

MATHEMATICAL LITERACY IN ISLAMIC INHERITANCE DISTRIBUTION: FOCUSING IN FRACTIONAL CONCEPTS

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Abstract :

This mixed-methods diagnostic survey mapped mathematical literacy competencies in Islamic inheritance distribution systems, specifically examining fraction concept application among 36 PGMI students at STIT Muhammadiyah Tempurejo Ngawi who had completed Basic Mathematics MI/SD courses. Data collection utilized a 25-item diagnostic test and clinical interviews, with analysis combining descriptive statistics and Newman's Error Analysis (NEA). Findings revealed: (1) 61% of respondents solved basic fractional calculations in simple inheritance cases; (2) 19% resolved complex cases requiring share adjustments; (3) significant competency gaps existed in heirs identification (58%) and fractional operations (33%). Qualitative analysis identified 72% of students experienced difficulties integrating jurisprudential inheritance rules with mathematical procedures. The study recommends three curricular improvements: (a) strengthening foundational understanding, (b) enhancing contextual fraction operation skills, and (c) embedding authentic inheritance case studies. This provides the first comprehensive baseline profile of Islamic inheritance mathematics literacy among PGMI students and informs Sharia-contextualized curriculum development at STIT Muhammadiyah Tempurejo Ngawi.

Kata Kunci: *Mathematical Literacy; Islamic Inheritance Distribution; Fractional Concept*

Abstrak :

Penelitian ini merupakan survey yang memetakan kemampuan literasi matematis dalam penerapan sistem pembagian warisan dalam Islam dan terfokus pada penerapan konsep bilangan pecahan. Penelitian ini melibatkan 36 mahasiswa PGMI yang telah menempuh mata kuliah matematika dasar MI/SD di STIT Muhammadiyah Tempurejo Ngawi sebagai responden. Penelitian ini merupakan survei campuran (mixed-method) dengan instrumen tes diagnostik sebanyak 25 butir dan wawancara klinis. Analisis data mengombinasikan antara statistik deskriptif dan analisis kesalahan Newman. Hasil survei menunjukkan hasil bahwa: 1) 61% responden mampu menyelesaikan perhitungan dasar pecahan dalam kasus pembagian waris sederhana; 2) 19% mahasiswa mampu menyelesaikan kasus kompleks penyesuaian bagian waris; 3) terdapat kesenjangan signifikan dalam identifikasi ahli waris sebanyak 58% dan operasi hitung bilangan pecahan sebanyak 33%. Temuan kualitatif menunjukkan 72% mahasiswa masih mengalami kesulitan mengintegrasikan ketentuan pembagian warisan dengan perhitungan matematis. Simpulan survei menyoroti tiga kebutuhan yang perlu dijadikan bahan pertimbangan untuk perbaikan mata kuliah selanjutnya, yaitu: (a) penguatan pemahaman dasar, (b) peningkatan keterampilan operasi pecahan kontekstual, dan (c) integrasi contoh kasus waris nyata dalam pembelajaran. Data hasil survei ini memberikan peta komprehensif pertama tentang kemampuan aktual mahasiswa PGMI dalam matematika waris Islam, sekaligus menjadi dasar kebijakan dalam pengembangan kurikulum berbasis konteks keislaman di STIT Muhammadiyah Tempurejo Ngawi

Kata Kunci: Literasi Matematis; Waris Islam; Bilangan Pecahan

INTRODUCTION

Mathematical literacy is the ability of individuals to formulate, use, and be able to interpret mathematics in a variety of contexts. Mathematical literacy is crucial in understanding and solving various daily problems (Purwanto et al., 2023). Mathematical literacy is not only limited to the ability to perform basic calculations, but also includes a deep understanding of concepts, the ability to apply that knowledge in a real context, and perform mathematical reasoning (Nurmasari et al., 2024). The importance of understanding these concepts is essential because failure to master basic mathematical concepts, including fractions, can have a significant impact on students' ability to solve more complex problems (Safitri et al., 2019)(Lusyana et al., 2024). Many studies show that students' difficulties in mathematics are often rooted in a lack of conceptual understanding, not just procedural skills, which hinders their ability to address contextual problems and practical applications (Wakit, 2023).

In this study, the researcher tried on the domain of religion such as the division of Islamic heritage due to the application of fractional numbers in real life. In this context, the division of inheritance in Islam, known as the science of *faraidh*, inherently involves mathematical concepts, especially the operation of counting fractional numbers, to ensure a fair distribution according to the sharia. When associated with ethnomathematics, the integration of mathematics with religious culture and practice (D'Ambrosio, 2016), such as the division of Islamic heritage, highlights the need for mathematical literacy that goes beyond standard algorithms to include an understanding of structures and relationships between concepts (Harianti, 2017). This indicates that logical, analytical, systematic, critical, and creative thinking skills, which are an integral part of mathematical skills, are needed to interpret and apply sharia principles into proper mathematical formulas (Faulina & Andriyani, 2020). Therefore, mastery of mathematical literacy is crucial to ensure accuracy and fairness in the implementation of Islamic inheritance law, where any miscalculation can have implications for sharia and social aspects (Sari et al., 2022). This ability not only has an impact on the accuracy of inheritance distribution, but also fosters the ability to reason in individuals (Al Musthafa & Mandailina, 2018).

This fact shows a very high relevance between mathematics, especially fractional number operations and inheritance, but studies that explicitly

examine the level of mathematical literacy of students, especially in the context of the application of the concept of fractions to the division of Islamic inheritance, are still limited. This phenomenon creates a significant research gap, given the importance of understanding mathematics as a basis for various disciplines and its ability to practice analysis and find logical relationships (Azis et al., 2022). In addition, low mathematical literacy in Indonesia in general is an issue that is constantly highlighted, affecting various levels of education and individual abilities in solving complex problems (Sulfayanti, 2023). For example, PISA results show that the average mathematical literacy scores of Indonesian students are consistently below the international average, indicating serious challenges in mastering basic mathematics concepts (Salsabilah et al., 2023).

This situation is exacerbated by the fact that mathematics learning in many institutions has not optimally improved students' thinking skills and understanding of meaningful concepts, so it often feels less relevant to real life (Lestari & Putri, 2020)(Murti, 2023). This gap between theory and practical application becomes more pronounced when confronted with specific material such as the division of Islamic heritage, which demands the integration of sharia understanding with the accuracy of mathematical calculations (Firdiana et al., 2022). This condition highlights the need to investigate empirically the extent to which students are able to apply the concept of fractions in the context of the division of Islamic heritage, identify specific areas of difficulty, and develop more effective learning strategies.

This study seeks to fill this gap by initially mapping the mathematical literacy ability of PGMI STIT Muhammadiyah Tempurejo Ngawi students in the context of the distribution of Islamic heritage, especially related to the concept of fractions, as well as identifying factors that affect their understanding. In particular, this study will identify gaps between conceptual understanding and students' procedural fluency in solving inheritance distribution problems involving fractions, as well as explore challenges in integrating sharia provisions with mathematical calculations (Firdiana et al., 2022). This research will also serve as an important foundation for the development of a more relevant and contextual curriculum, particularly in Islamic educational institutions, in order to bridge the gap between mathematical theory and its application in everyday religious practice. Therefore, this study is very relevant in an effort to improve students'

contextual mathematical literacy, especially in the realm of Islamic ethnomathematics which is still rarely explored in depth.

RESEARCH METHOD

This study adopts a mixed-methods approach with a survey design to map the mathematical literacy skills of PGMI students in the context of the division of Islamic heritage, especially related to the concept of fractions. This approach was chosen to gain a holistic understanding through a combination of quantitative and qualitative data, so as to identify common patterns and explore the reasons behind the phenomena found. This mixed survey design allows researchers to collect numerical data on ability levels and correlate them with students' subjective views and experiences through clinical interviews, thus providing a richer picture and deeper nuances of their mathematical literacy challenges in this specific context (Chu & Chang, 2017; Lenz et al., 2020).

The study involved 36 PGMI students from STIT Muhammadiyah Tempurejo Ngawi who had taken the basic mathematics course for MI/SD as respondents, selected purposively to ensure relevance to the focus of the research. The use of a 25-item diagnostic test instrument and clinical interviews allows for in-depth data collection regarding the understanding of concepts and application skills, in line with an action research methodology that emphasizes observation and analysis.

The data collected from the two instruments were analyzed using a convergent mixed-methods design, where quantitative and qualitative data were treated equally and integrated during the interpretation phase. The quantitative data from the diagnostic test were analyzed using descriptive statistics (mean, percentage, frequency distribution) to determine the overall profile of students' mathematical literacy skills and the prevalence of errors based on Newman's indicators (see Table 1). Concurrently, the qualitative data from clinical interviews were transcribed and thematically coded using the same Newman error categories to capture students' reasoning, misconceptions, and procedural difficulties.

Integration was achieved through joint display analysis and meta-inference. First, each student's test responses (quantitative) were matched with their interview excerpts (qualitative) to create a side-by-side comparison. Second, error patterns identified statistically (e.g., 60% of students made

transformation errors) were explained and triangulated with narrative evidence from interviews (e.g., students' inability to convert Islamic inheritance scenarios into fraction operations). This process allowed the researcher to confirm, contradict, or enrich quantitative findings with qualitative insights. For example, where descriptive statistics showed high reading errors, interviews revealed that students misread terms like "*ashabah*" (residuary) as numerical values—a finding that deepens the quantitative result. Thus, the integration produces a comprehensive understanding not only of *how many* students struggle, but *why* they struggle in the context of Islamic heritage fractions.

Table. 1 Newman Indicator

No	Indicators	Description
1	Reading	Errors in reading the mathematical words, terms, and symbolizations presented in the problem
2	Comprehension	Mistakes in grasping and understanding the meaning of the question
3	Transformation	Mistakes in turning story problems into mathematical models and calculation operations
4	Process Skills	Errors in the steps or processors in solving the problem
5	Final Answer Writing (Encoding)	Errors in writing the results of the completion

FINDINGS AND DISCUSSION

The research was conducted on 36 PGMI students using fraction-based story problems integrated with the context of Islamic inheritance distribution (*faraidh*). The findings are organized into three parts: (1) basic fraction concept understanding, (2) the gap between procedural computation and application in *faraidh* contexts, and (3) Newman error analysis with integrated quantitative-qualitative interpretation.

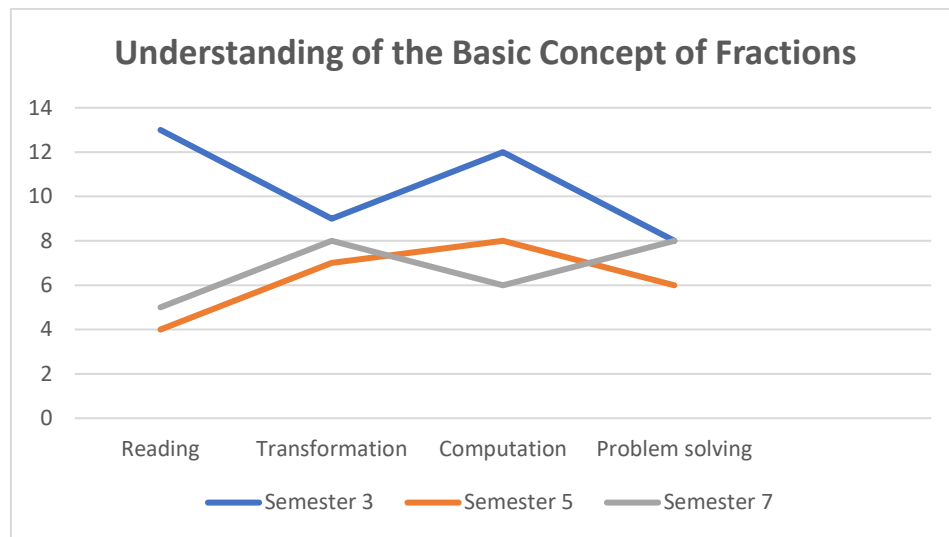


Figure 1. Findings on the Understanding of the Basic Concept of Fractions

The results of the respondents' analysis are as seen in Figure 1. Analysis of the presented images, it can be seen that the understanding of the concept of fractional numbers is measured through four main indicators, namely the ability to read numbers/simplify, calculation operations, and problem-solving. The data was compared across three levels of education (Semesters 3, 5, and 7), which showed the gradual development of students' understanding. The bar graph reveals significant variations in achievement in each indicator in each semester, with the ability to read and simplify fractions dominating the highest achievements, while problem-solving shows the lowest level in the final semester.

In particular, the graph indicates that although procedural skills such as reading and simplifying fractions can be mastered well even at the initial level (Semester 3), high-level thinking skills such as problem-solving stagnate or even decline in the higher semester (Semester 7). This highlights the gap between mastery of basic concepts and their application in complex contexts. These findings hint at the importance of a learning approach that emphasizes not only technical skills, but also on the development of mathematical reasoning and the application of concepts in real-world problems.

After analyzing the aspect of the ability of the fraction concept, the next finding was related to the results of respondents solving fractional problems that were integrated with the division of inheritance. Figure 2 is the data from the research results.

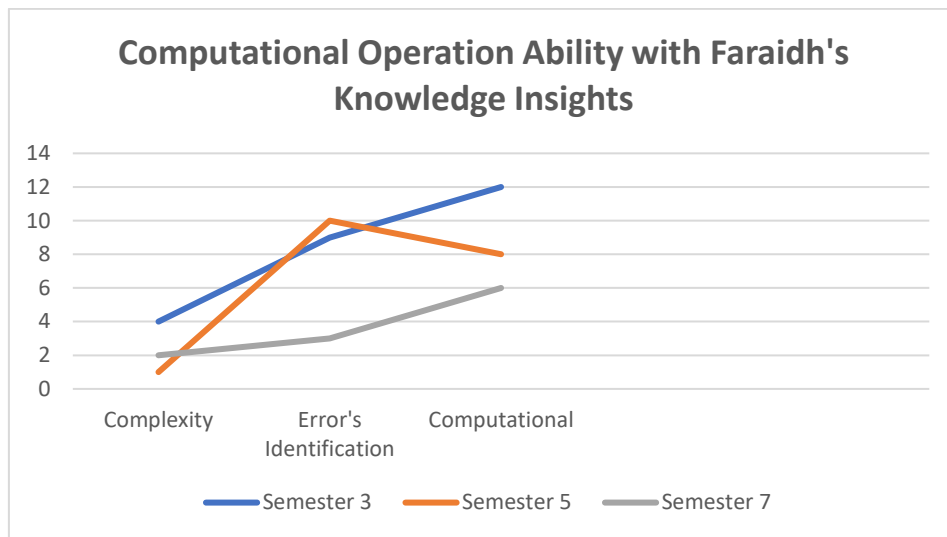


Figure 2. Findings of the Gap in Computational Operation Ability with Faraidh's Knowledge Insights

Based on data analysis from 36 respondents, it was revealed that the majority of students, namely 22 people (61.1%), had mastered basic competencies in completing fraction counting operations procedurally. This shows an adequate understanding of fractional number manipulation in a purely mathematical context. However, when this ability was tested in complex cases that simulated authentic faraidh problems, only 7 students (19.4%) managed to solve it. This finding consistent with the core of the problem as identified by Purwanto (Purwanto et al., 2023) is that true mathematical literacy goes far beyond getting the right answer on worksheet. These findings indicate a significant gap between the mastery of the technical skills of computational operations and the ability to apply them to solve integrated problems that require in-depth analysis, mathematical modeling, and contextual interpretation.

On the other hand, the analysis also identifies fundamental weaknesses at the earliest stage in the resolution of the faraidh problem. A total of 21 students (58.3%) made mistakes in identifying the inheritance recipients and their share of rights. Mistakes at this stage are fatal because they result in subsequent calculations, even if the student is proficient in fraction operations. This data confirms that the main obstacle lies not in the ability to calculate, but in the conceptual understanding of Islamic inheritance law (faraidh science) itself. Implicitly, the integration between mathematics and faraidh in learning requires a greater emphasis on the construction of a systematic framework of

thinking for analyzing kinship and legal relationships, before entering the numerical computing stage.

After analyzing the data of the research findings, let's analyze the results of students' answers using Newman's Theory with categories as shown in Table 1.

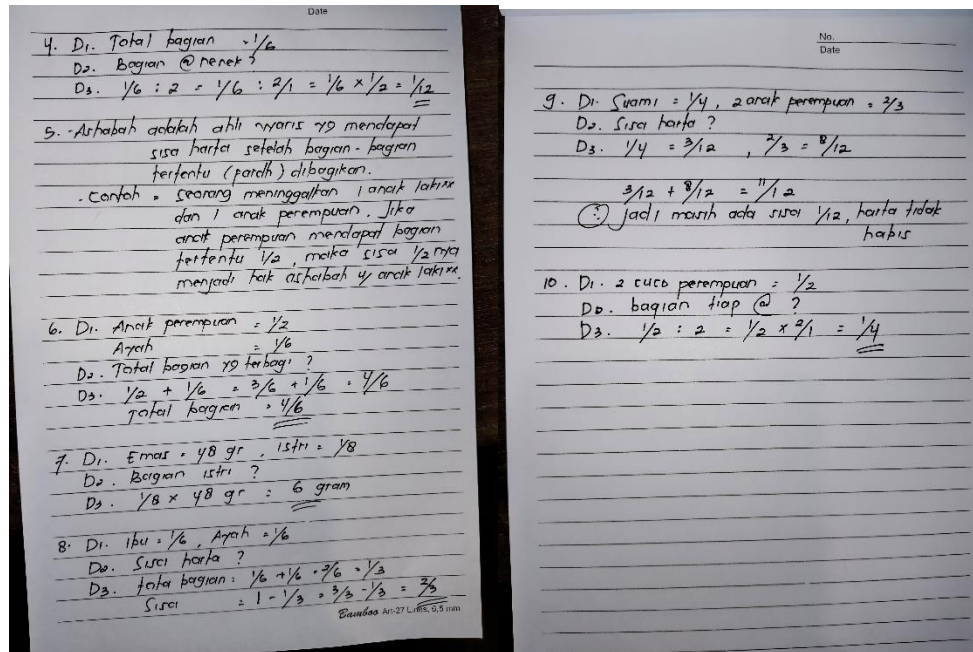


Figure 3. Student Answers

Based on the application of Newman's theory in analyzing student answers, it was identified that students' problem-solving abilities showed significant variations at each stage. At the reading and comprehension stages, students showed consistency in identifying essential information in questions 1, 2, 3, 5, 9, and 10, such as determining the share of heirs and the context of property distribution. However, there are systematic weaknesses in questions number 4, 6, 7, and 8, where students make mistakes in interpreting fractional values—such as writing $\frac{1}{2}$ as the father's part when it should be $\frac{1}{6}$ —which indicates a lack of accuracy in reading the questions. In the transformation stage, students are able to convert contextual problems into the form of appropriate mathematical operations when the input value is correct, but misreading leads to failure to build an accurate mathematical model.

At the stage of process skills and answer writing (encoding), students demonstrate competence in fractional operations such as addition, subtraction, and simplification of fractions with common denominators in questions with the right initial data (questions 1, 2, 3, and 9). However, in question 10, a

procedural error was found in the transformation of notation – such as writing $1/2 \times 2/1$ instead of $1/2 \times 1/2$ —even though the final result was correct, reflecting inconsistencies in the algorithm implementation. From the perspective of fractional knowledge and mathematical literacy, these findings reveal that students have an adequate conceptual understanding of fractions and their application in inheritance law, including the ability to explain the concept of 'ashabah precisely. However, the lack of accuracy in reading and transforming the questions results in a series of errors in the calculation results, especially in multistep problems. Implicitly, reinforcement in reading accuracy, procedural training of fractional operations, and improved encoding clarity are needed to minimize errors in the answer output.

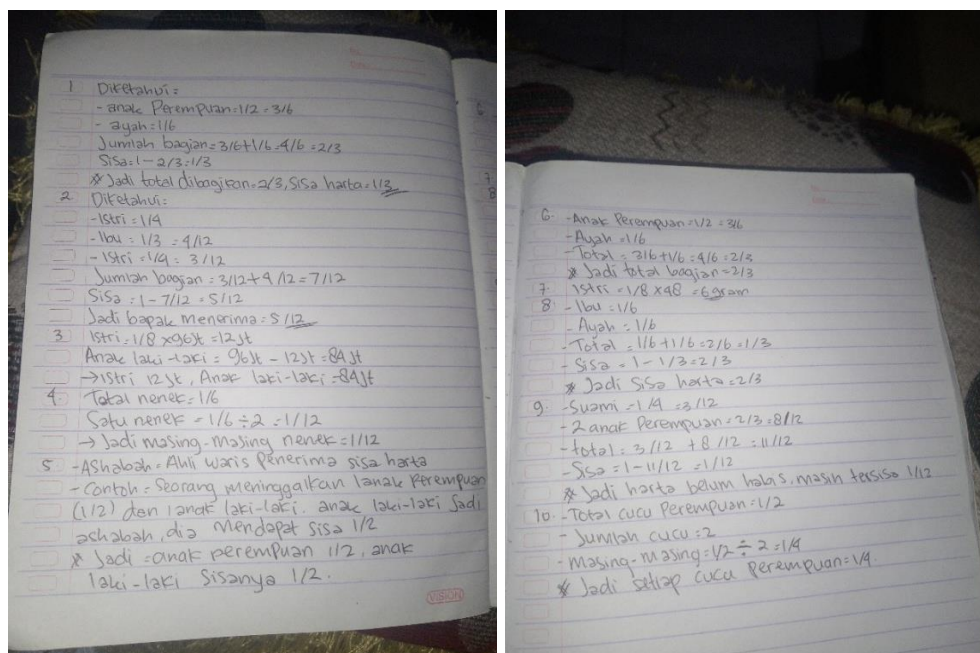


Figure 4. Student Outcomes

Based on the analysis using Newman's theory on students' answers to questions 1 to 5, it can be identified that students in general have an adequate understanding in solving the problem of fractional distribution of inheritance. At the reading and comprehension stages, students are able to interpret the information about the question precisely, such as determining the share of each heir and the context of the distribution of property. In the transformation stage, students successfully convert problems into relevant mathematical operations, such as converting fractions to common denominators and applying addition, subtraction, and fraction division operations. In the process skills stage, students demonstrate accurate computing skills, such as calculating the total parts, remaining assets, and proportional distribution of parts. However, there

are some minor errors in notation writing that indicate the need for improvement in encoding accuracy.

From the perspective of fractional knowledge and mathematical literacy, students demonstrate a solid mastery of fractional concepts, including fractional simplification, arithmetic operations, and applications in real-world contexts such as inheritance law. Students are also able to explain the concept of *ashabah* with the right examples, showing good mathematical literacy in connecting abstract concepts with practical situations. Overall, the students' performance in these questions was relatively good with a few weaknesses in the writing aspect that did not affect the veracity of the results substantively.

CONCLUSION

This research reveals that although the majority of PGMI STIT Muhammadiyah Tempurejo Ngawi students have mastered basic procedural skills in fractional operations, they experience significant difficulties in applying the concept in the context of the complex division of Islamic heritage. Only 19.4% of students were able to resolve inheritance cases that required section adjustments, while 58.3% experienced errors in identifying their respective heirs and shares. Qualitative analysis with Newman's theory shows that errors occur most in the reading and transformation stages, resulting in a series of errors in calculations. This study emphasizes the importance of a learning approach that integrates a conceptual understanding of Islamic inheritance law with mathematical skills, as well as the need to strengthen a contextual and case-based curriculum to improve students' mathematical literacy in the context of Islamic ethnomathematics. Thus, this research contributes a concrete evidence-based framework for designing an integrated mathematics-faraidh curriculum that embeds Islamic ethnomathematics into teacher education, thereby advancing the development of Islamic mathematical literacy as both a pedagogical goal and a culturally responsive assessment model.

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