Griya Journal of Mathematics Education and Application
Volume 5 Nomor 4, Desember 2025
e-ISSN 2776-124X| |p-ISSN 2776-1258
https://mathjournal.unram.ac.id/index.php/Griya/index

Development of E-Lkpd Mathematics based on the Realistic Mathematics Education (RME) Model to Improve Mathematical Representation Abality of student Islamic Elementary School

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Diterima: 12-12-2025 ; Direvisi: 20-12-2025 ; Dipublikasi: 24-12-2025

Abstract
This research is motivated by the low mathematical representation ability of elementary school students, particularly in the data presentation material. Students are still experiencing difficulty in communicating mathematical ideas visually, symbolically, and verbally. This condition is exacerbated by a learning process that tends to be conventional, a lack of media innovation, and the unavailability of technology-based teaching materials that support representation skills. Therefore, this research aims to develop mathematics E-LKPD based on the Realistic Mathematics Education (RME) model to improve students' representation abilities. This research was conducted at MI Al-Ishlah Bobos, involving 36 fifth-grade students as respondents. The method used in this research is Research and Development (R&D), referring to the ADDIE development model, which consists of five main stages: 1) Analysis, 2) Design, 3) Development, 4) Implementation, and 5) Evaluation. Based on the validation results from the expert team, the following media feasibility levels were obtained: media experts 96%, language experts 93%, and content experts 100%, all of which fall into the very valid category. After making improvements to the media and content based on validator feedback, the researcher proceeded to the implementation stage with 36 fifth-grade students. The results of this implementation showed that the media received a score of 70%, which falls into the "good" category.

Keywords: E-LKPD, Realistic Mathematics Education (RME), mathematical representation ability

Abstrak
Penelitian ini dilatarbelakangi oleh rendahnya kemampuan representasi matematis siswa sekolah dasar, khususnya pada materi penyajian data. Siswa masih mengalami kesulitan dalam mengomunikasikan ide-ide matematika secara visual, simbolik, maupun verbal. Kondisi ini diperparah dengan proses pembelajaran yang cenderung konvensional, minimnya inovasi media, serta belum tersedianya bahan ajar berbasis teknologi yang mendukung keterampilan representasi. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan E-LKPD matematika berbasis model Realistic Mathematics Education (RME) dalam meningkatkan kemampuan representasi siswa. Penelitian ini dilaksanakan di MI Al-Ishlah Bobos dengan melibatkan 36 siswa kelas V sebagai responden. Metode yang digunakan dalam penelitian ini adalah Research and Development (RnD) dengan mengacu pada model pengembangan ADDIE, yang terdiri dari lima tahapan utama, yaitu 1) Analisis, 2) perancangan, 3) pengembangan, 4) implementasi, 5) evaluasi. Berdasarkan hasil validasi dari tim ahli, diperoleh hasil tingkat kelayakan media sebagai berikut: ahli media sebesar 96%, ahli bahasa 93%, dan ahli materi 100%, yang seluruhnya masuk dalam kategori sangat valid. Setelah melakukan perbaikan pada media dan materi berdasarkan masukan validator, peneliti maju ke tahap implementasi kepada 36 siswa kelas V. Hasil dari implementasi tersebut menunjukkan bahwa media mendapat nilai 70%, yang masuk ke dalam kategori “baik”.

Kata Kunci: E-LKPD, Realistic Mathematics Education (RME), kemampuan representasi matematis

1. INTRODUCTION

Mathematics is one of the subjects that can be used to train a person's rational thinking process. This subject must be taught in both formal and non-formal school settings because it plays a very important role. Through learning mathematics, we can develop logical, systematic, and consistent thinking abilities (Alawiyyah & Arifuddin, 2024). This skill is very important for understanding and developing science and technology, which will help us comprehensively face future challenges. Additionally, mathematics plays a crucial role in daily life and supports progress in various other scientific fields (Agbata et al., 2024; Firma et al., 2021). Mathematics is also the foundation for understanding many scientific concepts, making it important to teach it from an early age. By studying mathematics from an early age, students can understand basic concepts and be able to solve mathematical problems they encounter in everyday life (Kusumaningrum & Nuriadin, 2022; NurdiniAtiqah, 2021; Radiusman, 2020). The presence of mathematics learning can equip students with mathematical abilities, one of which is representation skills, which can help students understand concepts and express mathematical ideas.

Representation ability is the ability of students to communicate mathematical ideas or concepts in a certain way. The mathematical ideas presented by students are an attempt to solve the problems they face (Afandi, 2024; Sholehah et al., 2023). In solving problems, mathematical ideas can be represented in various ways, such as images, tables, graphs, numbers, letters, symbols, and other representations (Hardianti & Effendi, 2021; Icha putri et al., 2022; Mulyadi & Fiangga, 2022). Therefore, the ability to represent is very important in solving problems and can improve students' thinking skills. Based on research conducted by (Ifa Sihombing et al., 2024), it was stated that students' mathematical representation abilities are still considered low, with an average score of 65.2% for visual representation indicators, 43.5% for expression and equation representation indicators, and 41.2% for word representation indicators. This aligns with research conducted by (Fiantika & Zhoga, 2021), which shows that students' representation abilities are still low, with only 2.9% of children aged 8-12 being able to answer the questions. The research results (Saila et al., 2024) also state that students' mathematical representation abilities at SDN Kebonsari Kulon 1 Probolinggo are still considered low. The reason for this low ability is that teachers do not give enough attention to students' mathematical representation skills, and it is also caused by several factors, including learning processes that are still teacher-centered and do not actively involve students, the non-use of concrete learning media, negative perceptions that still persist about mathematics, and a lack of student involvement in the learning process, which tends to make them passive (Antika et al., 2024; Hasriana et al., 2021; Soffa, 2022).

This is also in line with the results of direct interviews conducted by the researcher with 5th-grade teachers at MI Al-Ishlah Bobos, which showed that there are still some students who need to improve their representation skills. This situation is caused by students' difficulty in solving math problems and understanding the material, their tendency to be passive in class, only receiving information from the teacher without expressing their opinions, and rarely participating actively. Class discussions are often dominated by just a few students. Teachers rarely use learning models or media, relying solely on student worksheets and textbooks. One effort that can be made to improve students' representation abilities is by using Student Worksheets (LKPD), which are designed to help students understand and illustrate mathematical concepts more clearly and structurally. This effort is in line with previous research conducted by (Aryani et al., 2021), which found that using LKPD allows students to learn independently to find concepts, ideas, and solutions to mathematical problems. In addition, the use of LKPD in mathematics learning is expected to facilitate mathematical representation.

As time goes on, student worksheets can be innovated in their presentation. One such innovation is integrating student worksheets into electronic media or technology, or E-LKPD. Of course, developing E-LKPD can also support modern technology-based learning by developing learning media as an important tool (Handiyani & Abidin, 2023). The use of E-LKPD in learning affects student learning activities. This makes learning more fun and interactive and gives participants the opportunity to practice their skills, including their representational abilities (Wardani et al., 2023). Developing this E-LKPD can be beneficial and equally important to develop because it can help students in their learning. One of the learning models used to improve representation skills in mathematics is the Realistic Mathematics Education (RME) model. The Realistic Mathematics Education (RME) model is a learning approach that utilizes the surrounding environment or everyday situations. Therefore, this RME model is very suitable for conveying mathematical concepts at the elementary school level (Sudarma et al., 2022). In previous research conducted by (Safitri et al., 2020), it was stated that the final result of this study, a learning design based on the Realistic Mathematical Education (RME) approach, can develop students' mathematical representation abilities.

This e-LKPD can assist teachers in the learning process because it is presented with visuals that can capture students' attention (Indrastuti, 2024). Various studies have discussed the development of mathematics learning media, especially student worksheets. However, the uniqueness of this research lies in the development of digital learning media, namely E-student worksheets based on the Realistic Mathematics Education (RME) model, where learning is centered on real-world things relevant to daily life and is specifically designed for data presentation material at the elementary school level, with the main goal of improving students' representation abilities. This approach differs from previous research, such as the study conducted by (R. Y. Puspita

et al., 2023), which focused on the discovery learning model, or the study conducted by (Hayun & Syawaly, 2020), which emphasized the problem-based learning model. The focus of this research material is data presentation material for fifth-grade elementary school students, which also distinguishes it from previous studies, such as the study by (Firma et al., 2021), which discussed fractions using pizza and origami media; the study by (Rosanti et al., 2023), which discussed large whole numbers; and the study by (Febrianti et al., 2025), which focused on surface area material.

Based on the above description, the researcher is interested in conducting research and development focused on the topic "Development of Mathematics E-LKPD Based on the Realistic Mathematical Education (RME) Model on the Representation Ability of Fifth Grade Elementary School Students."

2. RESEARCH METHOD

Study This use method is Research and Development (R&D) with the development model ADDIE, which includes five stages, namely Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen because it assesses systematically as well as being capable of producing product learning in the form of E-LKPD based on Realistic Mathematics Education (RME), which is valid, practical, and effective.

The subject study consists of expert material, media experts, and experts in language that play a role as product validators; the class V (five) teacher of MI Al-Ishlah Bobos was involved in trial applicability, and 36 students of Class V (five) of MI Al-Ishlah Bobos, Cirebon, Indonesia, were the main users at the implementation stage. The procedure study started with stage analysis that includes identification of needs and problems in learning, as well as the condition of the student's mathematical ability representation through observation, teacher interviews, and literature studies. The next stage is design, namely compiling the design of the beginning of the E-LKPD based on RME, which is aligned with basic competence, indicators, achievements, and student characteristics.

At the stage of development, design the product, then realize it with the help of digital applications and validate it with experts in materials, media, and language to ensure quality content, appearance, and language. Stage implementation is carried out with implementing E-LKPD in learning in class V (five) MI Al-Ishlah Bobos, Cirebon Indonesia while stage evaluation includes evaluating the validity, practicality, and effectiveness of the product through limited trials.

Instruments used in the study This consists of one questionnaire validation expert. For evaluating eligibility of the product, questionnaires for teachers and student responses are used to measure the level of practicality, as well as test ability representation given

mathematics in the form of pretests and posttests to know the effectiveness of the product. Result data validation analyzed the use percentage score to determine the level of validity, while practicality data was analyzed through the percentage of teacher and student responses. As for the effectiveness of the product analyzed, use Paired Sample T-Test as well as calculation of the N-Gain Score to see improvement in ability representation mathematical student after using RME-based E-LKPD.

3. RESULTS AND DISCUSSION

3.1 Result

Based on a questionnaire distributed to fifth-grade students to find out the actual situation, especially the challenges faced in learning mathematics and the need for media or supporting devices or teaching materials. Students were asked to fill out the questionnaire to collect the necessary information. The results of the questionnaire showed that 36 students, or the equivalent of 89% of all students, needed RME-based E-LKPD mathematics to improve their mathematical representation skills. This was further strengthened by the results of interviews with fifth-grade teachers that students' representation skills were still relatively low, so there was a need for learning media that could improve these skills, because teachers also realized how important representation skills were in the mathematics learning process.

The product is then developed and adapted to student needs, resulting in an E-LKPD that is engaging, interactive, effective, and relevant to student needs (Sobirin et al., 2024). The process begins with curriculum and needs analysis, followed by selecting the most relevant topic, and culminates in writing and editing. Based on the results of a questionnaire distributed to material experts, media experts, and language experts, the developed E-LKPD based on RME was declared highly valid and met the criteria.

Table 1. Validation Assessment

Validator	Percentage	Category
Material Expert	100%	Very Valid
Media Expert	96%	Very Valid
Languange Expert	93%	Very Valid

Table 1 above shows that the E-LKPD meets the criteria of highly valid, with scores of 100% from material experts, 96% from media experts, and 93% from language experts. This indicates that the material content aligns with the curriculum, the media display is attractive and interactive, and the language is communicative and easy for students to understand. This high validity confirms that the product is suitable for use without significant revision. These results align with research by (Rosanti et al., 2023), who also found that the E-LKPD product based on a realistic approach is suitable for use after

obtaining a high validation score from experts. Practically speaking, the findings of the survey given to students and teachers indicated that teachers responded favorably to the E-LKPD based on RME.

Table 2. Recapitulation Results Student Questionnaire

Class Teacher	Total Score	Score Max	Percentage	Criteria
Class 5	23	24	97%	Very Practical

Based on the recapitulation of student response questionnaires in table 2 above, the practicality questionnaire score obtained is 70%, indicating that this E-LKPD is practical. Therefore, based on student response questionnaires, the RME model-based E-LKPD is considered practical.

Table 3. Recapitulation Results Teacher Questionnaire

Class	Total Score	Score Max	Percentage	Criteria
Class 5	797	1152	70%	Practical

Based on the practicality questionnaire scores filled out by teachers in table 3, a percentage of 97% was obtained, indicating that this RME model-based E-LKPD is very practical.

Table 4. Statistical Results Descriptive Results of Pretest and Posttest

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
PRETEST	36	9	54	25.83	9.712
POSTES	36	47	100	70.69	10.469
Valid N (listwise)	36				

From the results of the pretest and posttest In table 4 above, it can be seen that there is a significant improvement in the score in a descriptive way from pretest to posttest. The lowest score on the pretest was 9, while the highest score reached 54. On the other hand, the lowest score on the posttest increased to 47, and the highest score reached 100. This shows existence progress from pretest to posttest. The average pretest score was 25.83, while the average posttest score increased to 70.69.

Table 5. Normality Test Results

Tests of Normality							
		Kolmogorov-Smirnov [a]			Shapiro-Wilk		
	Category	Statistics	Df	Sig.	Statistics	df	Sig.
Pretest_Postest	Pretest	.094	36	.200 *	.962	36	.247
	Posttest	.102	36	.200 *	.973	36	.526

Based on table 4 above, the results of the normality test using Shapiro-Wilk show that the Sig. (2-tailed) values for the pretest and posttest were 0.247 and 0.526, respectively. The significance of the pretest data was 0.247, which is greater than 0.05, whereas the posttest significance was 0.526, which is also greater than 0.05. Can conclude that the data is normally distributed.

Table 6. Results of Homogeneity

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Pretest_Postest	Based on Mean	.210	1	70	.648
	Based on Median	.171	1	70	.680
	Based on Median and with adjusted df	.171	1	69.732	.680
	Based on trimmed mean	.171	1	70	.680

Based on table 6 above, the value significance of the data obtained is 0.648. This shows that 0.648 > 0.05, so we can conclude that the data are homogeneous.

Table 7. T-Test Results

Paired Samples Test								
		Paired Differences						
					95% Confidence Interval of the Difference			
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	PRETEST – POSTES	-44.861	9.059	1.510	-47.926	-41.796	-29.713	35	.000

Based on table 7 above, the sig. (2-tailed) value obtained is 0.000, which is smaller than 0.05. This means that there is a significant difference between the pretest and posttest marks on learning using E-LKPD based on the RME model. So it can be concluded that the use of E-LKPD based on the RME model has a significant effect on improving the ability of students to represent mathematical data in the lesson presentation.

Table 8. N-Gain Test Results

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Skor	36	.35	1.00	.6107	.12939
Ngain_Persen	36	34.57	100.00	61.0722	12.93909
Valid N (listwise)	36				

From the table 8 above, we can conclude that the average N-Gain capability representation student is 0.6107, which is included in the moderate category. If we use the N-Gain percent scale, the average result shows the figure 61,0722 (61%) is classified as in the category "improvement enough." Thus, the use of E-LKPD based on the RME model for increasing ability representation was considered effective enough for students.

3.2 Discussion

The development of RME-based mathematical E-LKPD for improving the mathematical representation abilities of fifth-grade students was carried out using the ADDIE model, which includes the analysis, design, development, implementation, and evaluation stages. The ADDIE model is simple and structured, allowing it to produce high-quality products (Dewanti Lucky & Yasmita Echa Martha, 2022). The analysis results revealed that students' representation abilities were low, as teachers still tended to use conventional methods and rely on limited textbooks. This condition is consistent with research by (Fahrudin et al., 2021) and (Prameswara & Pius, 2023), which found that using the lecture method makes students passive and less motivated. Therefore, the RME-based mathematics E-LKPD is designed to meet the needs of more innovative and structured learning.

The validation results show that the E-LKPD meets very valid criteria, with scores of 100% from content experts, 96% from media experts, and 93% from language experts. This aligns with previous research by (Rosanti et al., 2023), which reported that the Problem-Based E-LKPD with a Realistic Approach met the validity criteria. This is also consistent with research conducted by (Maharani et al., 2025), which stated that the E-LKPD based on the Indonesian Realistic Mathematics Education (PMRI) approach was also declared highly valid. Based on the validation results from media experts, language experts, and content experts, all of whom received very valid criteria, the E-LKPD teaching materials with the RME model for improving representation skills were declared valid and suitable for use in learning. This is supported by the opinion of (Syamsi, 2021), who stated that learning using E-LKPD, which includes the RME model, can train students' thinking skills to build knowledge on their own through the activities they perform in learning. Additionally, the RME model also emphasizes real-

life contexts in everyday life and makes students feel close to mathematics (Amelia et al., 2024).

Practicality was tested through questionnaires completed by teachers and students. The teacher gave a practicality score of 97% (very practical), indicating that the E-LKPD is easy to use as a learning medium, aligns with the objectives, and helps manage the class more interactively. Meanwhile, the students gave a score of 70% (practical), indicating that the product is quite easy to use, engaging, and motivates learning. This aligns with previous research conducted by (Khotimah, Yasa, & ..., 2020), which revealed that E-LKPD teaching materials are practical. It also aligns with (Maharani et al., 2025) research, which also revealed that E-LKPD, based on the Indonesian Realistic Mathematics Education (PMRI) approach, based on student responses, indicates that E-LKPD is very practical and easy to use. Additionally, (Sulastri & Wulantina, 2023) research also showed that LKPD based on the PMRI model for improving students' representation abilities falls into the very practical category. Meanwhile, (Afifah, 2024) also revealed that the RME-based LKPD developed met the criteria for being very practical.This is because E-LKPD based on the RME model is a digital learning facility presented as an exercise to develop students' cognitive aspects through learning experiences (Khotimah, Yasa, & Nita, 2020). E-LKPD in education makes student learning activities more interesting, makes learning more interactive, provides opportunities for students to practice, and motivates them during the learning process (V. Puspita & Dewi, 2021). In addition, E-LKPD is also a more interactive and engaging work guide for students, which can reduce boredom and make it easier to understand the material presented in electronic format, accessible via computer, laptop, smartphone, or mobile phone because it is in the form of a link (Budi et al., 2021). With the presence of this E-LKPD, students can utilize technological devices for learning, not just for playing games or using social media(Apriliyani & Mulyatna, 2021). However, technical challenges such as internet access and device limitations still need to be considered (Nida et al., 2023).

The effectiveness test using the paired sample t-test showed a significant difference between pretest and posttest scores (sig. $0.000 < 0.05$). The improvement in students' abilities is also demonstrated by an average N-Gain score of 0.61, which falls into the moderate category. This means that although the improvement hasn't reached a high category, the use of RME-based E-LKPD has proven effective in helping students understand and represent mathematical concepts.

This result is consistent with research conducted by (Sulastri & Wulantina, 2023), which revealed that developing student worksheets based on the PMRI model can improve students' representation abilities with an effectiveness percentage of 82.6%. This is also in line with (Ramadhani et al., 2025) research, which also revealed that applying the Realistic Mathematics Education (RME) model to elementary school

students' mathematical representation abilities was proven to make a significant contribution to improving students' ability to demonstrate mathematical representation. Additionally, (Bekti, 2024) research also revealed that developing E-LKPD can improve mathematical representation abilities and is effective for use in the learning process.

This is also supported by the opinion of (Firma et al., 2021), who stated that RME is able to improve students' conceptual understanding through real-world contexts. In addition, E-LKPD based on the RME model in the learning process is linked to students' real lives and experiences, making students more enthusiastic and interested in learning mathematics and considering mathematics important because it is useful in (Setyawati, 2020) students' real lives (Khasanah, 2022). E-LKPD based on the RME model also helps students play an active role in the learning process and understand mathematical concepts well. Not only that, students are also encouraged to find their own solutions to problems, thus increasing their creative thinking and representation abilities (Mahsum & Fitri, 2024). In addition, the RME model also has its own challenges, one of which is that because students are used to being given information first, they find it difficult to find the answers themselves (Setyawati, 2020). Therefore, this RME-based E-LKPD is considered quite effective in improving representation skills.

4. CONCLUSION

Based on the research findings and discussion, it can be concluded that the Realistic Mathematics Education (RME) model-based E-LKPD for mathematics meets the criteria of being valid, practical, and quite effective. This indicates that this RME-based E-LKPD for mathematics is suitable for use in mathematics learning at MI/SD. Therefore, this mathematics E-LKPD can be one alternative for MI/SD teachers, especially for improving mathematical representation skills in data presentation materials.

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