



Students' Mathematical Literacy Ability on Social Arithmetic Integrated with Islamic Contexts

Ellianti¹, Dewi Annisa^{1*}, Bintang Zaura¹, Erni Maidiyah¹, Suryawati¹, Putri Cunda Resti², and Nisa Sidratun²

¹ Department of Mathematics Education, Universitas Syiah Kuala, Banda Aceh, Indonesia

² Student of Mathematics Education, Universitas Syiah Kuala, Banda Aceh, Indonesia
dewiannisa@usk.ac.id

Abstract. Integrating Islamic context into mathematics problems provides a training stimulus for mathematical literacy through religion-based knowledge. This study aims to determine mathematical literacy ability and student responses to social arithmetic integrated with Islamic context. The study has a descriptive qualitative design and the subjects are 8th-grade students from a Junior High School in Banda Aceh. Data were collected through Islamic context-integrated mathematical literacy assessments adapted from PISA questions and interviews. Miles and Huberman's procedure, entailing data reduction, data display, and conclusion drawing, was used for data analysis. The findings indicated that students possessed mathematical literacy skills at levels 1 to 3. At levels 1 and 2, students demonstrated the ability to solve problems within familiar contexts, utilizing basic mathematical procedures. At level 3, students can solve problems by choosing the correct solution strategy. The interview results found that the integration of Islamic contexts was greeted positively by students. This can be seen in students' ability to appreciate the excellence of mathematics and recognize it as an important subject to learn because it is needed in solving the problem, including religious issues.

Keywords: Islamic Context, Mathematical Literacy, PISA.

1 INTRODUCTION

Mathematical literacy is the ability of an individual to formulate, use and interpret mathematical concepts across real-life situations. This involves reasoning skills that facilitate solving and predicting real phenomena by using concepts, procedures, facts, tools and symbols [1]. A person with mathematical literacy can proficiently use applicable mathematical methods to tackle real-life problems [2]. This explains that possessing mathematical literacy will aid individuals in comprehending and managing situations that arise in daily life more effectively [3].

The quality of national education has not fulfilled the importance of possessing good mathematical literacy abilities. Evidence supporting this can be found in the Programme for International Student Assessment (PISA) survey, which is an international student literacy assessment program. The 2018 PISA survey ranks Indonesia 73rd out of 79th participating countries in mathematics, with an average score of 379 compared to the OECD average of 489 [1]. This is corroborated by earlier research [4] indicating low mathematical literacy abilities among Indonesian students.

© The Author(s) 2024

R. Johar et al. (eds.), *Proceedings of the 2nd Annual International Conference on Mathematics, Science and Technology Education (2nd AICMSTE)*, Advances in Social Science, Education and Humanities Research 828, https://doi.org/10.2991/978-2-38476-216-3_15

This corresponds with the findings of Annisah's study [5], indicating that learners struggle with comprehending mathematics-based word problems and are unable to solve them autonomously. The absence of critical thinking skills impedes their ability to identify the appropriate principles to apply in overcoming the obstacles they encounter.

Following initial interviews with mathematics teachers at a Junior High School in Banda Aceh, it emerged that most students were unfamiliar with solving problems that were outside of their learning scope. Consequently, students have not been able to achieve self-reliance while arriving at problem-solving solutions. This can be attributed to the school curriculum that lays emphasis solely on procedural aspects instead of focusing on the problem-solving process. Limited mathematical literacy among students may arise from memorizing formulas without a proper understanding of applying them in a contextual problem-solving setting. This may impede their ability to employ critical thinking and mathematical reasoning in finding solutions to complete problems.

This issue appears to persist due to a tendency to focus on trivial problems that do not require logical or practical solutions [6-7]. Therefore, students' ability to reason and think critically when solving mathematical problems may be hindered. Negative perceptions of mathematics among students can further exacerbate low ability levels, particularly among those with educational backgrounds [8]. Furthermore, students often fail to recognise the potential advantages and practical applications of mathematics in daily life, including religious matters. Therefore, it is essential to introduce students to literacy-focused or contextual problem-solving activities that directly relate to their daily lives.

The habituation of literacy-based questions among students can take the form of practice exercises or as a learning evaluation tool. By introducing literacy-based math problems, learners can hone their capacity to think critically and creatively, sharpen their reasoning abilities, communication skills, and the capacity to generate suitable strategies while problem-solving. This assertion is supported by several studies [1, 6, 9]. Most of the problems presented by PISA relate to real-world situations or everyday contexts. This approach enables students to better understand and appreciate the practical benefits of mathematics.

Contextual understanding is a crucial aspect of mathematical literacy, as outlined in the PISA 2022 framework [10]. According to the KBBI [11], context refers to the background or circumstances surrounding a given problem. As a country with a majority of Muslims, it is possible to use contexts that integrate Islamic values for learning. The integration of Islamic values in the teaching of mathematics provides benefits for students [12]. Additionally, learning mathematics while integrated with Islamic contexts can facilitate the acquisition of knowledge and behavior in accordance with Islamic teachings, thereby fostering positive character, motivation, and good thinking [13-14]. When students perceive the advantages of the challenges or learning opportunities presented, this can greatly motivate them to apply the gained knowledge in practical applications [15].

Social arithmetic [16] is a mathematical subject that cannot be separated from human life. It is a branch of science dedicated to studying common economic activities involving sales, purchases, prices, profits, and losses. Islamic law, Sharia, provides a clear framework for economic activities. Trade, agriculture, and industry have all

developed since the time of Prophet Muhammad and the Caliphs, a process continuing to this day. Therefore, mathematical concepts will always be required to solve problems relating to economics.

Research carried out by Nizar, Putri, and Septy [6] developed PISA-style questions incorporating Islamic contexts in algebraic form materials with the concept of zakat. The resulting mathematical literacy abilities included mathematical communication skills, problem-solving strategies, representation skills, and mathematization skills. Research conducted by Imamuddin, Musril, and Isnaniah (2017), which integrates an Islamic context into the teaching of integer subjects, has found that the developed questions are able to motivate students, provide significant benefits in shaping their positive character with Islamic values, and improve their mathematical literacy ability.

Recognizing the importance of mathematical literacy, collaborative interventions are needed to improve it. Examining different techniques to create a learning environment that is relevant and appropriate to students' lives is one of them. This study aims to determine students' mathematical literacy in social arithmetic by integrating topics related to Islamic contexts, which is expected to be the first step in maximizing students' mathematical literacy abilities.

2 RESEARCH METHODS

The present research employs a descriptive qualitative approach, which generates written descriptions of the subjects' experiences [18]. The research sample consists of 15 eighth-grade students from a junior high school in Banda Aceh, out of a total of 19 students. The selection of research subjects was based on careful consideration, as the subjects are students from *Tahfidzul* Quran-based schools (memorizing the Qur'an) who also study mathematics in their school curriculum.

Data was collected for this research through the use of test and interview techniques. Each research subject participated in a mathematical literacy test, which consisted of three descriptive questions adapted from PISA and integrated with Islamic context. Following the test, one subject per level of mathematical literacy ability (high, medium, and low) was selected for an interview. The semi-structured interviews conducted in this study have questions that are prepared based on mathematical literacy indicators and other questions that are adapted to obtain more in-depth information. The classification of mathematical literacy levels is determined by the mathematical literacy indicators utilized by PISA, specifically, the capacity to formulate, employ and interpret mathematics [1, 10]. The table 1 outlines the literacy indicators used in the study:

Table 1. Mathematics Literacy Indicator

Cognitive Level	Indicator
Formulate	● Identify and describe the mathematical aspects of a real-world problem situation including identifying the significant variables.
Employ	● Select an appropriate strategy from a list.
	● Implement a given strategy to determine a mathematical solution.
Interpret	● Interpret a mathematical result back into the real world context

Source [10]

Table 1 showed the PISA mathematical literacy indicators. It will be used as a guide for assessing students' mathematical literacy and as a guide for preparing the questions to be used during interviews. After this stage, the data analysis procedure proposed by Miles & Huberman [19] was used, which includes data reduction, data display, and drawing conclusions. To strengthen the credibility and validity of research finding, qualitative research needs to be triangulated [31]. In this study, triangulation compared research subjects' interview responses with test results to verify the data. Table 2 in the following is an outline of the content of the test questions to assess mathematical literacy related to the topic of social arithmetic integrated with the Islamic context tested:

Table 2. Content Outline of Test Questions

Question Number	Level	Math Topics	Islamic Context
1	2	Social Arithmetic	Mukhabarah
2	3		Shadaqah
3	4		Zakat

3 RESULTS AND DISCUSSION

The subsequent sections depict the data on the mathematical literacy ability of students and provide additional explanations as present at table 3.

Table 3. Recapitulation of the achievement of mathematical literacy indicators

Ability Level	SC	1			2			3		
		Idc 1	Idc 2	Idc 3	Idc 1	Idc 2	Idc 3	Idc 1	Idc 2	Idc 3
High	S6	√	√	√	√	√	√	√	-	-
	S9	√	√	√	√	√	-	√	-	-
	S8	√	√	√	√	√	√	-	-	-
Medium	S11	√	-	-	√	√	-	√	-	-
	S2	√	√	-	-	√	-	√	-	-
	S12	√	√	√	√	√	-	-	-	-
	S13	√	√	√	√	√	-	-	-	-
	S14	√	√	-	√	-	-	-	-	-
	S15	√	√	-	√	-	-	-	-	-
	S4	-	√	-	√	√	-	-	-	-
Low	S5	√	√	-	-	-	-	-	-	-
	S7	√	√	-	-	-	-	-	-	-
	S10	√	√	-	-	-	-	-	-	-
	S1	√	√	-	-	-	-	-	-	-
	S3	√	-	-	√	-	-	-	-	-

Table 3 showed that the test results of students' mathematical literacy ability using questions adapted from PISA and integrated with Islamic contexts reveal that 2 students possess high abilities, 5 students hold medium abilities, and 8 students exhibit low abilities. These results hint at the majority of students in the school possessing inadequate mathematical literacy proficiency. The outcomes align with previous research [20], which highlights low mathematical ability.

In the formulate indicator, the majority of students were able to create mathematical problems by identifying the known information and the problem requirements. This was exemplified by several students who consistently recorded the necessary information to construct a mathematical model of the problem. However, some students have not achieved this indicator as they have not fully comprehended the given problem, leading to incomplete information. This aligns with prior research indicating that students struggle to convert practical problems into mathematical form, leading to a lack of mastery in formulating indicators. The root cause lies in the majority of students not fully comprehending the problem's meaning [21-22].

In the employ indicator, students understand and use formulas that have been previously learnt. Students still find it difficult to understand and apply formulas to the mathematical problems given. This is because students are used to working on routine problems and find it difficult when faced with problems that require reasoning. Students are not familiar with problems that require problem solving with logical reasoning and solutions [6-7]. Therefore, students still need to be trained to solve problems that are not just the application of formulas, but how students can understand concepts, procedures, facts, and use reasoning well.

The interpretation indicator is an important benchmark in mathematical literacy. Students' ability in this indicator is expected so that students are not only able to understand mathematics in the form of numbers, but train students to communicate and explain the descriptions found in the calculation process. In this study, it was found that most students had not written back the results of their findings. Students only write the solution in the form of numbers. This is in line with previous research which said that

some students have difficulty in interpreting or making inferences from mathematical problems back to real- world contexts [21].

The difficulties experienced by students are due to students being confused when faced with questions that require analysis to extract the right information, different from the questions that are usually done in the classroom. practicing previous problems. This is related to research which reveals that students are not familiar with problems that require problem solving with logical reasoning and applicative solutions [21-22]. Therefore, students still need to be trained to solve problems that are not just the application of formulas, but how students can understand concepts, procedures, facts, and use reasoning well. This is related with previous research which found that the cause of student errors in solving problems with PISA characteristics is students' low reasoning ability and creativity in solving problems with real contexts [23].

Furthermore, interviews were conducted to discover the responses and opinions of students regarding the mathematical literacy test questions, which were integrated with Islamic contexts. The following transcript presents the conclusion of the interview results.

P : Have you previously given a problem like this?

S : Never, Miss

P : Do you think this question is difficult or very easy?

S : Tend to be challenging. The solution cannot be attained directly and necessitates prior analysis.

P : I See. Can you reflect on the advantages of studying mathematics from your experience working on and comprehending these issues? Could you describe what it was like?

S : Yes, Mathematics can assist in computing zakat and crop yields and determining profit or loss from commercial transactions, ensuring fairness and avoiding deception.

P : That is correct, to ensure fair trade and avoid deception for both the buyer and the seller. Moreover, it can facilitate the calculation of inheritance sharing and additional matters.

S : Yes, Miss.

P : Do you appreciate questions and learning being linked to Islamic values or contexts?

S : Yes, I appreciate Islam-related lessons for their ease of learning. This is due to the presence of a specific study programme at school, such as *zakat*, Miss.

P : That's it. *Alhamdulillah* (thank God), glad to hear it.

Based on the outcome of student interviews, it is evident that students respond well to test questions embedding Islamic contexts. However, they encounter difficulties solving them since they are unaccustomed to operating with this model. Besides, students find mathematics useful and motivating as they can directly see its application in their daily lives.

An individual with proficient mathematical literacy will be able to utilize their mathematical expertise to solve problems encountered in diverse real-life problems [3]. Sufficient mathematical literacy is of great importance. Insufficient mathematical literacy restrains students' ability to reason, argue and innovate, rendering it challenging to resolve mathematical problems in day-to-day existence [24]. One way to enhance

students' mathematical literacy is by introducing them to literacy-based problems, as seen in PISA assessments. Additionally, presenting mathematical problems relevant to students' lives can effectively demonstrate the practical significance and advantages of mathematics.

The integration of Islamic contexts into education represents a promising strategy for improving students' mathematical literacy and reversing the decline of the ummah [6, 17, 25]. The integration of Islamic context in education has the potential to not only enhance mathematical proficiency and academic performance of students, but also develop a positive character, increase their motivation and interest in learning mathematics, and improve the subject's perception [25-27]. This marks a promising initiative towards enhancing the mathematical literacy of students. In previous research, it was discovered that improving mathematical literacy questions within Islamic contexts can have a positive impact, fostering the development of mathematical literacy abilities such as communication, representation, problem solving, and mathematization skills [6].

4 CONCLUSION

The study indicated that 8th grade students at a Junior High School in Banda Aceh had mathematical literacy skills at levels 1 to 3. At levels 1 and 2, students can solve problems whose context is the same as their knowledge and use simple mathematical operations; at level 3, students can solve problems by choosing the correct solution strategy. It was observed that the integration of Islamic context had an encouraging impact on the students' performance. It is seen from the interview results that the students recognize the advantages of mathematics and regard it as a crucial subject to acquire as it presents solutions for various issues, including those of a religious one.

The study's findings indicate that only a minority of students met the criteria for achieving mathematical literacy indicators. The majority were only capable of solving problems by identifying mathematical aspects, and only a minority could design strategies or create models, apply model designs and reinterpret mathematical problems in real-world contexts.

References

1. OECD. "PISA 2018 Assessment and Analytical Framework," OECD Publishing. Paris. 2019, doi: 10.1787/b25efab8-en
2. R. H. N. Sari. "Literasi matematika: apa, mengapa dan bagaimana?," Seminar Nasional Matematika dan Pendidikan Matematika UNY 2015, pp. 713-720, 2015.
3. Y. Ding. "How do students' mathematics self-efficacy, mathematics self-concept and mathematics anxiety influence mathematical literacy?-a comparison between Shanghai-China and Sweden in PISA 2012," [Thesis, University Of Gothenburg], Swedan. 2016.
4. A. Muzaki, and Masjudi, "Analisis kemampuan literasi matematis siswa," Mosharafa: Jurnal Pendidikan Matematika, vol. 8, issue. 3, pp. 493-502, 2019.

5. M. Annisa, "Kemampuan literasi matematis melalui model problem based learning dengan pendekatan pembelajaran matematika realistik pada materi bangun datar segitiga kelas VII SMPN 1 sukorejo," Malang. 2022.
6. H. Nizar., A. D. Putri., and L. Septy, "Islamic context on PISA-Like mathematics problem in junior high school," *Jurnal Didaktik Matematika*, vol. 9, issue. 2, pp. 298–313, 2022. doi: 10.24815/jdm.v9i2.26315
7. R. Octavia., A. T. Fatimah., and I. Nuraida, "Analisis kemampuan literasi matematis siswa SMP dalam penyelesaian soal matematika berbasis cerita," *J-KIP: Jurnal Keguruan dan Ilmu Pendidikan*, vol. 3, issue. 2, pp. 433-444, 2022.
8. C. Maisarah., M. Ikhsan, and K. Umam, "Persepsi siswa dengan latar belakang pendidikan tahfidzul quran terhadap matematika," *Jurnal Ilmiah Mahasiswa Pendidikan Matematika*, vol. 6, issue. 3, pp. 222–230, 2021.
9. A. Asmara., and D. J. Sari, (2021). Pengembangan soal aritmatika sosial berbasis literasi matematis siswa SMP," *Jurnal Cendekia*. Vol. V, issue. 3, pp.2950–2961. 2021.
10. OECD, "PISA 2022 Mathematics framework (draft)," USA: OECD-PISA, 2018.
11. KBBI, "Kamus Besar Bahasa Indonesia (KBBI)". [Online, 2021].
12. Abdussakir. "Internalisasi nilai-nilai islami dalam pembelajaran matematika dengan strategi analogi," <http://repository.uin-malang.ac.id/1885/2/1885.pdf>, 2017.
13. N. Sobarningsih., J. Juariah., R. Nurdiansyah., A. R. Purwanti., and R. Kariadinata, "Pengembangan soal matematika bernuansa Islami," *Jurnal Analisa*, vol. 5, issue. 2, pp. 109–123, 2019. doi: 10.15575/ja.v5i2.5895
14. N. Mufidah, "Pengajaran menuju budaya literasi dan pembentukan karakter muslim dengan kajian tokoh untuk jurusan pendidikan guru Madrasah Ibtidaiyah (PGMI)," *AL-MUDARRIS Journal of Education*, vol. 1, issue. 1, pp. 15–21, 2018.
15. M. Lutfianto., and A. F. Sari, "Respon siswa terhadap soal matematika mirip PISA dengan konteks berintegrasi nilai Islam," *Jurnal Elemen*, vol. 3, issue. 2, pp. 108, 2017. doi: 10.29408/jel.v3i2.342
16. F. D. Agustin., Syofni, and Armis, "Pengembangan perangkat pembelajaran model problem based learning dengan metode SQ3R untuk memfasilitasi kemampuan literasi matematis peserta didik materi aritmatika sosial kelas VII SMP/MTs," *Juring : Journal for Research in Mathematics Learning*, vol. 5, issue. 4, 2022.
17. M., Imamuddin., H. A. Musril., and Isnaniah. Pengembangan soal literasi matematika terintegrasi Islam untuk siswa Madrasah. *Aksioma: Jurnal Program Studi Pendidikan Matematika*, vol. 11, issue. 2, pp. 1355-1371. 2022. doi: 10.24127/ajpm.v11i2.4830
18. L. J. Moloeng, "Metode penelitian kualitatif," Bandung: PT. Remaja Rosdakarya, 2017.
19. Sugiyono. "Metode Penelitian Kuantitatif, Kualitatif, dan R&D," Bandung: Alfabeta CV, 2017.
20. R. Masfufah, and E. A. Afriansyah, "Kemampuan Literasi Matematis Siswa melalui Soal PISA," *Mosharafa: Jurnal Pendidikan Matematika Analisis*, vol. 10, issue. 2, 2021. <http://journal.institutpendidikan.ac.id/index.php/mosharafa>
21. F. Fadillah, and D. R. Mundandar, "Analisis kemampuan literasi statistis dalam pembelajaran matematika di masa pandemic," *JPMI: Jurnal Pembelajaran Matematika Inovatif*, vol. 4, issue.5, pp. 1157-1168. 2021.
22. M. Simalango., Darmawijoyo, and N. Aisyah. "Kesulitan siswa dalam menyelesaikan soal-soal PISA pada konten change and relationship level 4, 5, dan 6 di SMPN 1 Indralaya," *Journal Pendidikan Matematika*, vol. 12, issue. 1, 2018.
23. E. H. Wati., and B. Murtiyasa, "Kesalahan Siswa SMP dalam Menyelesaikan Soal Matematika Berbasis PISA pada Konten Change and Relationship," *Prosiding Konferensi Nasional Penelitian Matematika dan Pembelajarannya (KNPMP I)*, Surakarta, 2016.

24. A. S. Asmara., S. B. Waluya., and Rochmad, "Analisis kemampuan literasi matematika siswa kelas X berdasarkan kemampuan matematika," *Scholaria*, vol. 7, issue. 2, pp. 135-142. 2017.
25. Z. Abubakar, and I. M. Maishanu, "Adherence to islamic principles of success and academic achievement," *International Journal of Evaluation and Research in Education*, (IJERE), vol. 9, issue. 2, pp. 401–406, 2020, doi: 10.11591/ijere.v9i2.20473
26. M. Imamuddin, and Isnaniah, "Peranan Integrasi Nilai-Nilai Islam dalam Pembelajaran Matematika," *Kaunia : Integration and Interconnection of Islam and Science Journal*, vol. 19, issue.1, pp. 15–21, 2023.
27. M. Umar, and Sukarno, "The influence of fiqh insights and science literacy on student ability in developing Quran-based science," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 11, issue. 2, pp. 954–962, 2022, doi: 10.11591/ijere.v11i2.22012
28. J. D. Dagdag., N. A. Palapuz., and N. A. Calimag, "Predictive ability of problem-solving efficacy sources on mathematics achievement," *International Journal of Evaluation and Research in Education*, vol. 10, issue. 4, pp. 1185–1191, 2021. doi: 10.11591/IJERE.V10I4.21416
29. F. Hamidi., Z. Bagherzadeh., and S. Gafarzadeh, "The role of islamic education in mental health," *Procedia - Social and Behavioral Sciences*, vol. 5, pp. 1991–1996, 2010. doi: 10.1016/j.sbspro.2010.07.402
30. S. Keshavarz, "Quran point of view on dimensions of reflection and its indications in education system," *Procedia - Social and Behavioral Sciences*, vol. 9, pp. 1812–1814, 2010. doi: 10.1016/j.sbspro.2010.12.405
31. L. Cohen, L. Manion, L. and K. Morrison, "Research Methods in Education", 5th ed, Routledge, 2000.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

