INFINITY

by Nizaruddin Nizaruddin

Submission date: 15-Jun-2023 10:10AM (UTC+0700)
Submission ID: 2116352157
File name: 997-Article_Text-4019-1-10-20190317.pdf (465.83K)
Word count: 4104
Character count: 23698

Infinity Journal of Mathematics Education
Volume 8, No. 1, February 2019
p-ISSN 2089-6867
e–ISSN 2460-9285
https://doi.org/10.22460/infinity.v8i1.p21-30

THE EFFECTIVENESS OF REALISTIC MATHEMATICS EDUCATION TO IMPROVE STUDENTS' MULTI-REPRESENTATION ABILITY

Muhtarom*[1], Nizaruddin[2], Farida Nursyahidah[3], Nurina Happy[4]
[1,2,3,4] Universitas PGRI Semarang

Article Info

Article history:

Received Sept 30, 2018
Revised Jan 28, 2019
Accepted Jan 30, 2019

Keywords:

Multi-Representation
RME

ABSTRACT

This research aims to evaluate the effectiveness of Realistic Mathematics Education (RME) to improve students' multi-representation ability. A quasi-experimental design was used in this research. Sixty-four samples from the seventh-grade students of Junior School were randomly selected and divided into two classes: experimental class was treated using RME and control class was treated using conventional learning, with each class consisting of thirty-two students. The essay test was used to measure the multi-representation ability of students and the questionnaire was used to measure students' responses in RME learning. The data from the essay test were analyzed by N-Gain test and t-test in which normality and homogenity test were conducted previously, while the students' learning completeness and student responses were presented descriptive quantitative. The result of the research concluded that the multi-representation ability of students who get RME learning is better than the multi-representation ability in students who get conventional learning. 87.25% of students who get RME learning with the developed device have completed the KKM, and many students are very enthusiastic and interested in RME based learning, thus increasing their learning spirit in a learning process.

Corresponding Author:

Muhtarom,
Departement of Mathematics Education,
Universitas PGRI Semarang,
Jl. Sidodadi Timur No. 24, Semarang, Indonesia.
Email: muhtarom@upgris.ac.id

How to Cite:

Muhtarom, M., Nizaruddin, N., Nursyahidah, F., & Happy, N. (2019). The effectiveness of realistic mathematics education to improve students' multi-representation ability. *Infinity*, *8*(1), 21-30.

1. INTRODUCTION

Guided discovery, didactic phenomenology, and the principle of mediation model are the three basic principles of Realistic Mathematics Education (RME). Lessons are developed through mathematical concepts that originate from the real world in accordance with the Indonesian cultural context. The selected context is easily recognized by the students and can be imagined by students, languages, and diagrams presented very clearly to provide support in the development of mathematical concepts (Sembiring, Hadi & Dolk, 2008). RME is more effective in improving student learning outcomes than conventional learning (Laurens et al., 2018; Ginting et al., 2018; Zakaria & Syamaun, 2017). Laurens et al. (2018) stated that Realistic Mathematics Education (RME) improve students' mathematics cognitive achievement; improving the reasoning ability of elementary school student (Ginting et al., 2018) and improving students' achievement and attitudes towards mathematics (Zakaria & Syamaun, 2017). However, this study has not focused on multi-representation skills of students. This is possible because learning tools that contain multiple representations trained to students are rarely found. Whereas RME should be developed in accordance with the needs of students there is no exception for the development of multi-representation skills of students (Sembiring et al., 2008).

The development of multi-representation skills of students also reinforced by Neria & Amit (2004) study which states that only 153 students (44%) answered correctly with verbal representation, 131 students (37%) correctly answered with symbol representation. In addition, Nizaruddin, Muhtarom & Murtianto (2017) study states that the majority of students tend to use symbol representations to solve math problems, rather than using other representations. Even when using verbal representation, students find difficulties composing sentences while students have not been able to solve problems when using visual representations. Students are not able to accommodate to reconstruct their cognitive structure (Muhtarom, Murtianto & Sutrisno, 2017), including in the process of translation between representations. It shows that basically students still do not have multi-representation skills, students are still focused on one of the representations they think are suitable.

Table 1. Focus of Multi-Representation Ability

Representation	Description
Visual	▪ The ability to represent data or information in the form of diagram, graphics or table. ▪ Able to use visual representation to solve the problem. ▪ Able to draw to clarify and facilitate its solution
Verbal	▪ Able to identify the problem based on data or given representation ▪ Able to write the representation of given representation ▪ Able to write steps of math problem solving
Symbol	▪ Able to make math equation or model from other given representation ▪ Able to solve a problem by involving math expression

(Milrad, 2002)

On the other hand, Keller & Hirsch (1998); Bransford & Schwartz (1999) and Ainsworth (2006) strongly recommend a teacher to use more than one representation in the learning process of mathematics. The use of representations of more than one type at the same time is said to be multi-representation (Brenner et al., 1997). It is further emphasized that the ability of multiple mathematical representations is very important for students because they can develop mathematical concepts, relationships between concepts, using varied representations and help in communicating their way of thinking (NCTM, 2000). Hwang et al., (2007) divide the representations used in mathematics education into five types, i.e representations of real-world objects, concrete representations, symbol representations, verbal representations and visual representations. Among the five representations, the last three are more abstract and have higher difficulty levels. The representation of symbols is the skill of presenting the mathematical problems in the formula. the verbal representation is the skills of translating the nature and relationships in mathematical problems into the language or vowel, the visual representation is the skill of presenting math problems in pictures or graphs (Kaput & Romberg, 1999; Milrad, 2002).

Furthermore, these three representations will be the focus of this research, in which the description of each representation has been described in Table 1.

Thus, RME-based devices containing visual representations, verbal representations and symbol representations were developed to facilitate different student learning styles. This representation begins with a realistic situation close to the student so that they can develop other representations. Students build their confidence in problem-solving (Muhtarom, Juniati & Siswono, 2017) through their chosen form of representation, fearlessness, and beliefs in explaining the answers (Supandi et al., 2018). RME-based devices are expected to contribute positively to students in gaining understanding of mathematics, improving learning interactions, and developing multi-representation capabilities. Based on the above description, the problem in this research are:

a. Is there any difference in the multi-representation skills of students with RME and conventional learning?
b. How is the mastery of students with RME and conventional learning?
c. How is the improvement of multi representation skills of students with RME and conventional learning?
d. How is the student's response to RME-based tools developed?

2. METHOD

2.1. General Background of Research

The first stage of this research is the development of RME based learning tools that include lesson plans, modules based multi-representation, media, test description and student response questionnaire. The overall stages of this study use the concept of analysis, design, development, implementation, and evaluation (Almomen et al., 2016), in which the tools are developed based on local Indonesian wisdom and contain several mathematical representations. Figure 1 clearly outlines the stages of device development up to the evaluation of the effectiveness of RME learning tools developed.

2.2. Sample of Research

The sample of this research consisted of sixty four students grade VII Junior school in Pati Regency of Central Java Province, Indonesia. The sample is divided into two classes: experimental class was treated using the RME learning and control class was given treatment using the existing Learning strategy (conventional learning), with each class consists of thirty-two students. The research sample was selected using cluster random sampling technique to ensure the objectivity of the research, avoiding bias in the research and giving equal opportunity to a group of students who were collected in the class to be a research sample. Prior to treatment, the researchers tested the normality by the Lilliefors method to ensure that the sample came from a normally distributed population, tested homogeneity with Bartlett's test to ensure that both homogeneous samples, and t-test to show that both samples had the same initial ability.

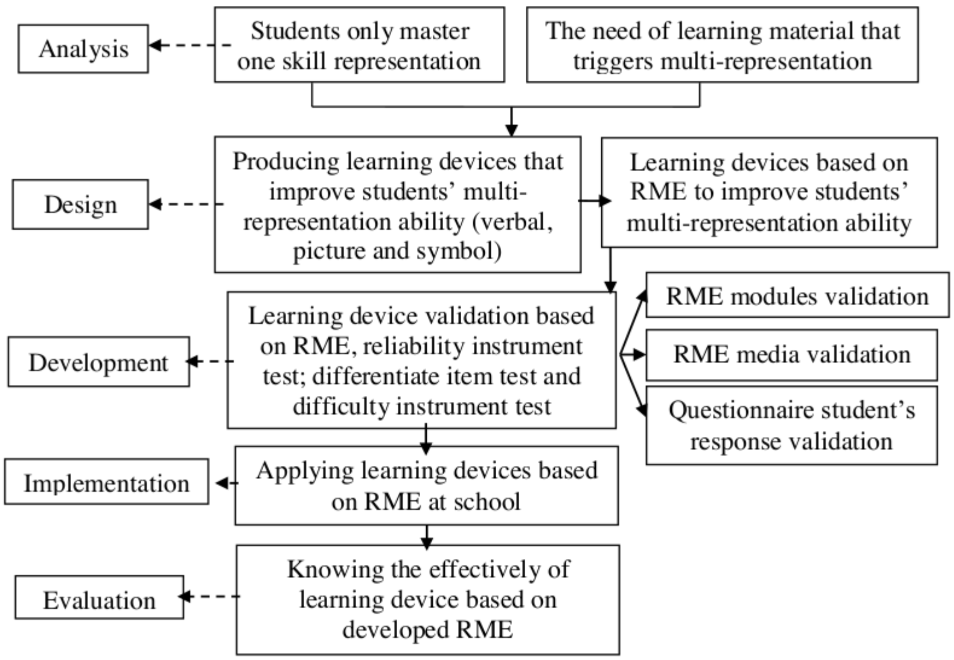

Figure 1. Research Step

2.3. Instrument and Procedures

The learning device developed include lesson plans, media, and RME-based modules. Prior to use, the device has been validated by three validators. They conclude that the device is eligible to use, in condition provided the text size should be enlarged. Furthermore, comments and suggestions from experts should be considered to improve the device so that the quality of media and RME module get better.

The essay test is structured referring to the syllabus of mathematics subjects in the 2013 curriculum in which the solution uses visual, verbal and symbol representations. Researcher uses RME-based long questions to measure students' multi-representation skills in experimental and control classrooms. Prior to use, the test question has been validated by three experts, already said three lines above then tested to determine the reliability, level of difficulty and the differentiation of the item. The analysis of essay test instrument result is presented in Table 2 which clearly indicates that there are five items used as pre-test and post-test in this study.

Table 2. Analysis of Essay Test Instrument

Question	Reliability		Difficulty level		Differentiation of item		Remark
	r	Criteria	Score	Criteria	Score	Criteria	
1			0.93	Easy	0.25	Enough	Used
2			0.70	Medium	0.59	Good	Used
3	0.65	Reliable	0.71	Medium	0.43	Good	Used
4			0.42	Medium	0.45	Good	Unused
5			0.29	Difficult	0.54	Good	Used

Question	Reliability		Difficulty level		Differentiation of item		Remark
	r	Criteria	Score	Criteria	Score	Criteria	
6			0.24	Difficult	0.50	Good	Unused
7			0.36	Medium	0.48	Good	Unused
8			0.88	Easy	0.39	Enough	Used

Student responses are needed to analyze the readability of RME devices that have been made and to know how the students respond to the RME-based devices. Quantitative data scoring obtained from the results of the questionnaires using Likert scale. Before the questionnaire was used it was validated by three validators who concluded that the questionnaire was worth using.

The prerequisite test includes the normality test and homogeneity test, which aims to find out the statistical tests to be used in the data analysis process. Parametric statistical tests are used if samples from classes with conventional learning and RME classes come from normally distributed populations, and the variance of both homogeneous groups. If the normality test requirement is not met, it will be used non-parametric statistical test.

The t-test is used to find out whether there is a difference of mean of multi-representation ability between RME class and conventional class. The data tested is the post-test result, in the following way:

H_0: the mean of multi-representation ability of RME class is less than the average of conventional class.

H_a: the mean of multi-representation ability of RME class is better than the average of conventional class

Students are said to master learning if they get multi-representation ability at the value of 75, and mastery learning is classically met if at least 85% of all students complete the study. 75 is the minimum criteria of mastery learning (MCML) established by the school (Hernawan, 2008).

To calculate the improvement of students' multi-representation skills before and after learning, it is calculated by the normalized gain formula (Meltzer, 2002), namely:

$$N-\text{Gain }(g)=\frac{\text{post test score}-\text{pre test score}}{\text{maksimum ideal score}-\text{pre test score}}$$

The result of N-Gain calculation then interpreted on Table 3.

Table 3. N-Gain Representation (g)

Amount of N-Gain (g)	Interpretation
$g \geq 0,7$	High
$0,3 \leq g < 0,7$	Medium
$g < 0,3$	Low

(Meltzer, 2002)

After the questionnaire is completed by the students, then it is analyzed and counted in percent. To be able to provide meaning and decision making, the researcher uses the provision as an indicator of student responses presented in Table 4.

Table 4. Percentage Range and Student Response Criteria

Interval	Criteria
81% - 100%	Very enthusiastic and interested
61% - 80%	Enthusiastic and interested
41% - 60%	Quite enthusiastic and interested
21% - 40%	Less enthusiastic and interested
< 21%	Not enthusiastic and interested

(Arikunto, 2010)

3. RESULTS AND DISCUSSION

3.1. Results

Table 5. Normality Test Result

Learning strategy	n	L_{obs}	L_{table}	Hypothesis	Remark
RME	32	0.149	0.157	H_0	accept
Conventional	32	0.148	0.157	H_0	accept

Table 5 presents that $L_{obs} < L_{table}$, with $\alpha = 0.05$ and $n = 32$. This means that sample from a class that uses conventional learning and a class that uses RME come from a normally distributed population.

Table 6. Homogenity Test Result

Learning strategy	N	varians	F_{obs}	F_{table}	Hypothesis	Remark
RME	32	80.32	0.883	1.822	H_0	accept
Conventional	32	71.35				

Table 6 shows that $F_{obs} = 0.883$, and $F_{table} = 1.822$, therefore H_0 is accepted. It can be concluded that both goup varians are homogen.

Table 7. The Results from the T-Test of The Post-Test Scores

Learning strategy	N	mean	t_{obs}	t_{table}	Hypothesis	Remark
RME	32	80.78	3.296	1.999	H_0	reject
Conventional	32	73.59				

Table 7 presents the result of t-test with the dependent variable is the students' multi-representation ability. It is clear that there is a significant difference between the multi-representation ability of the students, where sp = 8.723, $t_{obs} = 3.296$, with the value of $v = 32 + 32 - 2 = 62$ and $\alpha = 0.05$, obtained $t_{(0.05, 62)} = 1.999$; thus H_0 is rejected. It means that the multi-representation ability of students who get RME learning is better than the multi-representation ability of students who get conventional learning.

Student learning mastery is seen from the pre-test score taken before the students are given RME study, while post-test value is taken after students are given RME learning. Table 8 clearly shows the value of pre-test and post-test taken from both research class. It is clear that the average post-test score is higher than the average pre-test. Related to the achievement of student learning, in the class with RME the percentage of students who achieve mastery of 87.25% which means that almost all students complete the KKM. While in the conventional learning class percentage of students who achieve completeness only amounted to 53.125%.

Table 8. Mean of Pre-Test, Post-Test, and Mastery Learning Percentage

Learning strategy	Mean		Mastery learning Percentage
	Pre-test	Post-test	
RME	45.47	80.78	87.25%
Conventional	19.69	63.59	53.125%

After getting the value of pre-test and post-test, then in each class is tested with N-Gain test which aims to see improvement of multi-representation ability of students. Table 9 provides an overview of the multi-representation skills of students on RME learning. Consider that the image representation increases by 0.74, the increase in verbal representation by 0.79 and the increase in symbol representation by 0.95 or the increase in the high category.

Table 9. Improved Students' Multi Representation Skill in RME Class

Representation	N-Gain	Interpretation
Visual	0.74	High
Verbal	0.79	High
Symbol	0.95	High

Table 10. Improved Students' Multi-Representation in the Conventional Class

Representation	N-Gain	Interpretation
Visual	0.50	Medium
Verbal	0.25	Low
Symbol	0.89	High

Table 10 gives the depiction of students' multi-representation skill improvement in conventional learning. It is seen that the picture representation improvement amounted 0.50 or categorized as medium improvement, verbal representation improvement amounted 0.25 and symbol representation improvement as much as 0.89. While the comparison of multi-representation capability improvement of each class is presented in Table 11. It shows that almost all students who get RME learning have improved their multi-representation ability.

Table 11. Improved Students' Multi-Representation

Learning strategy	N-Gain	Interpretation
RME	0.80	High
Conventional	0.40	Medium

The RME learning implemented in the experimental class is equipped with RME-based tools. As already described that this device has been validated and feasible to use. The results of the assessment of 32 students who received learning with RME-based tools showed that 87.5% or 28 students stated very enthusiastic and interested, and 4 students stated quite enthusiastic and interested in learning with tools based on RME, thus increasing the learning spirit in the learning process.

3.2. Discussion

Our preliminary analysis indicates that many students only mastered the representation of symbols in a math problem. Thus, teaching materials are needed that triggers the multi-representation abilities of students. This teaching material contains several representations (verbal, pictures and symbols) so that it is expected to be able to improve students' multi-representation ability. The development of RME based learning tools that include lesson plans, modules based multi-representation, media, test description and student response questionnaires. The RME tools developed have been validated and declared feasible to be implemented in the learning process.

The results showed that multi-representation ability in students who got RME better than the ability of multi-representation in students who received conventional learning. This indicates that the RME tools developed have been able to foster students' beliefs and confidence in the use of multiple representations to solve mathematical problems (Nizaruddin et al., 2017). Supporting the description is shown that 87.25% or almost all students who get RME learning with the developed device have completed the KKM as determined by the school that is the value of 75; this is inversely proportional mastery of students with conventional learning is only equal to 53.125%. Further data show that many students are very enthusiastic and interested in RME based learning, thus increasing their learning spirit in learning process. Furthermore, the implementation of RME has been able to improve the multi-representation ability of students, which is obtained by an increase of 0.8 with high category in the application of RME and only an increase of 0.4 in the moderate category on conventional learning. The number of representations students use to solve math problems is a reflection of their understanding of mathematical concepts and procedures (Brenner et al., 1997).

The learning process begins using symbol representation, then using verbal and visual representations that help students in translating their representations. This is in line with the opinion of Keller & Hirsch (1998); Bransford & Schwartz (1999); Ainsworth (2006); and Hwang et al., (2007) saying that the use of more than one representation can avoid the limitations of one type of representation so as to build student understanding. During the student learning process in groups, students actively solve math problems, feel enthusiastic and more challenged to do using some kind of representation. Students actively develop an understanding of the concepts and their relationships so that they have multiple representational skills, and the multi-representation capabilities themselves can anticipate mistakes in understanding mathematical concepts (Hwang et al., 2007). This is shown when one group presents the results of the discussion, the others actively respond to what has been described; so that the mutual process of cooperative knowledge formation can be realized. While the conventional learning process shows students passively receive the knowledge described by teachers and students do not do the construction of knowledge (Muhtarom, Juniati & Siswono, 2017). Thus, students have been able to make different representations because they possess good mathematical knowledge and have knowledge of the kinds of representations as well as the nature of the relationships between their chosen representations (Janvier, 1987; Nizaruddin et al., 2017; Supandi et al., 2018), as was done during the process learning RME.

4. CONCLUSION

Multi-representation-based RME is one of the main factors in improving students' ability in learning mathematics. This research shows the fundamental differences in the multi-representation skills of students who get RME lessons and students who get conventional learning. Furthermore, RME learning by incorporating multi-representation is expected to be applied continuously by the teacher as an alternative in improving the quality of mathematics learning at school. Teachers need to be encouraged to always trill the ability of the representation, so that students are challenged to elicit multi-representation skills, especially in solving math problems.

ACKNOWLEDGEMENTS

We would like to thank the Rector of Universitas PGRI Semarang (UPGRIS) and the Dean of the Faculty of Mathematics Education, Natural Science, UPGRIS.

REFERENCES

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and instruction*, *16*(3), 183-198.

Almomen, R. K., Kaufman, D., Alotaibi, H., Al-Rowais, N. A., Albeik, M., & Albattal, S. M. (2016). Applying the ADDIE—analysis, design, development, implementation and evaluation—instructional design model to continuing professional development for primary care physicians in Saudi Arabia. *Int J Clin Med*, *7*(08), 538-546.

Arikunto, S. (2010). *Prosedur Penelitian Suatu Pendekatan Praktek*. Jakarta: Rineka Cipta.

Bransford, J. D., & Schwartz, D. L. (1999). Chapter 3: Rethinking transfer: A simple proposal with multiple implications. *Review of research in education*, *24*(1), 61-100.

Brenner, M. E., Mayer, R. E., Moseley, B., Brar, T., Durán, R., Reed, B. S., & Webb, D. (1997). Learning by understanding: The role of multiple representations in learning algebra. *American Educational Research Journal*, *34*(4), 663-689.

Hernawan, A. H. (2008). Makna ketuntasan dalam belajar. *Majalah Ilmiah Pembelajaran*, *4*(2).

Hwang, W. Y., Chen, N. S., Dung, J. J., & Yang, Y. L. (2007). Multiple representation skills and creativity effects on mathematical problem solving using a multimedia whiteboard system. *Journal of Educational Technology & Society*, *10*(2), 191-212.

Janvier, C. (1987). Representation and understanding: The notion of function as an example. In C. Janvier (Ed.), *Problems of representation in the teaching and learning of mathematics* (pp. 67–71). Hillsdale, NJ: Erlbaum.

Kaput, J. J., & Romberg, T. A. (1999). Mathematics worth teaching, mathematics worth understanding. In *Mathematics Classrooms That Promote Understanding* (pp. 15-30). Routledge.

Keller, B. A., & Hirsch, C. R. (1998). Student preferences for representations of functions. *International Journal of Mathematical Education in Science and Technology*, *29*(1), 1-17.

Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2018). How does Realistic Mathematics Education (RME) improve students' mathematics cognitive achievement. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(2), 569-578.

Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American journal of physics*, *70*(12), 1259-1268.

Milrad, M. (2002). Using construction kits, modeling tools and system dynamics simulations to support collaborative discovery learning. *Educational Technology & Society*, *5*(4), 76-87.

Muhtarom, Murtianto, Y. H., & Sutrisno (2017). Thinking Process of Students with High-Mathematics Ability (A Study on QSR NVivo 11-Assisted Data Analysis). *International Journal of Applied Engineering Research*, 12(17), 6934-6940.

Muhtarom, Juniati, D., & Siswono, T. Y. (2017). Consistency and inconsistency of prospective teachers' beliefs in mathematics, teaching, learning and problem solving. In *AIP Conference Proceedings* (Vol. 1868, No. 1, p. 050014). AIP Publishing.

NCTM (2000). *Principles and Standards for School Mathematics*. NCTM: Reston, VA.

Neria, D., & Amit, M. (2004). Students preference of non-algebraic representations in mathematical communication'. In *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 3, pp. 409-416).

Nizaruddin., Muhtarom, & Murtianto, Y.M. (2017). Exploring of Multi Mathematical Representation Capability in Problem Solving on Senior High School Students. *Problems of Education in the 21st Century*, 75(6), 591-598.

Ginting, M. S., Prahmana, R. C. I., Isa, M., & Murni, M. (2018). Improving the reasoning ability of elementary school student through the indonesian realistic mathematics education. *Journal on Mathematics Education*, *9*(1), 41-54.

Sembiring, R. K., Hadi, S., & Dolk, M. (2008). Reforming mathematics learning in Indonesian classrooms through RME. *ZDM*, *40*(6), 927-939.

Supandi, S., Waluya, S. B., Rochmad, R., Suyitno, H., & Dewi, K. (2018). Think-Talk-Write Model for Improving Students' Abilities in Mathematical Representation. *International Journal of Instruction*, *11*(3), 77-90.

Zakaria, E., & Syamaun, M. (2017). The Effect of Realistic Mathematics Education Approach on Students' Achievement and Attitudes towards Mathematics. *Mathematics Education Trends and Research*, *1*(1), 32-40.

INFINITY

ORIGINALITY REPORT

18%	10%	14%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	journal.unnes.ac.id Internet Source	1%
2	repository.uinjambi.ac.id Internet Source	1%
3	I Rozana, M Makmuri, L E Hakim. "Problem-based and thinking talk write learning model, mathematical reasoning, and transformation geometry", Journal of Physics: Conference Series, 2020 Publication	1%
4	Farrah Maulidia, Rahmah Johar, Andariah Andariah. "A CASE STUDY OF STUDENTS' CREATIVITY IN SOLVING MATHEMATICAL PROBLEMS THROUGH PROBLEM BASED LEARNING", Infinity Journal, 2019 Publication	1%
5	repository.upi.edu Internet Source	1%
6	ejournal.unsri.ac.id Internet Source	1%

7	media.neliti.com Internet Source	1 %
8	I Resita, C Ertikanto. "Designing electronic module based on learning content development system in fostering students' multi representation skills", Journal of Physics: Conference Series, 2018 Publication	1 %
9	Miftahul Husna, Heru Kuswanto. "Development of Physics Mobile Learning Based on Local Wisdom to Improve Vector and Diagram Representation Abilities", International Journal of Interactive Mobile Technologies (iJIM), 2018 Publication	1 %
10	Ida Nuraida, Asep Amam. "HYPOTHETICAL LEARNING TRAJECTORY IN REALISTIC MATHEMATICS EDUCATION TO IMPROVE THE MATHEMATICAL COMMUNICATION OF JUNIOR HIGH SCHOOL STUDENTS", Infinity Journal, 2019 Publication	<1 %
11	journal.walisongo.ac.id Internet Source	<1 %
12	Maximus Tamur, Sabina Ndiung, Adi Nurjaman, Jerito Pereira. "Sejauh Mana Perbedaan Kemampuan Matematis yang	<1 %

diukur Memoderasi Efektivitas Pendekatan Ralistic Mathematics Education: Studi Meta-Analisis", Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah di Bidang Pendidikan Matematika, 2021
Publication

13	d.researchbib.com Internet Source	<1%
14	Rahmad Bustanul Anwar, Dwi Rahmawati. "Symbolic and Verbal Representation Process of Student in Solving Mathematics Problem Based Polya's Stages", International Education Studies, 2017 Publication	<1%
15	Iis Tarsiyah, Abdul Hakim, Laili Komariyah. "The effect of guided inquiry learning model oriented multi-representation on multi-representation ability of senior high students in temperature and heat chapter", AIP Publishing, 2022 Publication	<1%
16	Putri Nur Malasari, Tatang Herman, Al Jupri. "Inquiry Co-Operation Model: An Effort to Enhance Students' Mathematical Literacy Proficiency", JTAM | Jurnal Teori dan Aplikasi Matematika, 2020 Publication	<1%

ojs.unimal.ac.id

17	Internet Source	<1%
18	repo.undiksha.ac.id Internet Source	<1%
19	vbn.aau.dk Internet Source	<1%
20	Ardhi Sanwidi. "STUDENTS' REPRESENTATION IN SOLVING WORD PROBLEM", Infinity Journal, 2018 Publication	<1%
21	Arief Aulia Rahman, Dian Kristanti, Andy Sapta, Mustika Fitri Larasati Sibuea et al. "Improve The Students' Mathematics Communication Ability Using Realistic Mathematics Education", Journal of Physics: Conference Series, 2018 Publication	<1%
22	Nurrahmawati Nurrahmawati, Cholis Sa'dijah, Sudirman Sudirman, Makbul Muksar. "Assessing students' errors in mathematical translation: From symbolic to verbal and graphic representations", International Journal of Evaluation and Research in Education (IJERE), 2021 Publication	<1%
23	Nurul Hamidah, Edi Istiyono. "The quality of test on National Examination of Natural	<1%

science in the level of elementary school", International Journal of Evaluation and Research in Education (IJERE), 2022
Publication

---

24 ijstr.org
Internet Source
<1 %

---

25 Runisah Runisah, Wiwit Damayanti Lestari, Nurfadilah Siregar. "STUDENTS’ MATHEMATICAL REASONING: HOW COULD IT BE THROUGH MHM-PROBLEM BASED STRATEGY AIDED INTERACTIVE MULTIMEDIA?", AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 2021
Publication
<1 %

---

26 docplayer.net
Internet Source
<1 %

---

27 dspace.nwu.ac.za
Internet Source
<1 %

---

28 journal.upgris.ac.id
Internet Source
<1 %

---

29 surface.syr.edu
Internet Source
<1 %

---

30 Bayu Wijayanto, Sumarmi Sumarmi, Dwiyono Hari Utomo, Budi Handoyo, Muhammad Aliman. "Problem-based learning using e-module: Does it effect on student’s high order
<1 %

thinking and learning interest in studying geography?", Journal of Technology and Science Education, 2023
Publication

---

31 D Ismunandar, F Gunadi, M Taufan, D Mulyana, Runisah. "Creative thinking skill of students through realistic mathematics education approach", Journal of Physics: Conference Series, 2020
Publication
<1 %

---

32 Edhy Rustan, Sela Maria Ningsih, Fauziah Zainuddin. "Development of Multi-representation Integrated Learning Media to Understand and Translate the Qur'an in Teaching the Qur'an and Hadith in Elementary Schools", AL-ISHLAH: Jurnal Pendidikan, 2022
Publication
<1 %

---

33 Muchamad Subali Noto, Wahyu Hartono, Dadan Sundawan. "ANALYSIS OF STUDENTS MATHEMATICAL REPRESENTATION AND CONNECTION ON ANALYTICAL GEOMETRY SUBJECT", Infinity Journal, 2016
Publication
<1 %

---

34 Ornit Spektor-Levy, Merav Yifrach. "If Science Teachers Are Positively Inclined Toward Inclusive Education, Why Is It So Difficult?", Research in Science Education, 2017
Publication
<1 %

35	W Mentari, Abdurrahman Abdurrahman, T Jalmo. "The Effectiveness of STEM Integrated Handouts to Improve Students Creative Thinking Skills in Biotechnology Material", Dinamika Jurnal Ilmiah Pendidikan Dasar, 2019 Publication	<1 %
36	William I. Ford, Kevin W. King, Mark R. Williams, Remegio B. Confesor. "Modified APEX model for Simulating Macropore Phosphorus Contributions to Tile Drains", Journal of Environment Quality, 2017 Publication	<1 %
37	ejournal.radenintan.ac.id Internet Source	<1 %
38	eprints.uny.ac.id Internet Source	<1 %
39	ikee.lib.auth.gr Internet Source	<1 %
40	journal.stkipsingkawang.ac.id Internet Source	<1 %
41	rosdianasidik.wordpress.com Internet Source	<1 %
42	"Development and Validation of Open Ended Based on Worksheet for Growing Higher Level	<1 %

Thinking Skills of Students", European Journal of Educational Research, 2020
Publication

43	D Susanti, M H Yaqiina, S Maulana. " Newton’s Gravity Interactive Simulation to Improve 10 - Grade Students’ Learning Outcome ", Journal of Physics: Conference Series, 2022 Publication	<1 %
44	Yenny Suzana, Sabaruddin Sabaruddin, Suesthi Maharani, Zainal Abidin. "MATHEMATICS LEARNING THROUGH CHARACTER EDUCATION BASED ON INTEGRATED THEMATIC LEARNING: A DEVELOPMENT OF LEARNING MATERIALS", Infinity Journal, 2021 Publication	<1 %
45	hdl.handle.net Internet Source	<1 %
46	Carolina Lestuny. "The Effectiveness of Using the Digital-Based Flipped Classroom Model in Learning German Grammar level A2.1", Pattimura Excellence Journal of Language and Culture, 2022 Publication	<1 %
47	Selected Regular Lectures from the 12th International Congress on Mathematical Education, 2015. Publication	<1 %

48	jurnal.umt.ac.id Internet Source	<1 %
49	ojs.umrah.ac.id Internet Source	<1 %

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		