mathematics is situated within recognizable cultural practices and community life, because such contextualization makes abstract concepts more intelligible and socially meaningful (Laamena & Laurens, 2021; Graven et al., 2022; Nurgabyl et al., 2023). In Madrasah or Islamic school settings, integrating Islamic values is therefore not merely an aesthetic addition, but a potentially powerful way to align mathematical reasoning with students' identity, moral formation, and everyday interpretive frameworks (Dian Rahma Sari et al., 2024). At the same time, the literature cautions that such integration must be carefully designed, validated, and made inclusive so that cultural authenticity is preserved without compromising mathematical rigor, accessibility, or fairness (Beccuti, 2024; Soboleva et al., 2020; Khalo et al., 2022; Harisman et al., 2023).

Although these bodies of literature are rich and productive, an important gap remains at their intersection. Much existing research has examined mathematical literacy conceptually, assessed it through PISA-like frameworks, localized contextual tasks, or explored the benefits of digital learning media and culturally grounded mathematics education in partial ways. However, relatively few studies have integrated these dimensions into a single framework for developing digital mathematics learning media that explicitly addresses mathematical literacy, contextual problem solving, learner engagement, and Islamic value integration in Madrasah Aliyah settings. Similarly, studies of digital mathematics learning in Islamic schools remain limited, and there is still insufficient evidence on how needs analysis can be used as a foundation for designing media that respond simultaneously to contextual demands, students' perceptions of current materials, and the identity-related expectations of Islamic secondary education (Khairah et al., 2024; Masyihtoh et al., 2025). This unresolved intersection marks a clear gap in the literature and suggests the need for research that is both theoretically informed and contextually grounded.

Based on this gap, the present study aims to analyze the need for developing interactive, contextual, and Islamic value-integrated digital learning media for mathematics instruction in Madrasah Aliyah. The study is based on the assumption that mathematical literacy is more likely to develop when students are supported by learning resources that are visually engaging, digitally responsive, contextually meaningful, and ethically aligned with their school environment and lived experiences (Alzoubi, 2024; Liu et al., 2025; Ulya et al., 2024). The novelty of the study lies in positioning needs analysis as the conceptual

and practical foundation for future media development that responds to four converging concerns at once: low mathematical literacy, the limitations of teacher-centered and abstract instruction, the pedagogical potential of interactive digital media, and the importance of integrating Islamic values into meaningful mathematics learning. Through this contribution, the study seeks to enrich the discourse on mathematical literacy while also supporting the design of more relevant, engaging, and context-responsive mathematics education for Madrasah Aliyah.

MATERIALS & METHODS

Research Design

This study employed a needs analysis design positioned within the **Analysis** phase of the **ADDIE** development model. In ADDIE-oriented educational research, needs analysis functions as the foundational phase through which learner characteristics, instructional constraints, curricular expectations, contextual conditions, and educational gaps are identified before design decisions are made (Sari, 2025; Mirandah, 2025; Rahmawati, 2025). In mathematics education, this phase is especially important because the design of subsequent learning materials should respond not only to theoretical expectations, such as mathematical literacy indicators, but also to the concrete realities of classroom practice, teacher needs, and learner difficulties (Supianti et al., 2025; Nusantara, 2025; Kusaeri et al., 2025).

Accordingly, the present study did not aim to test the effectiveness of a finished product, but to generate a comprehensive portrait of instructional needs as the basis for the future development of digital mathematics learning media integrated with Islamic values. The design combined qualitative descriptive and descriptive quantitative approaches. The qualitative component was used to investigate classroom practices, teacher perspectives, instructional constraints, and the contextual relevance of existing materials. The quantitative component was used to describe patterns in participants' perceptions of current mathematics learning materials and media through structured questionnaire responses. Such an approach is consistent with needs-analysis studies that combine stakeholder input, classroom evidence, and descriptive indicators in order to guide meaningful design decisions in later ADDIE stages (Sari, 2025; Mirandah, 2025; Supianti et al., 2025; Harisman, 2025).

This design was selected because the topic of the study, the development of interactive, contextual, and Islamic value-integrated digital media for mathematical literacy, requires a multi-source understanding of what learners currently experience, what teachers perceive as constraints, and how existing classroom resources align or fail to align with expected learning outcomes. As noted in prior needs-analysis research, a systematic Analysis phase should produce a prioritized understanding of competencies, contextual demands, and design requirements rather than relying solely on abstract assumptions or imported frameworks (Rahmawati, 2025; Supianti et al., 2025; Harisman, 2025).

Research Setting, Data Sources, and Participants

The study was conducted at Madrasah Aliyah Syekh Yusuf, focusing on mathematics learning in the context of upper secondary Islamic education. The institutional context was considered important because Madrasah Aliyah has distinct pedagogical and cultural expectations, including the need to integrate academic content with Islamic values and to make learning meaningful for students lived experiences in faith-based schooling.

The participants consisted of 2 mathematics teachers and 10 eleventh-grade students. In the quantitative component, the respondents specifically involved in the structured questionnaire were 1 mathematics teacher and 10 students, while the broader qualitative inquiry also drew on classroom

observation and teacher interviews. The participant size reflects the logic of needs-analysis research at the early stage of development, where the purpose is not statistical generalization but the generation of a grounded, context-sensitive profile of instructional needs (Supianti et al., 2025).

The study drew upon four principal data sources. First, classroom observations were used to document real teaching-learning interactions, classroom routines, the use of learning resources, the distribution of teacher and student discourse, and the degree to which classroom practice appeared to support mathematical literacy. Observation is frequently used in mathematics education needs analysis because it provides direct evidence of what happens in situ, including pain points in engagement, representation, and conceptual access that may not be fully revealed in self-reported data (Sari, 2025; Kusaeri et al., 2025).

Second, semi-structured interviews were conducted with mathematics teachers to explore their perceptions of students' mathematical literacy difficulties, the constraints of existing teaching materials, the practical conditions of instruction, and the need for digital and context-responsive learning media. Interview-based inquiry is central in needs-analysis studies because it captures stakeholder perspectives on instructional barriers, feasibility, and local priorities that may otherwise remain hidden (Mirandah, 2025; Nusantara, 2025; Harisman, 2025).

Third, questionnaires were used to gather participants' perceptions of current mathematics textbooks and the need for digital instructional media. In educational needs analysis, questionnaires, especially Likert-type instruments, are often employed to provide descriptive evidence about users' perceptions of clarity, usefulness, relevance, attractiveness, and learning support offered by materials or media (Sepriliani et al., 2022; Susilawati, 2025). In the present study, the questionnaire data were used to describe how students perceived the attractiveness, contextual relevance, literacy support, Islamic value integration, and clarity of the textbook currently in use.

Fourth, document analysis was used to examine curriculum-related expectations, instructional materials, classroom documents, and the existing textbook. Document analysis is essential in needs-analysis studies because it allows researchers to assess whether available materials are aligned with intended outcomes and to identify gaps between curriculum expectations and actual instructional resources (Sari, 2025; Rahmawati, 2025; Harisman, 2025).

Summary of Participants and Data Sources

This study was conducted at Madrasah Aliyah Syekh Yusuf. The qualitative participants consisted of two mathematics teachers and ten eleventh-grade students, while the questionnaire respondents included one mathematics teacher and ten students. The main data sources used in the study were classroom observations, interviews, questionnaires, and document analysis. These sources were employed to investigate classroom learning conditions, participants' perceptions of existing mathematics learning materials, and the design needs for developing digital mathematics learning media.

Research Procedures

The procedures were organized as a staged needs-analysis process consistent with the logic of ADDIE's Analysis phase. In many ADDIE-informed studies, observations and document reviews are conducted early to ground the inquiry in the actual learning environment, after which interviews and questionnaires are used to triangulate findings and refine interpretation (Sari, 2025; Mirandah, 2025; Supianti et al., 2025; Kusaeri et al., 2025). Following that logic, the present study proceeded through the following stages.

First, the researcher established the research focus by identifying the instructional

domain to be examined, namely mathematics learning, especially the topic of statistics in Madrasah Aliyah. At this stage, the study was conceptually anchored in literature on mathematical literacy, contextual learning, digital learning media, and Islamic value integration, which together shaped the lens through which the classroom needs were interpreted.

Second, the researcher identified the participants and instructional setting. The participants were selected purposively because they represented the immediate users and implementers of the planned future media design: mathematics teachers and students in the target grade level. Purposive selection is common in design-oriented needs analysis because the aim is to gather rich and relevant information from stakeholders who directly experience the instructional problem.

Third, classroom observation was conducted to examine how mathematics teaching was implemented in practice. The researcher documented the flow of instruction, teacher explanations, student participation, classroom interaction patterns, the use of textbooks and other materials, and the extent to which problem solving, representation, contextualization, and mathematical reasoning were visible in classroom activity. Observation findings were intended to provide a situational portrait of learning conditions that could later be compared with teachers' perceptions and students' responses.

Fourth, teacher interviews were carried out to gather more detailed explanations regarding the difficulties students faced, the reasons why instruction was still dominated by conventional or lecture-based approaches, the limitations of existing materials, and the need for alternative media. These interviews were also used to surface contextual issues such as time constraints, curricular pressure, and the challenge of integrating Islamic values into mathematics learning.

Fifth, a structured questionnaire was administered to respondents in order to quantify perceptions of the mathematics textbook currently used. The questionnaire focused on key indicators such as visual attractiveness, relevance to everyday life, support for word problems and mathematical literacy, integration of Islamic values, and clarity and systematic organization of the material. Descriptive quantitative summaries of these responses were then generated to show the prevalence of positive or negative perceptions across the participant group.

Sixth, documents and teaching materials were analyzed, including the textbook and related classroom materials. This analysis was intended to compare what the classroom claimed to value, such as contextual learning or Islamic integration, with what the actual materials visibly provided.

Seventh, all data were synthesized through qualitative and descriptive quantitative analysis in order to identify the most salient instructional needs. The final output of this stage was not a tested intervention, but a needs profile that could inform the design of future digital learning media. This is consistent with ADDIE needs analysis, which is expected to produce a clear statement of learning problems, target competencies, contextual constraints, and design implications before entering the design stage (Sari, 2025; Mirandah, 2025; Rahmawati, 2025; Supianti et al., 2025).

Data Analysis Techniques

The study employed two complementary forms of analysis: qualitative descriptive analysis and descriptive quantitative analysis**.**

Qualitative Analysis

The qualitative data drawn from observation, interviews, and documents were analyzed through three broad steps: data reduction, data display, and conclusion drawing. In the reduction stage, information directly relevant to the design of digital mathematics learning media was identified and selected. This included evidence

concerning student difficulties, instructional routines, material limitations, contextual constraints, and perceived needs.

In the data display stage, the selected information was organized systematically so that patterns across the different data sources could be compared. For instance, observation notes about teacher-centered instruction were examined alongside interview statements explaining why such instruction persisted, and these were further compared with questionnaire findings about students' dissatisfaction with the existing textbook. This cross-walking of findings is aligned with mixed-method needs-analysis practice, in which different data sources are interpreted together rather than in isolation (Supianti et al., 2025; Kusaeri et al., 2025; Harisman, 2025).

In the conclusion-drawing stage, the researcher identified recurring needs and translated them into design-relevant implications. These included the need for more contextual materials, support for mathematical literacy, greater use of interactive and visual media, and stronger integration of Islamic values.

Descriptive Quantitative Analysis

The questionnaire data were analyzed using descriptive statistics, specifically frequencies, counts of positive responses, and percentages. The purpose of this analysis was not hypothesis testing or population generalization, but the description of how respondents perceived the textbook currently used in class. This approach is consistent with perception-oriented needs analysis, where quantitative summaries are used to indicate prevalence and relative strength of perceptions across indicators (Sepriliani et al., 2022; Susilawati, 2025).

The interpretation categories for positive responses were as follows:

- 0–20% = Very Low
- 21–40% = Low
- 41–60% = Moderate
- 61–80% = High
- 81–100% = Very High

These categories were used to interpret how far the existing textbook met users' needs. The use of categorized percentages was intended to make the results easier to read and to connect them directly to practical design decisions.

Table Reference and Full Rewritten Table

The results of the questionnaire-based needs analysis are summarized in **Table 1**, which presents participants' perceptions of the mathematics textbook currently used.

Table 1. Results of Students' Needs Analysis of the Mathematics Textbook (n = 10)

No.	Evaluated Indicator	Positive Responses	Negative / Not Yet Positive Responses	Total Respondents	Positive Percentage	Category	Interpretive Meaning
1	The textbook is visually attractive	3 students	7 students	10 students	30%	Low	Most students do not perceive the textbook as visually engaging.
2	The material is connected to everyday life	2 students	8 students	10 students	20%	Very Low	The material is perceived as insufficiently contextualized to students' real experiences.
3	The textbook helps students understand word problems / literacy-based	3 students	7 students	10 students	30%	Low	The textbook provides limited support for mathematical literacy and word-problem

	tasks						understanding.
4	The textbook integrates Islamic values	0 students	10 students	10 students	0%	Very Low	No student perceived clear integration of Islamic values in the textbook.
5	The material is easy to understand and systematically presented	4 students	6 students	10 students	40%	Low	This is the strongest aspect, but it still does not reach a moderate category.

Table note:

- Source: extracted from the initial draft of students' needs analysis of the mathematics textbook.
- Total respondents: **10 students (n = 10)**.
- The "Negative / Not Yet Positive Responses" column was derived by subtracting the number of positive responses from the total respondents.
- Interpretation categories: **0–20% = Very Low; 21–40% = Low; 41–60% = Moderate; 61–80% = High; 81–100% = Very High**.

The study also refers to **Figure 5**, labeled in the draft as "Results of Student Interview NS." Because the original visual was not clearly preserved as a readable figure and appeared closely related to the same perception data, it is referred to in this methodology as a figure associated with early student interview findings about learning materials. The analytical discussion in this study relies primarily on the fully rewritten tabular data presented in Table 1.

Validity, Feasibility, and Ethics

Although the draft does not report a formal and extensive validity-testing procedure for every instrument, several elements of validity and feasibility are implicit in the design. First, the study uses triangulation of methods, observation, interviews, questionnaires, and document analysis to strengthen the credibility of the need's portrait. Triangulation is widely recommended in mathematics education needs analysis because each method reveals different aspects of learning conditions and participant experience (Sari, 2025; Mirandah, 2025; Rahmawati, 2025; Supianti et al., 2025; Kusaeri et al., 2025; Harisman, 2025).

Second, the study aligns its inquiry with both the literature and the classroom context. The focus on mathematical literacy, contextual learning, and the integration of Islamic values was not arbitrarily imposed, but derived from recurring patterns in previous research and from the actual needs surfaced by teachers and students. Such alignment supports content relevance and practical feasibility of the resulting design implications (Sari, 2025; Harisman, 2025).

Third, the use of clearly defined questionnaire indicators and descriptive interpretation categories contributes to transparency in the quantitative component. Although advanced psychometric testing such as Rasch modelling was not reported for the present stage, the study remains appropriate as an early-stage exploratory needs analysis whose main purpose is to describe, not yet to validate a large-scale assessment instrument (Supianti et al., 2025).

Regarding ethics, the draft does not explicitly mention formal ethics board approval, signed informed consent procedures, or confidentiality protocols. Nevertheless, the study appears to have operated within normal educational research practice by involving participants directly connected to the classroom context, focusing on non-invasive data collection, and using the information for instructional improvement rather than evaluative judgment of individuals. Even so, this

remains a limitation, and future stages of the research should describe ethical safeguards more explicitly, including participant consent, confidentiality, and transparent handling of data.

Finally, from the standpoint of feasibility, the study indicates that the proposed future media development is conceptually justified because the needs analysis revealed converging evidence from classroom observations, teacher interviews, student perceptions, and material review. The resulting needs profile therefore serves as a practical and theoretically grounded basis for the next ADDIE stages, especially the design of digital mathematics learning media that are contextual, interactive, literacy-oriented, and integrated with Islamic values (Harisman, 2025).

RESULT

This section presents the empirical findings of the needs analysis conducted in Madrasah Aliyah Syekh Yusuf. The results are organized according to the analytical framework established in the research design, namely: (1) students' mathematical literacy difficulties, (2) instructional practices observed in the classroom, (3) limitations of existing learning materials, (4) the absence of Islamic value integration in mathematics materials, and (5) quantitative results from the student needs questionnaire regarding the mathematics textbook currently used. The results are reported descriptively and objectively based on observation notes, interview summaries, document analysis, and questionnaire data.

Students' Mathematical Literacy Difficulties

One of the most prominent findings of the needs analysis concerns the difficulties experienced by students when dealing with mathematical literacy tasks, especially in the process of formulating contextual problems into mathematical representations.

Based on interviews with mathematics teachers, students tend to demonstrate adequate procedural skills when performing numerical calculations. However, they encounter difficulties when they are required to interpret contextual information and transform real-life situations into mathematical models. Teachers reported that students frequently struggle to identify relevant quantities, understand relationships among variables, and determine appropriate mathematical expressions when confronted with word problems or contextual scenarios.

Observation of classroom activities also revealed that students often waited for teachers to demonstrate the solution procedures before attempting to solve problems independently. When presented with contextual questions, many students hesitated and requested clarification about how the situation should be translated into mathematical form.

These findings are supported by institutional data from the Education Report (Rapor Pendidikan), which indicates that the mathematical literacy achievement level of students in the observed context is 64.44%. In the interpretation used within the study, this figure indicates that students' literacy competence is still relatively moderate and requires improvement, particularly in the ability to interpret and formulate contextual problems.

Teachers emphasized that students frequently "can perform calculations" but "experience difficulty connecting situations to mathematical concepts." This observation highlights that the main challenge lies not in arithmetic procedures but in contextual reasoning and problem formulation.

Quantitative indicator related to this finding

Mathematical literacy achievement score: 64.44%. This result indicates that students' mathematical literacy is still at a moderate level, meaning that while students generally possess basic computational skills, many still encounter difficulties when dealing with contextual mathematical problems. In particular, students tend to struggle to interpret real-life situations, identify relevant information, and transform these

situations into mathematical representations such as equations, tables, graphs, or symbolic expressions. In classroom practice, students often wait for teachers to demonstrate solution procedures before attempting problems independently, showing that their understanding of contextual reasoning and problem formulation is still limited. Therefore, the score of 64.44% not only reflects an average achievement level but also signals an instructional gap, suggesting that current learning practices have not fully supported the development of key mathematical literacy processes, especially in interpreting contextual problems, reasoning mathematically, and constructing mathematical models. This finding highlights the importance of developing learning resources particularly digital mathematics learning media, that can help students better understand real-life contexts, explore mathematical ideas more interactively, and gradually build stronger abilities in contextual problem solving.

Dominance of Lecture-Based and Teacher-Centered Instruction

Another important finding concerns the instructional practices commonly used in the classroom. Interviews with teachers and classroom observations indicate that mathematics instruction still tends to rely heavily on lecture-based approaches.

Teachers explained that time constraints, curriculum completion targets, and the lack of practical teaching resources often lead them to adopt direct explanation methods. In a typical lesson, the teacher introduces formulas, demonstrates example problems, and then asks students to complete exercises from the textbook.

Observation results indicate that interaction patterns in the classroom are predominantly one-directional. Teachers deliver explanations while students listen, take notes, and later attempt to solve exercises individually. Opportunities for discussion, exploration of contextual situations, or collaborative reasoning are relatively limited.

This instructional pattern affects the level of student engagement. Many students remain passive during lessons and rely on teacher explanations before attempting problem-solving tasks. As a result, the development of higher-order reasoning skills and contextual mathematical thinking appears to be constrained.

Teachers acknowledged that this situation is not ideal but explained that they often depend on conventional teaching approaches due to practical limitations such as instructional time and the absence of contextual teaching materials that are easily applicable in classroom practice.

This finding suggests that current instructional practices may not yet provide sufficient opportunities for students to develop mathematical literacy skills such as interpretation, reasoning, and contextual modeling.

Limitations of Existing Learning Materials

The analysis also revealed significant limitations in the mathematics textbook currently used in the classroom. Both teacher interviews and student feedback indicate that the textbook is perceived as heavily dominated by textual explanations and formulas, with relatively few visual elements or contextual illustrations.

Students reported that the book contains dense text and formal language, which makes the material difficult to engage with independently. Several students stated that the textbook is "full of formulas and explanations" but provides limited visual representation or contextual examples that relate mathematical ideas to everyday situations.

From the perspective of content structure, the textbook focuses mainly on procedural explanations followed by practice exercises. Contextual tasks or real-life applications of statistical concepts appear infrequently. As a result, the textbook does not sufficiently

support students in connecting mathematical concepts to real-world contexts.

Teachers also confirmed that they frequently need to provide additional explanations or create their own contextual examples during lessons because the textbook alone does not adequately bridge the gap between abstract mathematical ideas and students' everyday experiences.

These findings indicate that the limitations of current learning materials contribute to the difficulties students experience in understanding contextual mathematical problems. The design of the textbook, both in terms of visual presentation and contextual relevance, appears insufficient to support the development of mathematical literacy.

Lack of Islamic Value Integration in Mathematics Learning Materials

Another significant finding concerns the minimal presence of Islamic values in the mathematics learning materials used in the Madrasah Aliyah context.

Both students and teachers reported that the existing textbook does not meaningfully integrate Islamic perspectives, examples, or contexts related to religious or ethical life. For a school environment that emphasizes the integration of academic learning with Islamic values, this absence represents an important gap.

Students stated that they rarely encounter examples that connect mathematical topics to Islamic practices, community activities, or ethical considerations. Consequently, mathematics learning may appear detached from the broader educational mission of the madrasah, which aims to integrate knowledge and character development.

Teachers acknowledged that integrating Islamic contexts into mathematics instruction is important because it helps make learning more meaningful and relevant for students. However, they also indicated that existing textbooks provide very limited support for such integration. As a result, teachers must often create contextual examples independently if they wish to relate mathematical content to Islamic values or everyday religious life.

This finding suggests that the development of future mathematics learning media should incorporate Islamic contextualization in order to align more closely with the identity and educational goals of Madrasah Aliyah.

Quantitative Findings: Students' Needs Analysis of the Mathematics Textbook

To complement the qualitative findings, a questionnaire was administered to 10 students in order to capture their perceptions of the mathematics textbook currently used in the classroom. The questionnaire evaluated five indicators related to textbook design and usefulness.

Overall, the results show that students' perceptions of the textbook fall within the low to very low categories across all indicators. None of the indicators reached the moderate, high, or very high category.

Table 1. Students' Needs Analysis of the Mathematics Textbook (n = 10)

No	Evaluated Indicator	Positive Responses	Negative Responses	Total Respondents	Positive Percentage	Category	Interpretation
1	The textbook is visually attractive	3 students	7 students	10	30%	Low	Most students do not perceive the textbook as visually engaging.
2	The material relates to everyday life contexts	2 students	8 students	10	20%	Very Low	The textbook provides very limited contextual examples.
3	The textbook	3 students	7 students	10	30%	Low	Support for

	helps students understand literacy-based word problems						mathematical literacy tasks is still limited.
4	The textbook integrates Islamic values	0 students	10 students	10	0%	Very Low	No student observed Islamic value integration in the material.
5	The material is easy to understand and systematically presented	4 students	6 students	10	40%	Low	This indicator received the highest score but remains in the low category.

Interpretation categories:

- 0–20% = Very Low
- 21–40% = Low
- 41–60% = Moderate
- 61–80% = High
- 81–100% = Very High

The table shows that the highest score (40%) was obtained for the indicator "material is easy to understand and systematically presented." Although this is the strongest aspect of the textbook, it still falls within the low category.

The weakest indicator concerns the integration of Islamic values, which received **0% positive responses**. None of the participating students perceived the presence of Islamic contextualization in the mathematics textbook.

Tabel 2. Quantitative pattern summary

Analytical Aspect	Result
Highest percentage	40% (clarity and systematic presentation of material)
Lowest percentage	0% (integration of Islamic values)
Category distribution	3 indicators Low, 2 indicators Very Low
Strongest indicator	Material clarity and systematic structure
Weakest indicator	Islamic value integration
Overall pattern	All indicators remain below the Moderate category

The pattern observed in Table 1 reinforces the qualitative findings obtained from interviews and observations. Students perceive the current textbook as lacking visual attractiveness, contextual relevance, and support for literacy-based problem solving.

Figure 5. Student Interview Results (NS)

Caption: This figure represents a summary visualization of student interview responses related to their perceptions of mathematics learning materials. In the original draft, the figure label appeared as "Figure 5," although the available content consisted primarily of summarized response data rather than a fully preserved graphic. The figure is therefore maintained here as a placeholder indicating the intended location of the visual representation of interview findings.

Overall Pattern of Findings

When the qualitative and quantitative findings are considered together, several consistent patterns emerge.

First, students experience the greatest difficulty in interpreting contextual problems and translating them into mathematical representations. This difficulty appears closely related to the limited presence of contextual tasks and literacy-oriented materials in current learning resources.

Second, classroom instruction remains dominated by teacher-centered explanations

and lecture-based methods. This instructional pattern may limit opportunities for students to actively engage in reasoning, discussion, and contextual problem solving.

Third, the mathematics textbook used in the classroom is perceived as insufficiently engaging and insufficiently contextualized. Students report that the material relies heavily on formal explanations and formulas rather than interactive or contextual learning experiences.

Fourth, Islamic values are largely absent from the existing learning materials, even though such integration is considered important within the educational context of Madrasah Aliyah.

Finally, the quantitative survey results confirm that students' perceptions of the textbook are generally low across all evaluated indicators. This pattern indicates that current learning resources do not fully meet students' needs for engaging, contextual, and meaningful mathematics learning.

Overall, these findings provide a clear empirical basis for the next stage of the research, namely the design and development of interactive digital mathematics learning media that are contextual, literacy-oriented, and integrated with Islamic values.

DISCUSSION

Interpreting the Gap Between Expected Mathematical Literacy and Classroom Practice

The findings of this study indicate a clear gap between the mathematical literacy competencies expected in contemporary mathematics education and the instructional realities observed in the Madrasah Aliyah classroom. In principle, mathematical literacy is understood as an integrated competence that includes mathematizing, representation, reasoning, justification, and communication in authentic contexts rather than procedural fluency alone (Efriani et al., 2019; Colonnese, 2020). When this expectation is compared with the observed classroom situation in which students could often perform calculations but struggled to interpret contexts, formulate mathematical models, and connect mathematical concepts to real-life situations, the gap becomes pedagogically significant. This pattern suggests that the problem is not simply that students "lack ability," but that the enacted learning environment has not yet consistently cultivated the full range of competencies associated with mathematical literacy.

This interpretation is consistent with prior literature stating that mathematical literacy is frequently weakened when classroom learning remains dominated by routine and decontextualized procedures (Ekawati et al., 2020; Warner & Lim, 2019). Research on mathematical literacy has repeatedly shown that students may succeed at executing algorithms while still failing to formulate, represent, or justify solutions in contextual tasks (Muñiz-Rodríguez et al., 2020; Colonnese, 2020). The present findings strongly align with that pattern. Students' difficulty in transforming everyday situations into mathematical form supports the view that mathematical literacy requires sustained practice in modelling and contextual sense-making, not only repeated exposure to formal procedures (Efriani et al., 2019). Thus, the gap identified in this study can be interpreted as a mismatch between the competence framework promoted by mathematical literacy discourse and the actual opportunities available to learners in the classroom.

The data also suggest that this gap is not purely cognitive. Prior studies emphasize that mathematical literacy performance is shaped by task context, language demands, and the accessibility of classroom discourse (Harisman, 2025; Setianingsih et al., 2025). In the present study, students' hesitation when facing contextual problems and their dependence on teacher explanation indicate that the challenge lies partly in how mathematical ideas are communicated and scaffolded. This means that the gap should be read not only as a problem of student weakness, but also as a problem of

instructional design, discourse support, and the absence of learning materials that make contextual reasoning explicit and accessible (Colonnese, 2020).

Alignment with Previous Research on Mathematical Literacy Development

The findings of this study broadly align with previous research on mathematical literacy development in at least three ways. First, the results confirm that one of the most difficult aspects of mathematical literacy lies in the process of mathematizing contextual situations. Previous studies on PISA-like tasks have reported that students often struggle when they must translate authentic contexts into mathematical models, identify relevant quantities, and justify their conclusions (Efriani et al., 2019; Ekawati et al., 2020; Warner & Lim, 2019). The present study found a similar pattern: students were relatively more comfortable with calculation once a procedure had been shown, but experienced difficulty when they had to interpret word problems and formulate the mathematics independently. This supports the argument that contextual reasoning remains one of the central challenges in mathematical literacy learning (Muñiz-Rodríguez et al., 2020).

Second, the findings are compatible with research emphasizing the influence of classroom context and language on mathematical literacy performance. Previous literature has shown that contextual tasks can either reveal or obscure mathematical literacy depending on how familiar the context is, how accessible the language is, and how well students are supported in mathematical discourse (Colonnese, 2020; Harisman, 2025). In this study, the students' perception that the textbook language was formal, dense, and insufficiently connected to everyday life suggests that the current materials may suppress rather than support the emergence of mathematical literacy processes. In this sense, the findings do not diverge from prior work; rather, they add context-specific evidence from a Madrasah Aliyah setting.

Third, the study aligns with earlier research showing that teacher-centered pedagogy tends to under develop higher-order mathematical processes. Previous work has argued that when instruction is dominated by explanation, imitation, and one-directional delivery, students receive limited opportunities to engage in modelling, argumentation, and contextual reasoning (Turidho et al., 2021). The classroom observations and teacher interviews in the present study reflect that same condition. The persistence of lecture-based practices therefore appears to be one mechanism through which the gap between mathematical literacy ideals and classroom performance is reproduced (Colonnese, 2020).

At the same time, the study also contributes nuance to previous research. Some earlier literature has emphasized the critical and citizenship-oriented dimensions of mathematical literacy, including the interpretation of public data, social issues, and media discourse (Jablonka & Bergsten, 2021; Hemmings et al., 2010). While the present study does not directly examine civic numeracy or critical mathematical literacy in public discourse, it reinforces the same broader principle: mathematics becomes more meaningful when linked to real-life contexts and socially relevant values. In the Madrasah Aliyah context, that social meaning is not only civic but also ethical and religious, making Islamic value integration an especially important extension of contextualized mathematical literacy.

Interpreting the Role of Existing Textbooks and Learning Materials

The textbook findings provide a particularly important lens for interpreting the broader classroom gap. Quantitatively, all textbook indicators remained in the low or very low category, and qualitatively, students described the material as text-heavy, formula-dominated, visually limited, and weakly connected to daily life. These results suggest that the textbook is not functioning

as an effective support for mathematical literacy. Instead of serving as a bridge between mathematical concepts and real-world contexts, it appears to reinforce formal and abstract learning.

This interpretation is highly consistent with literature arguing that mathematical literacy depends on exposure to authentic, meaningful, and accessible contexts (Efriani et al., 2019; Muñiz-Rodríguez et al., 2020). If students mainly interact with materials that present mathematics as a sequence of symbolic procedures, then it is unsurprising that they find contextual problem formulation difficult. The textbook results therefore do not merely describe student preferences; they point to a structural feature of the learning environment that likely contributes to the underdevelopment of mathematical literacy.

The findings also resonate with research on digital-age learners, which emphasizes that contemporary students often engage more effectively with visual, interactive, and multimodal materials than with static text-only resources (Zahner et al., 2021; Bloom & Fuentes, 2019). The low rating of the textbook's visual appeal, together with the teacher's acknowledgement that current materials are not sufficiently practical or contextual, reinforces the idea that improved learning media should not only change content but also change mode of engagement. In other words, the need is both epistemic and pedagogical: students need materials that support mathematical reasoning, and they need formats that better match how they engage with learning.

The Significance of Islamic Value Integration in the Madrasah Context

One of the most distinctive findings of this study is the very low perception of Islamic value integration in the existing mathematics textbook, with zero students identifying such integration in the material. This is especially important because the study was conducted in Madrasah Aliyah, where the educational mission includes not only academic development but also the integration of knowledge with Islamic values and character formation.

From the perspective of the literature, this result can be interpreted as evidence that contextual relevance in faith-based schooling must include not only everyday realism, but also cultural and religious meaningfulness (Utari et al., 2025). Previous studies have noted that contextualized mathematical literacy tasks become more effective when they draw on students lived experiences, local knowledge, or culturally resonant frames (Bohlmann et al., 2017; He, 2024). In the present context, Islamic values are part of that lived and institutional reality. Therefore, the absence of Islamic integration represents more than a missing feature in textbook content; it represents a lack of alignment between mathematics instruction and the identity framework of the school.

This finding also supports literature on culturally grounded and ethically informed mathematics education. Studies on Islamic-context tasks, financial literacy in religious settings, and ethnomathematical approaches suggest that mathematics becomes more meaningful when it is linked to practices such as zakat calculation, equitable distribution, timekeeping, charity budgeting, and ethical decision making (Fachrudin, 2025; Susilawati, 2025; Sepriliani et al., 2022). The present study does not yet test such materials, but the needs-analysis evidence strongly supports their relevance. Thus, the study extends previous research by showing that in a Madrasah Aliyah setting, contextualization should be understood not only as a strategy for realism, but also as a strategy for religious and institutional coherence.

Pedagogical Implications for Mathematics Learning

The pedagogical implications of these findings are substantial. First, mathematics instruction in the observed context needs to move away from a predominantly transmissive model toward a more discourse-rich and context-based learning

environment. If mathematical literacy is to be strengthened, students need regular opportunities to interpret situations, pose questions, construct models, justify reasoning, and discuss alternative representations (Turidho et al., 2021). This implies a shift in classroom roles: teachers need to act not only as explainers of procedures, but also as facilitators of meaning-making and contextual inquiry.

Second, the findings imply that the design of learning materials should prioritize contextuality, visual support, and interactive engagement. Given that students perceived the existing textbook as abstract and difficult to connect with everyday life, future instructional resources should include tasks that explicitly connect mathematical concepts to real situations, especially situations meaningful to Madrasah students. The literature suggests that interactive and inquiry-driven materials can help students engage more deeply with representation, reasoning, and argumentation (Bloom & Fuentes, 2019; Zahner et al., 2021). The present findings provide local justification for applying those ideas.

Third, the findings indicate that mathematical literacy support must include attention to language and accessibility. Since students experienced the materials as overly formal and difficult to read, future media should use clearer language, accessible explanations, and scaffolds that reduce unnecessary linguistic burden while preserving mathematical challenge. This is especially important because the literature repeatedly warns that contextual tasks can become inequitable if language demands obscure reasoning (Harisman, 2025; Setianingsih et al., 2025).

Implications for the Development of Digital Media Integrated with Islamic Values

The strongest practical implication of the study is the need to develop digital mathematics learning media that are contextual, interactive, literacy-oriented, and integrated with Islamic values. This implication follows logically from the convergence of the findings: students struggle with contextual problem formulation, current instruction remains teacher-centered, textbooks are seen as visually and contextually weak, and Islamic values are absent from the materials despite their importance in the school context.

Digitally mediated media offer a promising response because they can combine multiple design strengths in one platform. They can present visual representations, interactive exploration, and immediate feedback; they can embed real-life and Islamic contexts more flexibly than static textbooks; and they can support students' gradual movement from context to model to interpretation (Bloom & Fuentes, 2019; Zahner et al., 2021). The literature suggests that digital media are especially useful when they are paired with clear mathematical objectives and contextual authenticity. In Madrasah contexts, this means that digital media should not simply add religious decoration, but should embed Islamic-informed domains such as zakat, charity, ethical budgeting, Islamic finance, fair distribution, or timekeeping in ways that preserve mathematical rigor (Fachrudin, 2025; Utari et al., 2025).

The study therefore contributes a locally grounded rationale for co-designing future media with both pedagogical and cultural authenticity in mind. It also implies that digital media development should involve teacher input, contextual validation, and iterative refinement so that the final product is usable, meaningful, and aligned with both mathematical literacy goals and Madrasah values.

Contribution of the Study

The contribution of this study lies primarily in its integration of several strands of concern that are often treated separately in the literature. First, it contributes empirical evidence from a Madrasah Aliyah context, which remains less represented in mathematical literacy research than more general secondary school settings. Second,

it brings together mathematical literacy, classroom practice, textbook perception, and Islamic value integration within a single needs-analysis framework. Third, it positions these findings as a foundation for future media design rather than treating them as isolated descriptive observations.

This contribution is important because it moves the conversation beyond the general claim that mathematical literacy is important. Instead, it shows specifically how and why the existing learning environment may fail to support that competence in a faith-based school setting. In doing so, the study helps articulate a more context-sensitive pathway toward improvement—one that joins literacy development, digital pedagogy, and Islamic educational relevance.

Limitations of the Study and Transition Toward the Conclusion

Several limitations should be considered when interpreting these findings. Most importantly, the study was conducted in a single Madrasah Aliyah with a relatively small sample consisting of two teachers and ten students, with questionnaire data based on one teacher and ten students. Because of this, the results should be interpreted as context-bound and exploratory rather than broadly generalizable to all Madrasah settings (Mirandah, 2025; Rahmawati, 2025; Supianti et al., 2025). The needs identified here may differ in schools with other curricular priorities, technological resources, student demographics, or linguistic environments.

A second limitation concerns instrument scope and validation. Although the study used triangulated methods, it did not report advanced psychometric validation or large-scale instrument testing. This is acceptable for an early-stage needs analysis, but it limits the comparability of the findings across wider populations. Relatedly, the study focused on perceived needs and observed conditions rather than testing the effectiveness of a newly developed medium. Thus, while the findings justify the direction of future development, they cannot yet demonstrate that the proposed digital media will improve mathematical literacy outcomes.

A third limitation lies in the temporal and contextual specificity of the findings. Educational needs may change as curricula evolve, teachers gain access to new resources, or digital infrastructure improves. For this reason, future work should include multi-site validation, larger participant groups, and iterative development cycles that test whether the needs identified here remain stable across different Madrasah contexts.

Even with these limitations, the findings provide a coherent and evidence-based account of why new digital mathematics media are needed in this setting and what core features such media should prioritize. These implications lead directly to the next section, where the study's overall claims are consolidated and the significance of the needs-analysis findings is brought into a final concluding frame.

CONCLUSION

This study examined the learning conditions and instructional needs related to mathematical literacy in a Madrasah Aliyah context. The findings indicate that a significant gap exists between the competencies expected in mathematical literacy frameworks and the practices currently observed in the classroom. Instruction tends to remain teacher-centered and procedural, providing limited opportunities for students to engage in contextual reasoning, modelling, and interpretation of real-life mathematical situations.

The analysis also revealed that existing mathematics textbooks are perceived as insufficient in supporting mathematical literacy development. Students and teachers reported that the materials are largely abstract, text-heavy, and weakly connected to everyday contexts. In addition, Islamic values an important element of Madrasah education, are largely absent from the

mathematics learning resources used in the classroom. These findings suggest that the current learning environment does not fully support the integration of contextual reasoning and value-based education expected in Madrasah settings.

Based on these findings, the study highlights the need to develop innovative learning resources that better align with the goals of mathematical literacy and the institutional identity of Madrasah education. In particular, digital mathematics learning media integrated with Islamic values offers a promising direction for future instructional design. Such media can support contextual problem solving, interactive learning experiences, and the integration of ethical and religious perspectives within mathematical contexts.

Although this study provides valuable insights into classroom needs, its findings are limited to a single Madrasah context with a relatively small sample. Future studies should expand the investigation across multiple institutions and include the design, development, and evaluation of digital learning media to examine their effectiveness in improving students' mathematical literacy.

Declaration by Authors

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