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The Effect of Mathematical Problem-Solving on Mathematical Literacy and Its Implications for Islamic Financial Literacy

Muniri[1], Wahyu Dwi Warsitasari[2*], Nurul Laili[3], Savera Eka Ardita[4]
[1, 2, 4] UIN Sayyid Ali Rahmatullah Tulungagung, Tulungagung, Indonesia
[3] Universitas Negeri Surabaya, Surabaya, Indonesia

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Korespondensi

E-mail: wahyu_dwi@uinsatu.ac.id *

ABSTRACT

The impact of mathematical problem-solving skills on mathematical literacy and its consequences for Islamic financial literacy among undergraduate students enrolled in Islamic Economics programs in East Java, Indonesia, are examined in this study. 385 students from three Islamic institutions were surveyed as part of a quantitative method employing multistage sampling. Partial Least Squares Structural Equation Modelling (PLS-SEM) was used to analyze the data. The findings demonstrate that whereas mathematics literacy strongly impacts Islamic financial literacy, problem-solving skills have a considerable beneficial impact on mathematical literacy. However, problem-solving ability does not have a direct or indirect significant effect on Islamic financial literacy. These findings indicate that mathematical literacy acts as a key cognitive bridge, although its role in Islamic financial literacy remains limited without contextual integration of financial knowledge. The model demonstrates stronger explanatory power for mathematical literacy compared to Islamic financial literacy, suggesting the presence of additional unobserved factors influencing financial literacy outcomes. The study concludes that Islamic financial literacy is not solely determined by mathematical competence but requires contextualized learning that integrates mathematical reasoning with Islamic financial concepts and financial behavioral exposure.

1. Introduction

In the twenty-first century, mathematical literacy has emerged as a critical competency that enables individuals to understand quantitative information, solve practical problems, and make informed decisions in various real-life contexts. In mathematics education, mathematical literacy extends beyond procedural knowledge to include the application of mathematical reasoning in authentic situations. This competency is increasingly emphasized in educational frameworks, as it equips learners with essential skills to address everyday challenges, including those related to economic and financial decision-making.

According to the Programme for International Student Assessment (PISA), mathematical literacy refers to an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. This competency enables individuals to use mathematical reasoning and tools to explain phenomena, evaluate information, and make informed decisions. Consequently, mathematical literacy is increasingly recognized as an essential skill for active participation in modern society and for addressing challenges encountered in everyday life [1].

A key supporting competency of mathematical literacy is mathematical problem-solving ability. Problem-solving involves understanding problems, formulating strategies, and interpreting solutions within meaningful contexts. Through this process, students develop higher-order thinking skills and adaptive reasoning, which are essential for transferring mathematical knowledge to real-world situations.

This process closely mirrors the core components of mathematical literacy itself, namely formulating, employing, and interpreting mathematics in context, and this close relationship has been emphasized in mathematics education literature. Students who demonstrate stronger

mathematical problem-solving abilities are expected to be better equipped to apply mathematical knowledge in real-world contexts [2]. Thus, mathematical problem-solving is not only a core objective of mathematics education but also an important pathway for strengthening mathematical literacy.

In applied contexts, financial decision-making represents one of the most relevant domains where mathematical literacy is essential. Financial literacy requires individuals to interpret numerical information, evaluate risks, and make rational decisions regarding budgeting, saving, and investment. Accordingly, financial literacy can be viewed as an applied manifestation of mathematical literacy, where mathematical competencies are used to support informed and responsible financial behavior. Many financial decisions involve comparing financial alternatives, assessing potential returns, and understanding quantitative information related to costs and risks. Therefore, individuals with stronger mathematical competencies are generally better positioned to process financial information and make informed financial decisions [3], [4].

This perspective aligns with the human capital perspective in financial literacy research, which considers knowledge and competencies as productive assets that enhance individuals' economic decision-making and long-term financial well-being. Financial literacy can therefore be viewed as an investment in human capital because it improves individuals' ability to manage financial resources effectively and make informed economic decisions. According to Lusardi and Mitchell [4], financial literacy contributes significantly to financial well-being and long-term economic outcomes.

With regard to Islamic finance, financial literacy becomes more complex, as it requires not only economic rationality but also compliance with Sharia principles. Islamic financial literacy combines conventional financial understanding with ethical and legal standards, such as the prohibition of gharar, maysir, and riba, as well as familiarity with Sharia-compliant instruments such as Islamic banking, takaful, and halal investment products [5]–[7]. Despite the rapid growth of the Islamic finance industry, literacy levels remain relatively low. In Indonesia, according to the Otoritas Jasa Keuangan (OJK) national survey [8], general financial literacy reached 65.43% in 2024, while Islamic financial literacy was significantly lower at 39.11%, with Islamic financial inclusion at only 12.88%. This gap indicates that industry growth has not been matched by adequate public understanding and utilization.

The Financial Capability Framework further suggests that financial literacy is a multidimensional construct encompassing knowledge, skills, attitudes, and financial behaviors rather than merely numerical competence [9], [10]. From this perspective, Islamic financial literacy requires not only an understanding of financial concepts but also the ability and willingness to apply such knowledge in accordance with Islamic ethical principles. Therefore, cognitive competencies may represent only one component among several determinants influencing Islamic financial literacy outcomes.

In higher education, particularly among students in Islamic economics programs, a higher level of Islamic financial literacy is expected due to academic exposure. Nevertheless, empirical evidence suggests that academic exposure alone does not guarantee a high level of Islamic financial literacy. For instance, a study among economics and business students in Indonesia found that even among students who had taken Islamic economics and finance courses, a considerable proportion remained at only a moderate level of Islamic financial knowledge, rather than reaching a high level [11]. This suggests that while course exposure contributes positively to literacy, it may not be sufficient on its own, and that underlying cognitive competencies may play a crucial factor in acquiring adequate Islamic financial literacy.

Previous research has demonstrated that financial literacy is influenced not only by contextual and educational factors but also by cognitive abilities such as mathematical literacy and

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problem-solving skills. Individuals who possess stronger mathematical reasoning skills are more capable of evaluating financial risks, interpreting quantitative data, and making rational financial decisions [12], [13]. Moreover, mathematical problem-solving skills, particularly in real-world contexts, have been found to support responsible financial behavior [3], [14].

The proposed relationships in this study can be explained through Transfer of Learning Theory, which describes how knowledge and skills acquired in one context are applied to different contexts and situations [15], [16]. According to this theory, successful transfer occurs when learners recognize similarities between previously acquired knowledge and new problems requiring its application. Mathematical literacy and problem-solving ability may therefore function as mechanisms through which mathematical competencies are transferred into financial contexts. However, Transfer of Learning Theory also suggests that competencies acquired in one domain are not always transferred directly to another domain and may require intermediary competencies to facilitate successful transfer. In the context of Islamic finance, this transfer process involves applying quantitative reasoning and mathematical knowledge to understand concepts such as profit-sharing schemes, zakat calculations, murabaha margins, and other Sharia-compliant financial products.

Integrating these theoretical perspectives, the human capital perspective explains the value of financial competencies as productive assets, the Financial Capability Framework conceptualizes Islamic financial literacy as a multidimensional capability involving knowledge, attitudes, and behavior, while Transfer of Learning Theory explains how mathematical competencies may be transferred into financial decision-making contexts. Together, these theories provide a comprehensive theoretical foundation for examining the relationships among mathematical literacy, problem-solving ability, and Islamic financial literacy.

Despite these findings, research examining the relationship between mathematical competencies and financial literacy remains limited. Existing studies have generally investigated mathematical literacy and financial literacy as separate areas of inquiry, while studies of Islamic financial literacy have predominantly focused on demographic, socioeconomic, and educational determinants. Consequently, the mechanism through which mathematical problem-solving ability contributes to mathematical literacy and its implications for Islamic financial literacy remain insufficiently understood, particularly among university students enrolled in Islamic economics programs.

Consequently, this study aims to examine the relationships among mathematical problem-solving ability, mathematical literacy, and Islamic financial literacy among university students enrolled in Islamic economics programs. Specifically, this study investigates the association between mathematical problem-solving ability and mathematical literacy, the relationship between mathematical literacy and Islamic financial literacy, and the mediating role of mathematical literacy in explaining these associations.

2. **Methods**

The population of this study comprised active undergraduate students of the Faculty of Islamic Economics and Business (FEBI) from three Islamic universities in East Java, Indonesia, namely UIN Sunan Ampel Surabaya, UIN Syekh Wasil Kediri, and UIN Sayyid Ali Rahmatullah Tulungagung. The total population was 9,867 students in the second semester of the 2024/2025 academic year, based on data obtained from the official PDDikti database. Second-semester students were selected to capture students' mathematical and Islamic financial literacy at an early stage of their academic program, providing a baseline understanding of these competencies before more advanced specialization in later semesters.

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With a 5% margin of error, the sample size was calculated using Slovin's formula, yielding 385 respondents. A combination of purposive and multistage random sampling was employed. East Java Province was purposively selected as the research location. Three Islamic universities offering Islamic economics-related programs were then purposively selected to represent different regions within the province. Proportional random sampling was subsequently used to determine the number of respondents from each institution, followed by simple random sampling to select individual participants. The final sample distribution consisted of 96 students from UIN Sunan Ampel Surabaya, 112 students from UIN Syekh Wasil Kediri, and 177 students from UIN Sayyid Ali Rahmatullah Tulungagung.

Although the sample size was initially estimated using Slovin's formula, additional justification was considered for the PLS-SEM analysis. Following the minimum sample size recommendations for PLS-SEM, the study exceeded the ten-times rule, which requires a sample size at least ten times the maximum number of structural paths directed at a latent construct. Since the maximum number of incoming structural paths in this model was two, the minimum recommended sample size was 20 observations. Furthermore, a post hoc statistical power analysis using G*Power with a medium effect size ($f^2 = 0.15$), significance level of 0.05, and statistical power of 0.95 indicated a minimum sample size substantially lower than the obtained sample of 385 respondents. Therefore, the sample size was considered adequate for PLS-SEM estimation.

Data were collected using a combination of tests and questionnaires administered through Google Forms. Mathematical problem-solving ability and mathematical literacy were measured using essay and contextual test items, whereas Islamic financial literacy was assessed using a structured questionnaire. The scores obtained from the mathematical problem-solving and mathematical literacy tests were aggregated across their respective dimensions to generate composite scores representing overall performance in each construct. Because these constructs were operationalized using performance-based assessments that produced aggregate competency scores, the resulting composite scores were modeled as single-indicator constructs in the PLS-SEM analysis. This approach is consistent with established PLS-SEM guidelines, which note that a single indicator can adequately represent a construct when it is derived from a composite score reflecting an underlying competency measured through multiple scoring dimensions [17].

The indicators were adapted from established frameworks and previous studies. Mathematical problem-solving ability was assessed using the problem-solving stages proposed by Polya [18], mathematical literacy was based on the OECD PISA framework [1], and Islamic financial literacy was measured using dimensions of knowledge, attitude, and behavior adapted from previous Islamic financial literacy studies [19]. The responses were scored using analytic rubrics aligned with the dimensions of each construct. For mathematical problem-solving ability, scores were assigned based on students' performance in understanding the problem, designing solution strategies, executing procedures, and evaluating results. For mathematical literacy, scores were assigned based on students' ability to formulate, employ, and interpret mathematics in contextual situations. Meanwhile, Islamic financial literacy was measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Prior to data collection, the instrument was reviewed by three experts in mathematics education and Islamic economics to evaluate content validity. The expert review process focused on item relevance, clarity, and representativeness of the intended constructs. Revisions were made iteratively based on the experts' suggestions until agreement was reached regarding the appropriateness of the items for measuring the targeted constructs. Although formal content validity indices such as the Content Validity Index (CVI) were not calculated, the expert review process was conducted to ensure the adequacy of content representation and item suitability prior to data collection.

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Participation in this study was voluntary, and informed consent was obtained from all respondents before data collection. The anonymity and confidentiality of participants' responses were ensured throughout the research process. Since this study employed a cross-sectional and non-experimental research design, the findings should be interpreted as associations among variables rather than causal relationships.

To investigate the research hypotheses, PLS-SEM, or partial least squares structural equation modelling, was employed in this investigation. PLS-SEM was selected because it is suitable for predictive modelling and examining complex relationships among latent constructs represented by both composite scores and multiple indicators. Assessment of the measurement model and evaluation of the structural model were the two phases of the analysis. The measurement model assessment focused on evaluating indicator reliability and construct validity for multi-item constructs, whereas the single-indicator constructs were treated as observed composite variables in accordance with PLS-SEM recommendations for performance-based assessments. Using a bootstrapping process with t-statistics and p-values, the structural model was assessed to look at the correlations between constructs and test the hypotheses.

The indicators for each latent construct are presented in Table 1.

Table 1. The Indicators for Latent Construct

No	Variable	Concept	Indicators
1	Mathematical Problem-Solving Ability [18]	The skill to analyze problems, formulate strategies, and apply appropriate procedures to obtain solutions	a. Understanding the problem b. Designing solution strategies c. Executing the solution d. Evaluating results
2	Mathematical Literacy [1]	The ability to formulate, apply, and interpret mathematics in real-world contexts	a. Formulating problems from real-life contexts b. Using mathematical concepts and procedures c. Interpreting and evaluating results
3	Islamic Financial Literacy [19]	The ability to understand, evaluate, and manage financial matters in accordance with Islamic principles, as reflected in financial knowledge, attitudes, and behavior.	a. Knowledge b. Attitude c. Behavior

Figure 1 illustrates the conceptual framework of the relationship among variables.

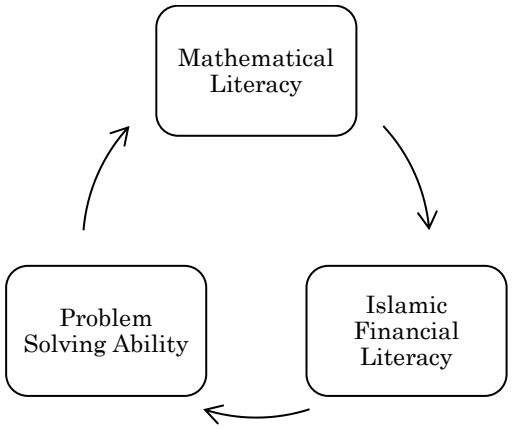

Figure 1. Conceptual Framework

The following formulation of the study's hypotheses is based on the conceptual framework:

H1: Mathematical problem-solving ability is significantly associated with mathematical literacy.

H2: Mathematical literacy is significantly associated with Islamic financial literacy.

H3: Mathematical problem-solving ability is significantly associated with Islamic financial literacy.

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H4: Mathematical literacy mediates the relationship between mathematical problem-solving ability and Islamic financial literacy.

3. Result and Discussion

Convergent validity, reliability, and discriminant validity were assessed for the measurement model before the structural model was tested. With factor loadings that range from 0.748 to 0.878 and an Average Variance Extracted (AVE) of 0.675, Islamic Financial Literacy (IFL) demonstrated strong convergent validity. Mathematical Literacy (ML) and Problem-Solving Ability (PSA) were modelled as single-indicator constructs using composite scores derived from performance-based assessments. For each construct, students' responses were evaluated using rubric-based scoring across the respective dimensions, and the resulting scores were aggregated to represent overall competency. This approach is appropriate for objective test-based measures in which multiple scoring dimensions collectively reflect a single latent construct [17]. Nevertheless, modelling performance-based assessments as single-indicator constructs may underestimate measurement error and represents a methodological trade-off between parsimony and construct representation. The essay-based responses for PSA and ML were scored by the researcher using analytic rubrics developed from the theoretical dimensions of each construct to ensure consistency across participants.

As shown in Table 2, all indicator loadings exceed 0.70 and all AVE values are above 0.50, indicating satisfactory convergent validity. For the single-indicator constructs (PSA and ML), reliability coefficients were automatically estimated as 1.000 by the PLS-SEM algorithm because each construct was represented by a single composite indicator. These values should therefore be interpreted as a modelling consequence rather than empirical evidence of perfect reliability. For Islamic Financial Literacy, the Composite Reliability and Cronbach's Alpha values exceeded 0.70, indicating satisfactory internal consistency. Two items (A4 and A6) were removed from the final model due to insufficient outer loadings (below 0.70), in line with the item-deletion criteria for reflective constructs.

Table 2. Convergent Validity and Reliability

Variable	Indikator	Loading Factor	AVE	CR	CA
Problem Solving Ability (PSA)	Composite Score	1.000	1.000	1.000	1.000
Mathematical Literacy (ML)	Composite Score	1.000	1.000	1.000	1.000
Islamic Financial Literacy (IFL)	A1	0.853	0.675	0.961	0.957
	A2	0.878			
	A3	0.769			
	A5	0.748			
	A7	0.854			
	A8	0.775			
	A9	0.823			
	A10	0.822			
	A11	0.859			
	A12	0.835			
	A13	0.765			
	A14	0.866			

The greatest Heterotrait–Monotrait (HTMT) ratio, 0.412, is below the suggested threshold of 0.85. This shows that the constructs, as shown in Table 3, are empirically distinct from one another.

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Table 3. Discriminant Validity (HTMT Ratio)

Constructs	ML	PSA	IFL
ML	-	-	-
PSA	0.412	-	-
IFL	0.181	0.026	-

Overall, the measurement model demonstrated acceptable validity and reliability for the purposes of structural model estimation, although the use of single-indicator constructs for PSA and ML should be considered when interpreting the findings.

A bootstrapping procedure using 5,000 resamples was conducted to test the structural relationships among constructs. Predictive relevance was additionally assessed using Stone-Geisser's Q^2 values. The results (Table 4) indicate that Problem-Solving Ability significantly influences Mathematical Literacy ($\beta = 0.412, t = 4.520, p < 0.001$), supporting H1. In addition, Mathematical Literacy has a significant positive effect on Islamic Financial Literacy ($\beta = 0.237, t = 2.356, p = 0.019$), supporting H2. However, the direct effect of PSA on IFL is negative and not statistically significant ($\beta = -0.094, t = 1.511, p = 0.131$), leading to rejection of H3.

Table 4. Path Analysis Results

Hypothesis	Relationship	Path Coefficient (β)	t – value	p – value	Result
H1	PSA → ML	0.412	4.520	< 0.001	Supported
H2	ML →IFL	0.237	2.356	0.019	Supported
H3	PSA → IFL	–0.094	1.511	0.131	Not Supported

The indirect effect of Problem-Solving Ability on Islamic Financial Literacy through Mathematical Literacy was positive but not statistically significant ($\beta = 0.098, t = 1.952, p = 0.052$), indicating that H4 is not supported at the 0.05 significance level. Although the indirect effect was not statistically significant at the 0.05 level, the result was close to the significance threshold and may indicate that the indirect pathway deserves further examination using larger samples or additional explanatory variables.

Table 5. Indirect Effect and Mediation

Hypothesis	Relationship	Indirect Effect (β)	t – value	p – value	Result
H4	PSA → ML → IFL	0.098	1.952	0.052	Not Supported

Table 6. Structural Model Quality: R^2 and Q^2

Endogenous Construct	R^2	f^2 (Effect Size)	Q^2
Mathematical Literacy (ML)	0.170	0.205	0.161
Islamic Financial Literacy (IFL)	0.047	0.008	0.025

Table 7. Structural Model Quality F^2

Endogenous Construct	f^2 (Effect Size)	Interpretation
PSA → ML	0.205	Medium
PSA → IFL	0.008	Negligible
ML → IFL	0.049	Small

Regarding structural model assessment, the R^2 values indicate that the model explains 17.0% of the variance in Mathematical Literacy and 4.7% in Islamic Financial Literacy. This reflects low-to-moderate explanatory power for Mathematical Literacy and weak explanatory power for Islamic Financial Literacy. The relatively low R^2 value for Islamic Financial Literacy suggests that factors beyond mathematical competencies may play a substantial role in shaping students' Islamic financial literacy. Such factors may include financial experience, religiosity, socioeconomic background, family influence, and exposure to Islamic financial services.

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The effect size (f^2) results indicate that Problem-Solving Ability has a medium effect on Mathematical Literacy ($f^2 = 0.205$). In contrast, Problem-Solving Ability has a negligible effect on Islamic Financial Literacy ($f^2 = 0.008$), while Mathematical Literacy exerts a small effect on Islamic Financial Literacy ($f^2 = 0.049$). Furthermore, the Q^2 values indicate that the model has moderate predictive relevance for Mathematical Literacy ($Q^2 = 0.161$) and weak predictive relevance for Islamic Financial Literacy ($Q^2 = 0.025$).

Overall, the structural model exhibits stronger explanatory and predictive power for Mathematical Literacy compared to Islamic Financial Literacy. This suggests that the model is more effective in capturing cognitive mathematical processes than domain-specific financial literacy outcomes, implying that Islamic Financial Literacy may be influenced by additional unobserved factors beyond the current model specification.

a. Effect of Problem-Solving Ability (PSA) on Mathematical Literacy (ML)

The results revealed that problem-solving ability has a significant positive effect on mathematical literacy ($\beta = 0.412, p < 0.001$). This finding indicates that students with stronger problem-solving ability tend to demonstrate higher levels of mathematical literacy. Moreover, the relatively substantial path coefficient suggests that problem-solving ability constitutes an important cognitive foundation for the development of mathematical literacy among university students.

Theoretically, problem-solving ability is closely aligned with the core components of mathematical literacy, namely the ability to formulate, employ, and interpret mathematics in a variety of contexts [1]. Previous studies have also emphasized that mathematical literacy involves applying mathematical knowledge to real-life situations rather than merely performing procedural calculations [20]. Mathematical literacy requires individuals not only to possess mathematical knowledge but also to apply that knowledge to unfamiliar and real-world situations. Such processes involve understanding contextual problems, identifying relevant information, selecting appropriate strategies, and evaluating the reasonableness of solutions, all of which are fundamental aspects of problem-solving ability. Similarly, Ojose [21] argued that mathematical literacy emphasizes the practical application of mathematical knowledge to solve real-life problems, highlighting the central role of problem-solving processes in the development of mathematical literacy.

This relationship can also be explained through Polya's problem-solving framework, which consists of understanding the problem, devising a plan, carrying out the plan, and looking back at the solution [18]. These stages closely resemble the processes emphasized in the OECD mathematical literacy framework, particularly the abilities to formulate real-world situations mathematically, employ mathematical concepts and procedures, and interpret mathematical outcomes [1]. In addition, Schoenfeld [22] emphasized that effective problem solving requires strategic thinking, monitoring, and reflective evaluation. These competencies are likewise central to mathematical literacy because students must continuously evaluate and refine their reasoning when solving contextual mathematical problems.

The present finding is also supported by empirical evidence reported by Abidin et al. [23], who found that students frequently experience difficulties in mathematical literacy tasks due to weaknesses in understanding problems, selecting solution strategies, and interpreting mathematical results. These findings suggest that successful performance in mathematical literacy tasks depends heavily on effective problem-solving ability. Therefore, mathematical literacy can be viewed not merely as a product of mathematical knowledge but also as an outcome of students' ability to engage in systematic and reflective problem-solving processes.

Furthermore, the effect size analysis showed that problem-solving ability has a moderate effect on mathematical literacy ($f^2 = 0.205$). This result indicates that problem-solving ability contributes meaningfully to students' mathematical literacy performance, although other factors

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may also influence mathematical literacy development. From an educational perspective, this finding highlights the importance of instructional approaches that emphasize problem-solving activities, contextual tasks, and mathematical reasoning. Learning environments that encourage students to explore, analyze, and evaluate solutions to authentic problems may provide valuable opportunities for strengthening both problem-solving ability and mathematical literacy [1], [18], [21], [22].

b. Effect of Mathematical Literacy (ML) on Islamic Financial Literacy (IFL)

The results revealed that mathematical literacy has a significant positive effect on Islamic financial literacy ($\beta = 0.237, p = 0.019$). This finding indicates that students with higher levels of mathematical literacy tend to demonstrate better Islamic financial literacy. This result suggests that mathematical competence plays an important role in supporting students' understanding of Islamic financial concepts and practices. Regarding Islamic finance, activities such as calculations, numerical data analysis, and rational decision-making are closely related to mathematical abilities, particularly numeracy and mathematical modeling. Theoretically, mathematical literacy involves not only procedural skills but also the ability to create, use, and understand mathematical concepts in practical situations [1]. These competencies serve as an essential foundation for understanding financial concepts, including Islamic finance, which requires comprehension of transactions, profit calculations, and financial decision-making in accordance with Islamic principles.

The positive effect of mathematical literacy on Islamic financial literacy may also be explained by the cognitive demands involved in understanding Islamic financial products and services. Unlike conventional financial literacy, Islamic financial literacy requires individuals not only to understand numerical and financial information but also to evaluate financial decisions in accordance with Sharia principles. For example, individuals need to compare profit-sharing schemes, estimate investment returns, understand financing contracts, and distinguish between permissible and non-permissible financial transactions. These tasks require the ability to interpret quantitative information, reason logically, and evaluate alternative decisions, competencies that align closely with the numeracy-driven dimensions of financial reasoning identified in prior literature [24]. Therefore, students with higher levels of mathematical literacy are likely to possess greater capacity to understand and apply Islamic financial concepts in practical situations.

This finding is consistent with previous studies demonstrating that mathematical and quantitative literacy are important determinants of financial literacy [24]–[27]. Gilliland et al. [26] reported that quantitative literacy is closely associated with individuals' financial understanding, while Skagerlund et al. [24] found that numeracy plays a significant role in shaping financial literacy and financial decision-making. Similarly, Acar [25] highlighted the contribution of mathematical literacy to positive financial outcomes among young people. Although these studies do not specifically address Islamic financial literacy, they suggest that mathematical ability is one of the key cognitive factors supporting general financial understanding. Furthermore, integrating Islamic financial concepts into mathematics learning through a contextual approach such as Mathematics-based Islamic Financial Literacy can strengthen the relationship between mathematical skills and Islamic financial understanding. This approach not only enhances arithmetic skills but also introduces Islamic economic principles such as contracts (akad), halal transactions, and Islamic financial planning [12], [28]. Thus, mathematical literacy can be regarded as an important cognitive prerequisite in the development of Islamic financial literacy, although its effectiveness is strongly influenced by learning contexts that integrate Islamic values and financial practices.

Although mathematical literacy significantly influenced Islamic financial literacy, the effect size was relatively modest, as reflected in the overall weak explanatory power of the model for this construct ($R^2 = 0.047, Q^2 = 0.025$). This suggests that mathematical literacy represents only one

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aspect of Islamic financial literacy development. Other factors such as religiosity, financial experience, family background, exposure to Islamic financial institutions, and socioeconomic characteristics may also contribute substantially to student [29], [30]. The relatively low explanatory power of the current model therefore suggests that Islamic financial literacy is a multidimensional construct that cannot be adequately explained by cognitive variables alone [19], [31], [32] and may additionally be shaped by financial socialization, money attitudes, and income-related factors reported in recent studies [33], [34]. Therefore, mathematical literacy should be viewed as an important cognitive foundation rather than the sole determinant of Islamic financial literacy.

From an educational perspective, this finding highlights the importance of integrating financial and Islamic economic contexts into mathematics instruction. Mathematics learning that is connected to authentic financial situations may help students recognize the practical relevance of mathematical concepts while simultaneously developing financial competencies [14]. Recent discussions also emphasize that mathematical knowledge alone is insufficient without contextual financial education and exposure to authentic financial practices [34], [35]. For students enrolled in Islamic economics programs, such integration may provide opportunities to strengthen both mathematical literacy and Islamic financial literacy, thereby supporting more informed and Sharia-compliant financial decision-making in their future personal and professional lives.

c. Effect of Problem-Solving Ability (PSA) on Islamic Financial Literacy (IFL)

The results revealed that problem-solving ability does not have a significant effect on Islamic financial literacy ($\beta = -0.094, t = 1.511, p = 0.131$). This finding suggests that mathematical problem-solving skills do not directly determine students' level of Islamic financial literacy. Theoretically, problem-solving ability involves higher-order cognitive processes such as reasoning, information analysis, and decision-making. However, Islamic financial literacy requires not only mathematical cognitive skills but also conceptual and normative understanding related to Islamic economic principles, such as contracts (akad), halal transactions, and Islamic financial ethics. The non-significant effect suggests that mathematical problem-solving ability is domain-specific and cannot be directly transferred to Islamic financial contexts without relevant contextual learning. This aligns with cognitive transfer theory, which posits that the transfer of cognitive skills across domains depends on the structural similarity between the source and target domains, as well as the presence of contextual alignment [15], [36].

It is worth noting that the path coefficient for this relationship was negative, although not statistically significant. This pattern may be attributable to the overlapping variance shared between problem-solving ability and mathematical literacy, given the strong direct effect of problem-solving ability on mathematical literacy ($\beta = 0.412$). When a substantial proportion of the predictive variance is already captured through the mediating path, the residual direct effect may shift in sign without carrying substantive meaning. This finding should therefore be interpreted with caution and warrants further verification in studies with larger and more diverse samples.

Another plausible explanation relates to the difference in measurement approaches between the two constructs. Problem-solving ability was measured through performance-based test items reflecting students' cognitive competence, whereas Islamic financial literacy was assessed using a self-reported Likert-scale questionnaire capturing knowledge, attitude, and behavior. This distinction parallels the broader literature on objective versus subjective measures of financial literacy, which similarly notes that performance-based assessments and self-reported measures do not always align, as self-reported measures may be influenced by confidence levels and self-perception rather than actual competence [4]. This methodological difference implies that problem-solving ability primarily reflects what students are capable of doing in a controlled testing context, while Islamic financial literacy reflects students' self-perceived knowledge and habitual financial

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behavior. The non-significant relationship may therefore partly stem from the conceptual distance between demonstrated cognitive ability and self-reported financial disposition, rather than indicating a complete absence of any underlying relationship between the two constructs. This interpretation is further supported by the effect size analysis, which showed that the influence of problem-solving ability on Islamic financial literacy was negligible ($f^2 = 0.008$). This finding indicates that problem-solving ability contributes very little to explaining variations in students' Islamic financial literacy. Consequently, factors that are more directly related to Islamic financial knowledge, attitudes, and behavior may play a substantially greater role than general mathematical competencies in shaping Islamic financial literacy outcomes.

This finding is in line with Indefenso and Yazon [3], who reported that although numeracy and problem-solving skills are related to general financial literacy, this relationship does not always hold in specific contexts such as Islamic financial literacy. In addition, Aisyah [37] found that Islamic financial literacy is more strongly influenced by financial knowledge and behavior rather than mathematical ability alone.

Taken together, these findings point to an important distinction between domain-general and domain-specific cognitive competencies. Previous literature suggests that cognitive skills developed in one domain do not automatically transfer to another domain unless meaningful contextual connections exist between them [21]. While problem-solving ability substantially enhances mathematical literacy as a domain-general quantitative competence, its influence does not automatically extend to a domain-specific construct such as Islamic financial literacy, which is embedded within normative and religious frameworks. This pattern suggests that cognitive skills developed through mathematics instruction remain confined to mathematical and quantitative reasoning unless deliberately extended through curricula that explicitly connect such reasoning to Islamic financial contexts.

Therefore, improving Islamic financial literacy requires a more comprehensive and contextual learning approach that goes beyond mathematical skills alone. For instance, courses such as Fiqh of Muamalah and Islamic Financial Institutions could be redesigned to incorporate quantitative case studies that require students to apply mathematical reasoning directly within Sharia-compliant financial scenarios, such as calculating profit-sharing ratios in mudharabah contracts or evaluating the cost-benefit structure of murabahah financing. Such integration may help bridge the gap between abstract mathematical competence and the normative, contextual knowledge required for Islamic financial decision-making.

Nevertheless, several studies have reported a more direct contribution of numeracy and problem-solving skills to financial literacy outcomes, particularly in conventional financial contexts where quantitative reasoning plays a dominant role in budgeting, saving, and investment decisions. The discrepancy between those findings and the present study may reflect the distinctive characteristics of Islamic financial literacy, which incorporates religious principles, ethical considerations, and behavioral dimensions beyond quantitative reasoning alone. Such inconsistencies across studies may arise from differences in the conceptualization and measurement of financial literacy, particularly between conventional financial literacy frameworks that emphasize financial calculation skills and Islamic financial literacy frameworks that additionally incorporate religious and ethical dimensions.

d. Effect of Problem-Solving Ability (PSA) on Islamic Financial Literacy (IFL) through Mathematical Literacy (ML)

This section examines the indirect effect of problem-solving ability on Islamic financial literacy through mathematical literacy as a mediating mechanism. The proposed mediation model was conceptually informed by cognitive transfer theory, which suggests that higher-order cognitive skills acquired in one domain may influence performance in another domain through intermediate

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competencies that share similar cognitive structures [38]. The mediation analysis revealed that mathematical literacy did not significantly mediate the relationship between problem-solving ability and Islamic financial literacy ($\beta = 0.098, t = 1.952, p = 0.052$). Although the indirect effect was positive, it did not reach the conventional 0.05 significance threshold. Nevertheless, the p-value of 0.052 indicates that the indirect effect was very close to statistical significance, suggesting that mathematical literacy may partially transmit the influence of problem-solving ability under different sample characteristics or model specifications.

This finding suggests that the cognitive pathway from problem-solving ability to Islamic financial literacy was not statistically supported through mathematical literacy in the present sample. From a theoretical perspective, as discussed in the preceding section, the transfer of cognitive skills across domains is not automatic. Building on this premise, the present mediation result suggests that mathematical literacy, despite functioning as a domain-general quantitative competence, did not emerge as a statistically supported bridging mechanism through which problem-solving ability could influence Islamic financial literacy [38].

In this study, although problem-solving ability enhances students' reasoning and strategic thinking in mathematical tasks, these skills do not necessarily transfer to Islamic financial decision-making contexts. Mathematical literacy, as conceptualized in the recent PISA framework, refers to the ability to formulate, employ, and interpret mathematics in real-world contexts [1]. However, its focus remains primarily on quantitative reasoning and does not inherently include financial, ethical, or religious domain knowledge required in Islamic financial literacy.

Islamic financial literacy itself is a multidimensional construct that integrates knowledge, skills, and behavioral competence in applying Islamic financial principles such as risk-sharing, contracts (akad), and Sharia-compliant transactions. Recent studies emphasize that financial literacy is not only cognitive but also behavioral and context-dependent [4], [39]. Although mathematical literacy significantly contributed to Islamic financial literacy, the present findings suggest that it was not sufficient to fully transmit the influence of problem-solving ability to Islamic financial literacy. This suggests that the transfer of mathematical competencies to Islamic financial literacy may be limited when mathematical reasoning is not accompanied by relevant financial and Islamic contextual knowledge, consistent with the view that cognitive transfer across domains requires structural and contextual alignment between source and target domains [38].

Financial literacy outcomes are more strongly influenced by financial knowledge and behavioral exposure than by mathematical ability alone, a finding that is consistent with evidence showing that while financial and mathematical knowledge are each associated with financial behavior, their combined presence tends to yield better financial outcomes than either one alone [35]. This interpretation is also supported by the relatively low coefficient of determination for Islamic financial literacy ($R^2 = 0.047$), indicating that substantial variation in Islamic financial literacy remains unexplained by the cognitive variables included in the model. As discussed in the preceding section regarding the effect of mathematical literacy on Islamic financial literacy, contextual integration approaches such as Mathematics-based Islamic Financial Literacy [12], [28] may help bridge this gap by embedding quantitative reasoning directly within Islamic financial contexts, thereby strengthening the transfer pathway that the present mediation analysis was unable to confirm.

Islamic financial literacy is a multidimensional construct that may also be influenced by contextual factors such as religiosity, financial experience, family financial socialization, and exposure to Islamic financial institutions [29], [34], [40]. The present study intentionally focused on cognitive competencies, particularly mathematical literacy and mathematical problem-solving ability, as predictors of Islamic financial literacy. Future studies are encouraged to integrate both cognitive and contextual factors to provide a more comprehensive explanation of Islamic financial

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literacy. Furthermore, because the present study employed a cross-sectional and non-experimental design, the findings should be interpreted as associations among constructs rather than definitive evidence of causal relationships. Longitudinal and experimental studies may provide stronger evidence regarding the causal mechanisms underlying the development of Islamic financial literacy.

4. Conclusion

This study concludes that mathematical problem-solving ability plays an important role in enhancing mathematical literacy, which in turn significantly contributes to Islamic financial literacy among Islamic Economics students. However, problem-solving ability did not exhibit either a significant direct effect or a significant indirect effect on Islamic financial literacy through mathematical literacy, suggesting that the contribution of problem-solving ability may not readily transfer to Islamic financial contexts without additional domain-specific knowledge and contextual support.

The findings further reveal that although mathematical literacy contributes positively to Islamic financial literacy, its explanatory power remains limited, as reflected in the relatively low R^2 value of the structural model. This suggests that Islamic financial literacy is a complex construct that cannot be fully explained by cognitive mathematical abilities alone.

In addition, the absence of a significant direct and mediated effect of problem-solving ability highlights that cognitive transfer from mathematical reasoning to Islamic financial contexts is not automatic. Instead, such transfer requires contextual alignment and domain-specific knowledge integration.

This study has several limitations that should be acknowledged. First, the cross-sectional design limits the ability to draw causal inferences from the observed relationships; the influence of problem-solving ability on mathematical literacy and Islamic financial literacy should therefore be interpreted as predictive rather than causal. Second, the sample was drawn exclusively from three Islamic universities in East Java, Indonesia, which may limit the generalizability of the findings to students in other regions or institutional contexts. Third, the use of different measurement approaches across constructs, namely performance-based tests for problem-solving ability and mathematical literacy versus a self-reported Likert-scale questionnaire for Islamic financial literacy, may have contributed to the relatively weak relationships observed between cognitive ability and Islamic financial literacy, as self-reported measures are susceptible to social desirability bias and may not fully reflect actual financial behavior.

Future research is recommended to address these limitations in several ways. Longitudinal or experimental designs could be employed to better establish the causal pathways between mathematical competencies and Islamic financial literacy over time. Expanding the sample to include students from a wider range of regions and institutions, including non-Islamic universities, would allow for more robust generalization and potential comparison across institutional contexts. In addition, future studies should consider incorporating additional predictors of Islamic financial literacy that were not included in the present model, such as religiosity, financial experience, family financial socialization, and exposure to Islamic financial institutions, given the relatively low explanatory power of the cognitive variables examined in this study. Finally, future research may also benefit from using performance-based or behavioral measures of Islamic financial literacy, in addition to self-reported instruments, to provide a more comprehensive and objective assessment of students' actual financial competence.

Consistent with prior research, the results suggest that financial literacy outcomes are more strongly influenced by financial knowledge and behavioral exposure than by mathematical ability

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alone [41]. Therefore, the development of Islamic financial literacy should emphasize instructional approaches that integrate mathematical reasoning with Islamic financial concepts and real-life financial practices. Such an approach is expected to bridge the gap between abstract mathematical competence and practical financial behavior in Islamic contexts.

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