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Realistic Mathematics: Application in Mathematical Literacy in Junior High Schools

Realistik Matematika : Penerapan dalam Literasi Matematis di Sekolah Menengah Pertama (SMP)

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Abstract

The background of this research is motivated by the lack of students' skills in applying mathematical concepts in real contexts. One way for students to get used to applying mathematical concepts to real contexts is to use a realistic mathematical approach. Based on the results of the literature review, this approach has been carried out, but researchers want to study and find out more deeply how this application can play a role in improving mathematical literacy skills. Therefore, the purpose of this study is to analyze the application of a realistic mathematical learning approach so that students' mathematical literacy skills, especially at the secondary school level, can improve. This study is a systematic literature review study by searching for article materials in the Google Scholar database from 2016-2024 which are indexed by Sinta, Scopus journals, or from proceedings for the results and discussion sections, with problem limitations in secondary schools. The results of the study show that by applying a realistic mathematics education approach, mathematical literacy skills can improve. As for the realistic mathematics education learning process, teachers can choose learning models and learning media by paying attention to the characteristics of RME.

Keywords: *Mathematical literacy, mathematics, realistic mathematics, junior high school.*

Abstrak

Penelitian ini dilatarbelakangi bahwa kurangnya keterampilan pelajar dalam menerapkan konsep matematika dalam konteks nyata. Salah satu cara agar pelajar terbiasa menerapkan konsep matematika ke dalam konteks nyata adalah dengan menggunakan pendekatan *realistic mathematic.* Berdasarkan hasil kajian *literature* pendekatan ini sudah dilakukan namun peneliti ingin mengkaji dan mengetahui lebih dalam bagaimana penerapan tersebut dapat berperan dalam meningkatkan keterampilan literasi matematis. Oleh sebab itu, tujuan dari penelitian ini adalah menganalisis penerapan pendekatan pembelajaran realistik matematika sehingga keterampilan literasi matematis peserta didik khususnya pada jenjang sekolah menengah dapat meningkat. Penelitian ini merupakan penelitian *systematic literature review* dengan mencari bahan artikel pada database google scholar tahun 2016-2024 yang terindeks jurnal sinta, scopus, ataupun berasal dari prosiding untuk bagian hasil dan pembahasannya, dengan batasan permasalahan pada sekolah menengah. Hasil penelitian menunjukkan bahwa dengan penerapan pendekatan *realistic mathematics education* keterampilan literasi matematis dapat meningkat. Adapun saat proses pembelajaran *realistic mathematics education,* guru dapat memilih model pembelajaran dan media pembelajaran dengan memperhatikan karakteristik dari RME.

Kata Kunci: Literasi matematis, matematika, realistik matematika, sekolah menengah pertama.

1. Introduction

Mathematical literacy skills are the skills needed by every individual in the 21st century (OECD, 2022). In the study (Anwar, 2018) the components of mathematical literacy contained in 21st century skills are critical and problem solving, communication and collaboration, and creativity and innovation. These components are needed because they can answer and solve the challenges of the problems that will be given in the times.

The importance of mathematical literacy skills is not directly proportional to the skills of students in Indonesia. Based on the results of the literature review (Khoirudin et al. 2017) and (Yunita et al., 2020), it shows that the mathematical literacy skills of secondary school students are still low. Internationally, the mathematical literacy skill scores of students in Indonesia tend to go down. This can be seen in the PISA data from 2015-2022. In 2015 the score obtained was 386, in 2018 the score obtained was 379, and in 2022 the score obtained was 366 (OECD, 2023). Based on three periods of participation, the score is still below the minimum score.

The reason why students' mathematical literacy skills in Indonesia are not good is because they are not used to solving real context problems (Selan et al., 2020). Based on the results of interviews in the literature (Widianti & Hidayati, 2021) it is still found that these students have not been able to make plans in solving a problem and interpret it into a real context. This could be due to the fact that teachers still rely on giving routine problems (Susanti & Syam, 2017). In addition, interest in learning (interest) also affects the growth of this skill (Rodhi, 2021).

In his article "Why to teach mathematics so as to be useful" (Freudenthal, 1968), he expressed his thoughts regarding the world of mathematics education. In his view, although mathematics has been recognized as a very useful subject, understanding how an individual can apply their theoretical knowledge of mathematics to practice (real situations) is a big challenge. A teacher who can apply mathematics to their daily life do not necessarily know the reasons why they do so and use this knowledge in their teaching.

One approach to learning mathematics that presents real-world or "realistic" problems is the Realistic Mathematic Education or RME approach (Van den Heuvel-Panhuizen & Drijvers, 2020). This mathematics learning approach was developed by Hans Freudenthal, in the Netherlands. The foundation of this learning approach is Freudenthal's statement that mathematics is a human activity (Van den Heuvel-Panhuizen & Drijvers, 2020; Wijaya, 2012). The human activity expressed by Freudenthal implies that learning mathematics is not just an activity to memorize formulas and solve them according to the rules, but this activity is carried out by humans to understand and solve problems in everyday life.

Based on this description, mathematical literacy skills are very important for every individual to have. One way to improve the numeracy literacy skills of secondary students is by implementing realistic mathematics learning. The results of the search that has been done that this approach has been done by many researchers to improve numeracy skills, but researchers want to examine and find out more deeply how the application can play a role in improving mathematical literacy skills. Therefore, the purpose of this study is to analyze the application of the mathematical realistic learning approach so that the mathematical literacy skills of students, especially at the secondary school level, can increase.

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2. Literature Review

2.1. Mathematical Literacy

In the article review (Niss & Jablonka, 2014) the term mathematical literacy first appeared in 1944 in the United States where learning in schools should ensure that everyone should have mathematical literacy skills. The definition of mathematical literacy in that year was not yet clearly defined but NCTM in 1989 put forward a general goal to achieve mathematical literacy for all learners. The objectives of mathematical literacy that he stated were: (1) that they learn to appreciate mathematics, (2) that they become confident in handling mathematical tasks, (3) that they become mathematical problem solvers, (4) that they learn to communicate mathematically, and (5) that they learn to reason mathematically.

The definition of mathematical literacy began to emerge in 1999 by the OECD. Mathematical literacy is a person's ability to identify, know the role of mathematics in the world, can make decisions with strong and logical mathematical principles, so that the person can handle the needs of life both present and future as someone who is constructive, attentive, and as a reflective citizen (OECD, 1999). The definition expressed by the OECD underwent several changes as the implementation of PISA was carried out. The definition of mathematical literacy according to (OECD, 2018) related to the 2015 and 2018 PISA assessments is that mathematical literacy is a person's ability to formulate, use, and interpret mathematics using various contexts. This includes the ability to reason mathematically and use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena, thus encouraging people to recognize the role of mathematics in a world that can make the judgments and decisions required by constructive, engaged and reflective citizens.

2.2. Realistic Mathematics Education: Understanding and Characteristics

The Realistic mathematics education approach was first developed by Hans Freudenthal when he was director of the IOWO institute in 1973, in the Netherlands (Van den Heuvel-Panhuizen & Drijvers, 2020). Realistic mathmeatics learning is a learning approach to understanding mathematics using contextual problems, so that the learning process is more meaningful (Mirtasari & Sutarni, 2022; Oftiana & Saefudin, 2017).

There are six principles of realistic mathematics education learning proposed by Treffers, namely (1) the principle of activity, learners act actively during the learning process; (2) the principle of reality, meaning that in the learning process learners can apply mathematics in solving "real life" problems and teaching begins with problems in a context that is familiar to learners; (3) the principle of level, this principle emphasizes learning mathematics means that learners pass through various levels of understanding from solutions related to informal contexts to create various levels of understanding; (4) the principle of intertwinement, which means learners can use a variety of mathematical tools and knowledge; (5) the principle of interactivity, which means learning activities not only done individually but there are social activities (discussions, group work), and (6) the principle of guidance, which means in learning the teacher should have a proactive role and contains learning scenarios that work as levers to achieve changes in learners' understanding (Van den Heuvel-Panhuizen & Drijvers, 2020).

The characteristics of RME are: (1) applying real-life contexts as the basis of mathematics learning, (2) applying models that prioritize informal solutions before applying formal processes or formulas, (3) relating to other topics in mathematics, (4) applying interactive methods in mathematics learning, and (5) appreciating the diversity of responses and participation of students.

3. Research Methods

The research method used was Systematic Literature Review (SLR). This method was chosen because it can help researchers in finding evidence in articles for understanding mathematical literacy and realistic mathematics, what support has been done in improving mathematical literacy through realistic mathematics, and what applications have not been explained or done (Cooper, 2016). The strategy used in this research is to collect research articles on the definition of mathematical literacy, realistic mathematics education (RME), and the application of mathematical literacy in realistic mathematics education. The search keywords used were: (a) mathematical literacy; (b) mathematical literacy; (c) realistic mathematics education (RME) or PMRI; (d) junior high school. The keywords are searched on the google scholar database indexed by Sinta, Scopus, or from the proceedings with the help of the publish or perish 8 application. The author will make a selection to examine and review the contents of the research article. The following is the selection of data on the articles used. Which is shown in Table 1. and Figure 1.

Table.1. Article Selection Criteria

Acceptance/Rejection	Criteria
Acceptance (Inclusion)	1. The content of the article is in line with the topic. 2. The content of the article is related to the math learning. 3. Junior high school level in Indonesia.

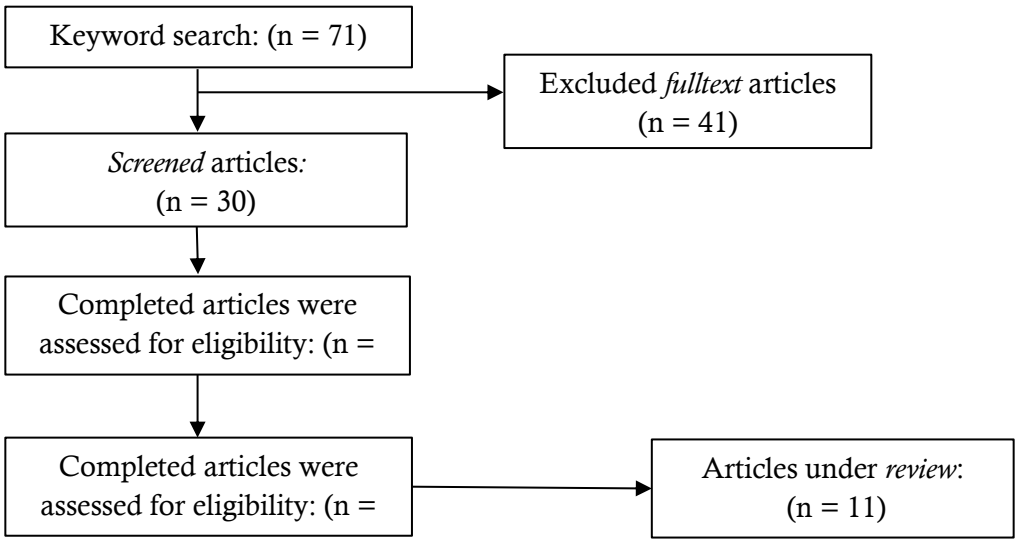

Figure.1. Flow of Article Selection

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4. Results and Discussion

4.1. Results

Based on the research objectives, the researchers searched and collected articles related to the application of realistic mathematics education and mathematical literacy skills of secondary school students. Which is shown in masrurog.

Table.2. Publication of RME Articles Related to Mathematical Literacy Skills

No.	Researcher	Year	Research Results
1.	Wardono, S B Waluya, Scolastika Mariani, S Candra D	2016	Mathematical literacy skills can be improved by using the RME approach assisted by Edmodo.
2.	Wardono and S Mariani	2017	Through the PMRI approach assisted by Schoology, it is effective to improve mathematical literacy skills because there is an achievement of classical completeness of mathematical literacy skills in learning
3.	Wardono, B Waluya, Kartono, Mulyono, and S Mariani	2018	The RME approach with the use of ICT (Information and Communication Technologies) can help improve mathematical literacy skills.
4.	Wardono, Scolastika Mariani, Rista Tri Rahayuningsih, Endang Retno Winarti	2018	Problem-based learning assisted by Edmodo can improve mathematical literacy skills
5.	Euis Fajriyah, Mulyono, M. Asikin	2019	The mathematical literacy skills of students who apply RME learning with a double loop problem solving model are of good quality.
6.	Wardono, Norma Istiqomah, and Scolastika Mariani	2020	The learning quality of the project-based RME approach has good quality in improving mathematical literacy skills.
7.	Uswatun Hasanah, Novita Sari, Novika Sumaningthias, and Zuli Nuraeni	2021	Through PMRI based on blended learning, students' mathematical literacy skills can be improved.
8.	Dewi Yanwari Madyaratri, Wardono, and Kartono	2022	RME Approach with Discovery Learning Model Assisted by Schoology effective on mathematical literacy skills
9.	Melda Maulyda and Achmad Mudrikah	2023	Mathematical literacy skills that apply the RME approach are better than the scientific approach.
10.	Masruroh and Maya Nurfitriyanti	2023	Mathematical literacy skills can be improved with the RME approach
11.	Bunga Trinanda, Novita Sari, Novika	2024	The application of e-worksheet-based RME learning is effective enough to

No.	Researcher	Year	Research Results
	Sukmaningthias, and Ruth Helen Simarmata		improve students' mathematical literacy skills.

Researchers obtained 11 articles related to the application of the realistic mathematic education (RME) approach to mathematical literacy skills presented in Table 2. Based on these 11 articles, only by applying the approach, the mathematical literacy skills of secondary school students can increase (Masruroh & Nurfitriyani, 2023; Maulyda & Mudrikah, 2023). Using learning media and choosing the right learning model can support students' mathematical literacy skills and increase the interest of their learning activities. These learning activities are of course arranged in accordance with the characteristics of the realistic mathematics approach. Learning media that support in improving mathematical literacy skills are the use of schoology, edmodo, and ICT / ICT media (Wardono et al., 2016; Wardono, et al., 2018; Wardono et al., 2020; Wardono, et al., 2018) while the realistic mathematics-based learning models that have been used are problem-based learning, project-based learning, double loop problem solving, discovery learning, and blended learning (Fajriyah et al., 2019; Wardono et al., 2016; Wardono et al., 2020; Hasanah et al., 2021; Madyaratri et al., 2022; Wardono, et al., 2018).

4.2. Discussion

The application of mathematical literacy skills of secondary school students can increase through the implementation of realistic mathematics education approach learning by compiling learning activities in the form of worksheets, materials, and problems used related to routine activities in everyday life, contextual problems, or contexts known by students (Fajriyah et al., 2019; Hasanah et al., 2021; Maulyda & Mudrikah, 2023). Worksheets are designed using real contexts that are transformed into abstract (Maulyda & Mudrikah, 2023) or by using tools such as e-worksheets (Trinanda et al., 2024). After learners are given worksheets, they can identify problems, detect their causes and apply temporary solutions (Fajriyah et al., 2019).

Learning activities with the realistic mathematics approach are also carried out in an interactivity manner, namely discussing in groups because it can involve the contribution of students (Hasanah et al., 2021). Learners' discussions can be related to evaluating the results of their findings by comparing and discussing their answers and deciding whether or not deeper analysis is needed, so that they can implement the main solution (Fajriyah et al., 2019). The application of learning in this lesson is based on Vygotsky's theory, namely learners can improve their mathematical literacy skills by discussing with their groupmates to discuss real problems (Madyaratri et al., 2022) and solve problems (Maulyda & Mudrikah, 2023).

Group discussions can be conducted virtually because this learning approach can be collaborated with learning media. Group discussions with friends and teachers can be done through zoom meetings, google classroom, edmodo, and schoology (Hasanah et al., 2021; Wardono et al., 2016; Wardono, et al., 2018; Wardono et al., 2020; Wardono, et al., 2018). The use of edmodo in the study is a means for students to search and upload PISA questions or questions that require reasoning in the solution process (Wardono et al., 2016; Wardono, Rahayuningsih, et al., 2018). Teachers can share discussion topics so that students can see, discuss, understand, and solve problems correctly. The use of schoology as a learning tool for teachers to conduct learning activities, such as sending videos, images, or audio to students (Wardono et al., 2020). Activities using schoology can develop students' interest in learning, because with the role

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of students who become active in the use of e-learning both outside the classroom (Wardono & Mariani, 2017).

Based on the results of analyzing students' answers in the study (Trinanda et al., 2024) revealed that high ability category students will bring up 4-5 components of mathematical literacy, while students with low ability only bring up 2 components of mathematical literacy. (Wardono et al., 2020) also stated that through project-based learning with the RME approach assisted by schoology, the quality of students' mathematical literacy skills is good, because learning plans such as lesson plans, project LKS and teaching materials are prepared and tested for validity first.

5. Conclusion

Mathematical literacy skills are individual skills needed in solving problems related to real-world contexts. Therefore, there is a need for a teaching approach that aims to train thinking so that students' skills in improving mathematical skills. The realistic mathematics education approach has the characteristic that learning mathematics is a human activity. The things that need to be considered in developing learning activities need to be considered learning media and learning models that can be integrated with the RME approach. The suggestions for further research that can be done are to develop teaching materials or teaching modules whose application uses the RME approach.

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