International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 12, Issue 8
August, 2025
Pages: 372-383

The Effectiveness of Culturally-Integrated RME with Liveworksheets in Improving Junior High School Students' Mathematical Literacy

Aditya Pratama Puja Kesuma; Marsigit

Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

http://dx.doi.org/10.18415/ijmmu.v12i8.6919

Abstract

This study examines the effectiveness of the Realistic Mathematics Education (RME) approach, which integrates local cultural contexts and is supported by the digital platform Liveworksheets, in enhancing the mathematical literacy of junior high school students. A pre-experimental one-group pretest-posttest design was applied to eighth-grade students at a public school in Yogyakarta. The instruction focused on number patterns using culturally relevant content such as traditional batik motifs. Data were gathered through a mathematical literacy test and observation sheets. The findings revealed a significant improvement in students' literacy skills, as posttest scores were considerably higher than pretest scores. The n-Gain score of 0.64, falling within the moderate category, suggests that integrating RME with cultural content and digital media effectively enhances students' understanding of mathematics. The study concludes that incorporating local culture and technology into mathematics education can provide meaningful and engaging learning experiences, and is recommended as a strategy to improve mathematical literacy among students.

Keywords: *RME; Local Culture; Liveworksheets; Mathematical Literacy; Number Patterns*

Introduction

In the context of sustainable development, mathematical literacy is an essential competency for both individuals and society. Defined as the ability to reason, formulate, employ, and interpret mathematics in various real-life contexts (OECD, 2023b). Mathematical literacy supports the achievement of at least two Sustainable Development Goals (SDGs). It plays a pivotal role in achieving Sustainable Development Goal (SDG) 4 by fostering inclusive, equitable, quality education and promoting lifelong learning opportunities for all. Additionally, it contributes to the realization of SDG 8 by equipping individuals with the competencies required for decent employment and sustainable economic growth. (UNESCO, 2017). The World Economic Forum (WEF) (2025) further projects that analytical and numerical abilities will remain among the top ten skills most demanded in the workforce. Hence, mathematical literacy not only empowers individuals but also serves as an integral component of the global development agenda.

Indonesia's "Merdeka Curriculum" policy supports the strengthening of mathematical literacy, as articulated in Permendikbudristek No. 5 of 2022 concerning graduate competency standards. This regulation requires all secondary-level students to demonstrate numeracy skills by logically applying mathematical concepts, procedures, facts, and tools to solve problems relevant to their personal lives, local environment, communities, and global issues (Kemendikbudristek, 2022b). However, the 2022 Programme for International Student Assessment (PISA) results revealed that Indonesian students still exhibit low mathematical literacy, with an average score of 366, considerably lower than the OECD average score of 472, positioning Indonesia at 70th among the 81 participating nations (OECD, 2023a). This indicates a pressing need for more contextual and meaningful learning approaches.

One relevant instructional approach is Realistic Mathematics Education (RME). Rooted in the philosophy of Dutch mathematician and educator Hans Freudenthal, RME views mathematics as a human activity that should be constructed through real-life experiences and the modeling of everyday situations (Freudenthal, 1973; Gravemeijer, 1994). This approach is guided by three core principles: phenomenological exploration, didactical modeling, and guided reinvention (Gravemeijer, 1994; Treffers, 1987). Several studies have demonstrated that RME effectively enhances students' mathematical literacy, especially when integrated with interactive learning media that incorporate real-world contexts (Istiqomah et al., 2021; Nurhayati et al., 2023).

A key strength of RME lies in its flexibility to use various real-life contexts familiar to students, including local cultural contexts, to bridge understanding. The integration of cultural dimensions into mathematics teaching can strengthen the meaningfulness of the subject matter and actively engage students, while also highlighting the importance of mathematics in their societal and cultural contexts (Rosa & Orey, 2016). Therefore, mathematics instruction is encouraged to incorporate students' cultural backgrounds (Sunzuma et al., 2021). This approach aligns with the principles of ethnomathematics, which views local culture as a resource for learning mathematics (Gerdes, 1999). Ethnomathematics is a field that explores how mathematical concepts are adapted and developed within specific cultural contexts (Marsigit, 2016).

Alongside its emphasis on contextualized education, the Merdeka Curriculum supports the integration of digital tools to enhance teaching and learning processes, as outlined in the Permendikbudristek No. 16 of 2022 on process standards, which stipulates that instructional strategies should be implemented through the integration of information and communication technologies (Kemendikbudristek, 2022a). One digital platform that supports this initiative is Liveworksheets, which transforms conventional worksheets into interactive formats. Several studies have shown that the use of Liveworksheets in secondary-level mathematics instruction has a positive impact on student learning processes and outcomes. Rizki et al. (2023) found that Liveworksheets can promote the development of critical thinking skills. Sugandi et al. (2024) also demonstrated that Electronic Student Worksheets (E-LKPD) that supported by Liveworksheets, are effective in improving students' critical thinking. Similarly, Qur'aniyah et al. (2024) found that integrating Liveworksheets into mathematics learning activities had a positive impact on student achievement.

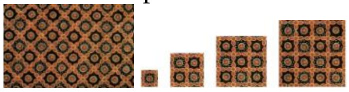
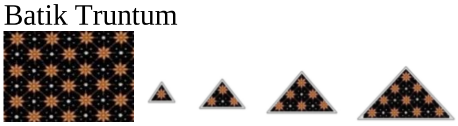
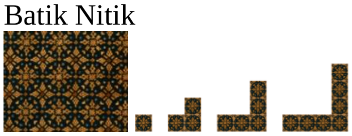
Given the need to improve mathematical literacy and the potential effectiveness of RME when integrated with local cultural contexts and digital technologies, there is a growing need for further development and investigation of contextual, interactive, and culturally grounded mathematics instruction. This study aims to examine the effectiveness of RME using the context of Yogyakarta batik, supported by Liveworksheets, in enhancing students' mathematical literacy. This research contributes to the field by integrating cultural contextual approaches and digital media within a relevant and meaningful mathematics learning framework.

Methods

A quantitative method was employed in this research, utilizing a pre-experimental design with a single group assessed before and after the intervention. The study was conducted at a public junior high school located in the city center of Yogyakarta, which has implemented the Merdeka Curriculum. The school was selected based on the consideration that its students are familiar with local cultural artifacts, such as batik, which remains an integral part of daily life in Yogyakarta society.

All eighth-grade learners served as the population for this research, with the sampling process conducted using a cluster random approach. Sampling was based on classroom availability, lesson schedules, and recommendations from the mathematics teacher. The selected class was Class VIII-G, consisting of 32 students. The study was conducted during the first semester of the 2024/2025 academic year, focusing on the topic of number patterns. The cultural context used is Yogyakarta batik motifs. The instructional content was delivered using the RME approach contextualized with Yogyakarta batik, utilizing traditional batik motifs as the context for learning. The specific batik motifs used in the lessons are presented in Table 1.

Table 1. Yogyakarta Batik Context for Teaching Number Patterns

No.	Motifs Used in Teaching Number Patterns	Mathematical Aspects Studied
1	Batik Grompol 	**Square Number Patterns** The Grompol batik motif was used to discover the formula for square number patterns by arranging each motif into a pattern, as shown.
2	Batik Kawung 	**Rectangular Number Patterns** The Kawung batik motif was used to discover the formula for rectangular number patterns by arranging each motif into a pattern, as shown.
3	Batik Truntum 	**Triangular Number Patterns** The Truntum batik motif was used to discover the formula for triangular number patterns by arranging each motif into a pattern, as shown.
4	Batik Nitik 	**Odd Number Patterns** The Nitik batik motif was used to teach and discover the formula for odd-number patterns by arranging each motif into a pattern, as shown.
5	Batik Sekar Jeram 	**Even Number Patterns** The Sekar Jeram batik motif was used to teach and discover the formula for even number patterns by arranging each motif into a pattern, as shown.
6	Combined Batik Motifs of Parang and Kawung 	**Arithmetic Sequences and Series** A combination of Parang and Kawung motifs was used to discover the formulas for arithmetic sequences and series by identifying the order in which the Parang and Kawung motifs appear.

The batik motifs were selected to contextualize mathematical pattern exploration through culturally relevant visual arrangements.

Data were obtained through direct observation of teaching implementation as well as written tests designed to assess students' proficiency in mathematical literacy. Observations were conducted during the learning sessions by a single observer. The test consisted of essay questions developed based on the three main processes of mathematical literacy. The instruments used included observation sheets and pretest-posttest question sets. Detailed indicators and the test blueprint are presented in Table 2.

Table 2. Test Blueprint for Mathematical Literacy Instruments

Process	Indicators	Contexts	No.
Formulate	Representing given real-world problems in mathematical forms	Occupational	1a
Employ	Using mathematical concepts, facts, procedures, and reasoning to solve given problems	Occupational	1b
Interpret and Evaluate	Interpreting mathematical results obtained within real-world contexts	Occupational	1c
	Evaluating solutions obtained based on real-world contexts		

Adapted from the PISA mathematical literacy framework; all items use occupational contexts.
Source: OECD (2023b)

Before being used, the test instruments underwent validity and reliability testing. Validation was conducted by three experts utilizing a rating scale from 1 (not valid) to 5 (highly valid). After the experts provided their assessments, the validity index was calculated using Aiken's V index. The results indicated that both the pretest and posttest instruments were valid, with improvements made based on the experts' suggestions and feedback. The reliability of the instruments was tested using Cronbach's Alpha formula, with criteria adapted from DeVellis (2017), as shown in Table 3.

Table 3. Instrument Reliability Criteria

Reliability Index	Category
$\alpha < 0.60$	Unacceptable
$0.60 \leq \alpha < 0.65$	Undesirable
$0.65 \leq \alpha < 0.70$	Minimum acceptable threshold
$0.70 \leq \alpha < 0.80$	Fairly good
$0.80 \leq \alpha \leq 0.90$	Excellent

Adapted from DeVellis (2017)

After testing, the instruments were declared reliable. The results of the instrument reliability calculations are presented in Table 4.

Table 4. Reliability Results of Pretest and Posttest Instruments

Instrument	Criteria Reliability	Statistics	Decision
Pretest	0.65	0.66	Reliable
Posttest	0.65	0.83	Reliable

The reliability decision was made based on the criteria presented in Table 3

The steps carried out in this study included selecting the class, administering a pretest to measure initial mathematical literacy skills, conducting RME-based learning with the Yogyakarta batik context supported by Liveworksheets as the treatment, and a posttest to assess improvements in mathematical literacy. The material was delivered through the context of batik motifs, such as Grompol, Kawung, Truntum, Sekar Jeram, and Parang, corresponding to the types of number patterns studied.

Data analysis was conducted both descriptively to describe learning outcomes before and after the treatment, and inferentially to test the hypothesis. Normality testing was performed using the Shapiro-Wilk test, followed by a paired-sample t-test to determine the significance of the differences between pretest and posttest scores. The effectiveness of the learning was measured using the n-Gain score. The hypotheses for the paired sample t-test are as follows:

- H_0: $\mu_1 = \mu_2$ (the mean pretest score is equal to the mean posttest score)
- H_1: $\mu_1 < \mu_2$ (the mean pretest score is less than the mean posttest score)

The decision criteria for the hypothesis test were that H_0 is rejected if the calculated t-value < -t table value or if the p-value < α. The n-Gain score was calculated using the following equation:

$$n - Gain = \frac{Posttest\ score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

Then, to determine the criteria for the magnitude of the n-Gain score improvement, the classification was adapted from Hake (1998) was used, as presented in Table 5.

Table 5. Interpretation Criteria for n-Gain Scores

n-Gain Score	Interpretation
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Moderate
$g < 0.3$	Low

Source: Hake (1998)

Effectiveness was assessed by implementing RME with Yogyakarta batik content supported by Liveworksheets, measured through: (1) a significant difference in students' average mathematical literacy scores before and after the intervention, and (2) an n-Gain index within at least the moderate range.

Findings and Discussion

Findings

Findings from the study reveal an enhancement in students' mathematical literacy following the implementation of RME instruction contextualized with local culture and facilitated through Liveworksheets. A detailed description of the results is presented in Table 6.

Table 6. Description of Students' Mathematical Literacy Ability Results

Description	Pretest	Posttest
Average score	2.84	6.88
Average score percentage	31.6	76.39
Standard deviation	1.32	1.53
Minimum score	0.00	3.00
Maximum score	5.00	9.00

The data were obtained using JASP software.

Table 6 presents the descriptive statistics of students' mathematical literacy abilities. The average pretest score was 2.84 (31.6%), and it increased to 6.88 (76.39%) on the posttest, representing an improvement of 44.79 percentage points. The standard deviation increased from 1.32 to 1.53, indicating a slight increase in variation in results after the treatment. The minimum score rose from 0.00 to 3.00 (33%), while the maximum score increased from 5.00 (56%) to 9.00 (100%). These results demonstrate a significant improvement in students' mathematical literacy skills following the intervention. To observe the percentage improvement between pretest and posttest scores for each mathematical literacy indicator, refer to Table 7.

Table 7. Percentage Improvement of Mathematical Literacy Ability by Indicator

Process	Indicators	Average Score Percentage		Improvement
		Pretest	Posttest	
Formulate	Representing given real-world problems into mathematical forms	51	86	35
Employ	Using mathematical concepts, facts, procedures, and reasoning to solve given problems	32	78	46
Interpret and Evaluate	Interpreting mathematical results obtained within real-world contexts Evaluating solutions obtained based on real-world contexts	11	64	53

The data were obtained using Microsoft Excel software.

Table 7 shows that all indicators of mathematical literacy ability improved from pretest to posttest. The highest increase was observed in the interpret and evaluate process, with an improvement of 53%, followed by the employ process at 46%, and the formulate process at 35%. As a preliminary step before hypothesis testing, the Shapiro-Wilk normality test was carried out at the 0.05 alpha level. The findings are presented in Table 8.

Table 8. Normality Test Result

Category	Statistic	Sig. Level	Decision
Pretest	0.052	0.05	Normal
Posttest	0.056	0.05	Normal

The data were obtained using JASP software.

As presented in Table 8, the Shapiro-Wilk test yielded significance values of 0.052 for the pretest and 0.056 for the posttest, both of which exceeded the 0.05 threshold. These results suggest that the mathematical literacy data are normally distributed. After confirming that the data met the normality assumption, a paired t-test was conducted to assess the influence of RME instruction, incorporating Yogyakarta batik and Liveworksheets, on students' mathematical literacy performance. The results are summarized in Table 9.

Table 9. Paired Sample t-Test Result

Category	Mean	Calculated *t*	df	$-t$ table	*p-value*	Decision
Pretest Posttest	2.84 6.87	-11.841	31	- 1.695	<0.001	H_0 rejected

The data were obtained using JASP software; α = 0.05

Based on Table 9, the average score of students' mathematical literacy ability before the treatment was 2.84, while the average score after the treatment was 6.87. The calculated t-value with $\alpha = 0.05$ and df = 31 was -11.841, which is less than the negative critical t-value of -1.695, the calculated t < - t table. The p-value was < 0.001, which is less than $\alpha = 0.05$, so p-value < α. Therefore, the decision is to reject H_0. This means that the average pretest score is significantly lower than the posttest score, indicating that the RME approach with the Yogyakarta batik context supported by Liveworksheets has a significant effect on students' mathematical literacy abilities. Subsequently, the n-Gain score was computed to assess the degree of instructional effectiveness. The findings from this calculation are displayed in Table 10.

Table 10. n-Gain Calculation Results

Average Percentage Score of Pretest	Average Percentage Score of Posttest	n-Gain	Interpretation
32	76	0.64	Moderate

The gain interpretation was made based on the criteria presented in Table 5

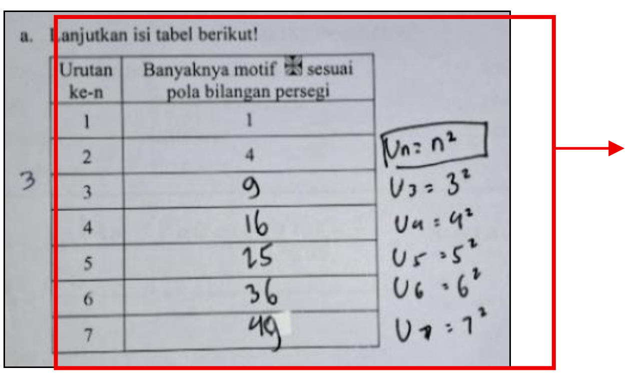
Based on Table 10, there is a noticeable improvement in the average posttest score compared to the pretest, with an n-Gain of 0.64, which is interpreted as a moderate gain.

Considering both effectiveness indicators, the application of the RME approach within the Yogyakarta batik context is deemed effective in enhancing students' mathematical literacy, as evidenced by a statistically significant improvement in pretest-posttest scores and an n-Gain score classified as moderate.

Discussion

The treatment in this study was learning using the RME approach with the context of Yogyakarta batik, supported by Liveworksheets. The learning process began with contextual apperception, followed by the active application of RME through discussions and the integration of Yogyakarta batik, and concluded with feedback and joint reflection. The Yogyakarta batik context was used as a tool to provide a meaningful understanding of number patterns through the arrangement of motifs that illustrate repeating patterns. Liveworksheets was used as a medium to present student activity sheets (LKPD) in a more engaging and interactive way for students. The LKPD contained activities designed to improve students' mathematical literacy skills. Based on the observation sheet, the learning process was carried out effectively, as indicated by an average implementation score of 95%. This shows that each stage of the learning process ran according to plan.

Students' mathematical literacy skills showed improvement after the treatment. In the formulation process, the students' average maximum score increased by 35%; in the employ process, it increased by 46%; and the largest improvement was observed in the interpret and evaluate process, with an increase of 53%. The highest gain in the third process likely occurred because the students' average score in that area was very low during the pretest. Below are excerpts from students' posttest answers for each process.



a. Lanjutkan isi tabel berikut!

Urutan ke-n	Banyaknya motif sesuai pola bilangan persegi
1	1
2	4
3	9
4	16
5	25
6	36
7	49

Continue the table below!

Term (n)	Number of motifs following the square number pattern
1	1
2	4
3	...
4	...
5	...
6	...
7	...

Figure 1. Excerpt of Posttest Answer Number 1a

On question 1a, which measured the formulation process, most students were able to continue the table based on the general form of square number patterns. This indicates that students were already capable of representing real-world problems in the question in mathematical forms, specifically in the form of a table.

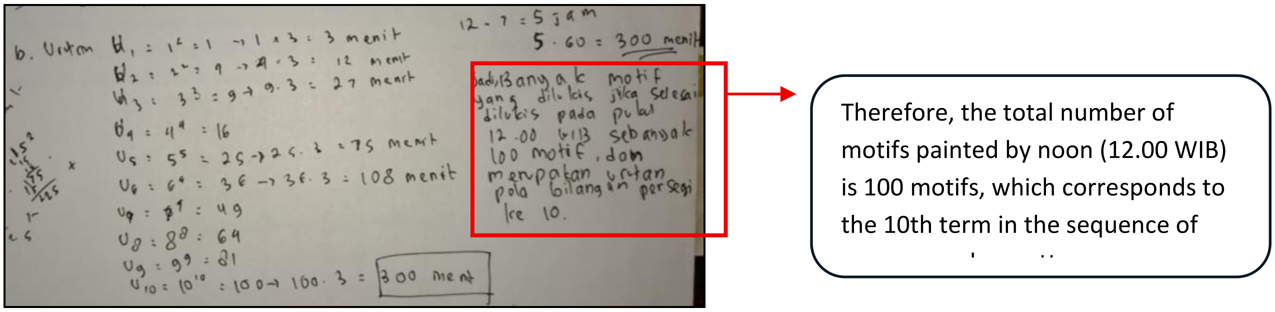


Figure 2. Excerpt of Posttest Answer Number 1b

On question 1b, which measured the employment process, it was evident that students were able to determine the number of motifs completed within a certain period by following the square number pattern and identify the sequence of the resulting terms. This shows that students were capable of using number pattern concepts, calculation procedures, and mathematical reasoning to solve the given problem.

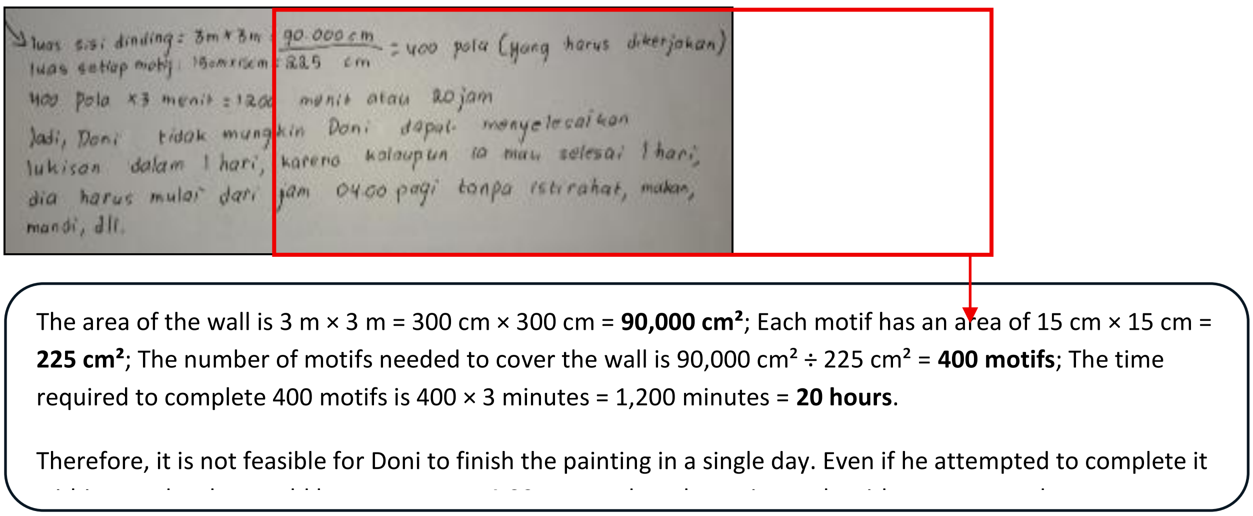


Figure 3. Excerpt of Posttest Answer Number 1c

On question 1c, which measured the interpret and evaluate process, it was evident that students were able to interpret the results obtained in the previous question and assess whether the answers were appropriate. This indicates that students were already capable of interpreting and evaluating mathematical results within real-world contexts.

The inferential analysis results indicate that the RME approach, based on the Yogyakarta batik context and supported by Liveworksheets, is moderately effective in improving students' mathematical literacy, as reflected in the n-Gain score of 0.64. This finding aligns with the study by Fauzana et al. (2020), which reported similar effectiveness of RME in enhancing mathematical literacy.

The inherent connection between the RME approach and mathematical literacy is notably strong, as both emphasize the meaningful application of mathematics in real-life contexts. Rooted in the perspective that mathematics is a human activity constructed through contextual experience rather than rote memorization (Freudenthal, 1973), RME encourages students to model real-world situations mathematically, process them analytically, and reinterpret the results within the original context. Boswinkel and Moerlands (2002) describe the learning process in RME through the metaphor of an iceberg, which consists of four progressive levels: (1) *mathematical world orientation*, introducing concepts in realistic contexts; (2) *model material*, involving the use of tools or visual representations as bridges to abstraction; (3) *building stone*, which strengthens relational understanding and mathematical structures; and (4) *formal notation*, representing the highest level of symbolic operations. The lower layers of the iceberg, though often unseen, form the essential foundation for student understanding (Webb et al., 2008). This process corresponds with horizontal mathematization, where students transform real-world problems into mathematical representations (Freudenthal, 2006). This is reflected in the "formulate" process in mathematical literacy. Vertical mathematization, on the other hand, involves developing and refining formal mathematical models to gain deeper conceptual understanding (Freudenthal, 2006). This aligns with the “employ” and “interpret” processes, where students solve problems using mathematical reasoning and interpret the results meaningfully.

Accordingly, the mathematization process in RME not only deepens students' conceptual understanding but also directly cultivates their mathematical literacy by equipping them with the ability to reason, model, and apply mathematics reflectively and responsibly in real-world contexts. This is supported by studies from Istiqomah et al. (2021) and Sudi et al. (2022), which found RME-based learning more effective than conventional approaches. Furthermore, a meta-analysis conducted by Ariati et al. (2022) confirmed the consistent positive impact of RME on students’ mathematical literacy in Indonesia. Putri et al. (2024) also emphasized RME’s effectiveness in bridging mathematical concepts with real-life situations, thereby enhancing both understanding and application.

The use of local culture as the context for learning plays a vital role in bridging the mathematization process with students’ concrete experiences. This is in line with constructivist theory by Piaget (1970), which asserts that knowledge is constructed through active experience and engagement. In this study, the Yogyakarta batik context was utilized during the process of mathematization. Students observed batik patterns, recognized the repetitive nature of the motifs, and related them to the concept of number patterns. When the context originates from familiar cultural environments, students are better able to construct meaningful mathematical understanding (Rosa & Orey, 2016).

Empirical findings have shown that culture-based learning significantly enhances students’ mathematical literacy (Ulya & Rahayu 2018) and is more effective than traditional approaches (Hanum et al., 2020; Indriati et al., 2022). Moreover, local cultural contexts have been proven to support students in solving real-life problems mathematically (Munthahana et al., 2023). These findings affirm that incorporating local culture is a relevant and effective strategy in developing students’ mathematical literacy.

In addition, the integration of Liveworksheets functioned as a digital tool to present interactive worksheets, enabling students to explore patterns in batik motifs, construct number patterns, and generalize these into mathematical expressions. Liveworksheets facilitated a more engaging and independent learning experience. This finding is consistent with Umbara and Nuraeni (2019), who reported that the use of technology to enhance visualization significantly improves learning engagement and motivation in mathematics. Technology also aids in visualizing abstract mathematical concepts (Oktavianingtyas et al., 2018). Therefore, incorporating digital tools such as Liveworksheets allows students to grasp abstract mathematical ideas more easily by connecting them to real-life contexts.

Conclusion

Drawing on the findings and their interpretation, it is reasonable to conclude that the RME approach, based on the local cultural context of Yogyakarta batik, combined with interactive media Liveworksheets, is sufficiently effective in enhancing students' mathematical literacy. The effectiveness is evident not only from the increase in n-Gain scores but also from the active involvement of students in the mathematization process, which reflects the three core competencies of mathematical literacy: formulating, employing, and interpreting and evaluating. The use of local cultural context provides a meaningful bridge between students' concrete experiences and mathematical representations, while the integration of technology supports students' cognitive engagement in the learning process.

This research is expected to provide valuable insights into the design of culturally responsive and technology-enhanced learning models that incorporate contextual learning. This study confirms that integrating the RME approach into local cultural contexts, supported by digital media such as Liveworksheets, can transform mathematics learning into a more authentic, engaging, and practical experience. Practically, these findings can serve as a reference for teachers in designing lessons that not only focus on content mastery but also strengthen students' mathematical literacy through context-based and technology-enhanced approaches.

Despite the positive results, several challenges need to be addressed. First, the success of this approach heavily relies on teachers' understanding and skills in developing and integrating cultural contexts into mathematics instruction. Second, the use of technology, such as Liveworksheets, requires adequate digital infrastructure, including devices and digital literacy skills among both students and teachers. Third, the scope of generalization is limited due to the study being conducted in a single classroom within a single school setting. Therefore, further research with a larger scale and more rigorous experimental designs is needed to confirm these findings and explore other variables such as self-efficacy, motivation, and student engagement more deeply.

References

Ariati, C., Anzani, V., Juandi, D., & Hasanah, A. (2022). *Meta-Analysis Study: Effect Of Realistic Mathematics Education (RME) Approach On Students' Mathematical Literacy Skill*. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 2953–2963. https://doi.org/10.24127/ajpm.v11i4.6182.

Boswinkel, N., & Moerlands, F. (2002). Het topje van de ijsberg. *K. Groenewegen (Red.). Nationale Rekendagen*, 103–114.

DeVellis, R. F. (2017). Scale Development Theory and Applications (Fourth Edition). *SAGE Publication*, *4*, 256.

Fauzana, R., Dahlan, J., & Jupri, A. (2020). The influence of realistic mathematics education (RME) approach in enhancing students' mathematical literacy skills. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/1521/3/032052.

Freudenthal, H. (1973). *Mathematics as an educational task*. D. Reidel Publishing Company.

Freudenthal, H. (2006). *Revisiting mathematics education: China lectures* (Vol. 9).

Gerdes, P. (1999). Geometry from Africa. In *Geometry from Africa* (Vol. 10). The Mathematical Association of America. https://doi.org/10.1090/clrm/010.

Gravemeijer, K. (1994). *Developing Realistic Mathematics Education*. Technipress.

Hake, R. R. (1998). Interactive-engagement versus traditional methods. *American Journal of Physics*, *66*(1), 64–74. https://pubs.aip.org/aapt/ajp/article-abstract/66/1/64/1055076/Interactive-engagement-versus-traditional-methods.

Hanum, A., Mujib, A., & Firmansyah, F. (2020). Literasi Matematis Siswa Menggunakan Etnomatematika Gordang Sambilan. *JIPMat*, *5*(2), 173–184. https://doi.org/10.26877/jipmat.v5i2.6777.

Indriati, M., Turmudi, T., & Dahlan, J. A. (2022). Effectiveness of ethnomathematics-based visual thinking approach in increasing mathematics literacy and cultural motivation. *International Journal of Trends in Mathematics Education Research*, *5*(4), 394–402. https://doi.org/10.33122/ijtmer.v5i4.145.

Istiqomah, P., Kamid, K., & Hasibuan, M. H. E. (2021). Pengaruh Model Realistic Mathematics Education Terhadap Kemampuan Literasi Matematika Ditinjau Dari Self Efficacy Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2775. https://doi.org/10.24127/ajpm.v10i4.4334.

Kemendikbudristek. (2022a). *Permendikbudristek Nomor 16 Tahun 2022 tentang Standar Proses Pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah*.

Kemendikbudristek. (2022b). *Permendikbudristek Nomor 5 Tahun 2022 Tentang Standar Kompetensi Lulusan pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah*.

Marsigit. (2016). Pengembangan Pembelajaran Matematika Berbasis Etnomatematika. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika*. https://jurnal.ustjogja.ac.id/index.php/etnomatnesia/article/view/2291.

Munthahana, J., Budiarto, M. T., & Wintarti, A. (2023). The Application Of Ethnomathematics In Numeracy Literacy Perspective: A Literature Review. *Indonesian Journal of Science and Mathematics Education*, *06*(2), 177–191. https://doi.org/10.24042/ijsme.v5i1.17546.

Nurhayati, S. E., Supratman, S., & Rahayu, D. V. (2023). Pengembangan Media Pembelajaran Interaktif Berbantuan Canva for Education Dengan Pendekatan Rme Untuk Meningkatkan Kemampuan Literasi Matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(4), 3627. https://doi.org/10.24127/ajpm.v12i4.8257.

OECD. (2023a). *PISA 2022 Results: Factsheets - Indonesia*.

OECD. (2023b). *Program For International Student (PISA) 2022 Assessment and Analytical Framework*. https://www.oecd-ilibrary.org/education/pisa-2022-assessment-and-analytical-framework_dfe0bf9c-en.

Oktavianingtyas, E., Salama, F. S., Fatahillah, A., Monalisa, L. A., & Setiawan, T. B. (2018). Development 3D Animated Story as Interactive Learning Media with Lectora Inspire and Plotagon on Direct and Inverse Proportion Subject. *Journal of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012111.

Piaget, J. (1970). *Science of education and the psychology of the child*. Orion Press.

Putri, A. D., Juandi, D., & Turmudi. (2024). Realistic mathematics education and mathematical literacy : a meta-analysis conducted on studies in Indonesia. *Journal of Education and Learning (EduLearn)*, *18*(4), 1468–1476. https://doi.org/10.11591/edulearn.v18i4.21650.

Qur’aniyah, I. A., Susanti, V. D., & Lestariningsih, A. R. (2024). Upaya Meningkatkan Hasil Belajar Matematika Siswa Dengan Menggunakan Model Pembelajaran STAD Berbantuan Media Liveworksheet Kelas VIII G SMPN 4 Madiun. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *9*(2), 19.

Rizki, N., Inganah, S., & Baiduri, B. (2023). Analysis of Critical Thinking Ability in Liveworkheet Assisted Cooperative Learning Settings. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *12*(1), 1474. https://doi.org/10.24127/ajpm.v12i1.7130.

Rosa, M., & Orey, D. C. (2016). *State of the Art in Paleoecology*. 11–37. https://doi.org/10.1007.

Sudi, W., Jafar, Kadir, & Salim. (2022). Efektivitas Pendekatan Pembelajaran Matematika Realistik Terhadap Literasi Matematika Siswa. *Jurnal Amal Pendidikan*, *3*(2), 160–171. https://doi.org/10.36709/japend.v3i2.28874.

Sugandi, A. I., Sofyan, D., Bernard, M., Widianti, D., & Linda. (2024). Pengembangan E-Lkpd Berbasis Pbl Berbantuan Web Liveworksheet Untuk Meningkatkan Kemampuan Berpikir Kritis Matematis. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *13*(4), 1215–1227. https://doi.org/10.24127/ajpm.v13i4.9364.

Sunzuma, G., Zezekwa, N., Gwizangwe, I., & Zinyeka, G. (2021). A Comparison of the Effectiveness of Ethnomathematics and Traditional Lecture Approaches in Teaching Consumer Arithmetic: Learners' Achievement and Teachers' Views. *Pedagogical Research*, *6*(4), em0103. https://doi.org/10.29333/pr/11215.

Treffers, A. (1987). *Three dimensions: A model of goal and theory description in mathematics instruction—the Wiskobas Project*. D Reidel Publishing Co. https://psycnet.apa.org/record/1987-97303-000.

Ulya, H., & Rahayu, R. (2018). Efektivitas Pembelajaran Probing-Prompting Berbasis Etnomatematika Terhadap Kemampuan Literasi Matematika. *Teknodika: Jurnal Penelitian Teknologi Pendidikan*, *16*(2), 53–60. http://jurnal.fkip.uns.ac.id/teknodika.

Umbara, U., & Nuraeni, Z. (2019). Implementation Of Realistic Mathematics Education Based On Adobe Flash Professional CS6 to Improve Mathematical Literacy. *8*(2), 167–178. https://doi.org/10.22460/infinity.v8i2.p167-178.

UNESCO. (2017). Education for Sustainable Development Goals: Learning Objectives. In *Education for Sustainable Development Goals: learning objectives*. United Nations Educational, Scientific and Cultural Organization. https://doi.org/10.54675/cgba9153.

Webb, D., Boswinkel, J. G. H., & Dekker, G. H. (2008). Beneath the Tip of the Iceberg: Using Representations to Support Student Understanding. *Mathematics Teaching in the Middle School*, *14*.

World Economic Forum (WEF). (2025). Future of Jobs Report 2025. In *World Economic Forum* (Issue January). World Economic Forum. https://www.weforum.org/reports/the-future-of- jobs-report-2025/.