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Implementation of the Realistic Mathematics Education (RME) Approach in Geometry Learning in Secondary Schools

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ABSTRACT

This study aims to analyze the implementation of the Realistic Mathematics Education (RME) approach in geometry learning in secondary schools. Realistic Mathematics Education, which emphasizes mathematics learning through relevant contexts and students' real experiences, aims to improve students' understanding and skills in geometry. This study evaluates the effectiveness of the implementation of RME and identifies various challenges and potential solutions in its implementation. The method used is a literature review that includes studies related to the implementation of RME in geometry learning. The results of the analysis show that RME can improve students' understanding of geometric concepts by linking materials to everyday situations, thereby motivating and involving students more actively in the learning process. This approach helps students link theory to real practice, deepen their understanding, and develop problem-solving skills. There are challenges such as teacher readiness, limited resources, and limited time allocation, recommendations to improve teacher training, develop supportive policies, and provide adequate resources can help overcome these problems. With the right strategy and adequate support, RME has great potential to improve the quality of geometry learning in secondary schools and have a positive impact on student learning outcomes.

INTRODUCTION

The modern era of education demands an innovative approach to mathematics learning to improve students' understanding and skills (Lavicza, 2022). Conventional mathematics education often focuses on theoretical and abstract aspects, which can make it difficult for students to relate mathematical concepts to practical applications in everyday life (Lester, 2020). Realistic Mathematics Education (RME) emerges as an effective solution to this challenge by emphasizing the use of real and relevant contexts in the learning process. This approach is designed to connect mathematical materials with students' concrete experiences, making learning more meaningful and understandable. Realistic Mathematics Education encourages students to be actively involved in discovery, exploration, and problem solving based on real contexts, which motivates and deepens their understanding of mathematical concepts (Bray, 2021). In the context of geometry learning,

RME provides a new way to deliver material that is often considered abstract, by relating geometric concepts to everyday situations. The use of geometric models or representations taken from surrounding objects helps students see the relationship between theory and practice and develops critical thinking and problem-solving skills (Hwang, 2023). The application of RME in geometry learning in secondary schools aims to improve students' understanding, create an interactive and inspiring learning environment, and increase students' motivation and interest in geometry subjects.

In mathematics education, geometry often poses a significant challenge for many students in secondary school because concepts involving shape, size, and spatial relationships tend to be considered abstract and difficult to understand. This difficulty can hinder students' understanding and reduce their interest in this subject. To overcome this problem, a creative and applicable approach is needed. The implementation of Realistic Mathematics Education (RME) in geometry learning offers an effective solution by linking geometry material to real situations that are relevant to students' daily lives. By utilizing familiar contexts and concrete situations, this approach helps students understand the relationship between geometry theory and its application in the real world. Geometry concepts with interior design, architecture, or everyday activities such as planning room layouts can make it easier for students to understand and apply these concepts (Burry, 2022). Through RME, students learn directly and exploratively, which enhances their understanding of geometric principles. Activities such as building geometric models and solving real-world problems make learning more interesting and relevant, while encouraging students to think critically and creatively. RME integration aims to create a dynamic and contextual learning environment, so that students feel more involved, motivated, and ready to face future mathematics challenges (Kizito, 2022).

Geometry is a branch of mathematics taught at various levels of education, from elementary school to college. This discipline is very relevant to students' daily lives, because almost all visual objects around them are geometric shapes. Freudenthal (Afgani, 2021) stated that geometry is a space where children are, live, and move. In this context, children need to learn to understand (to know), explore (to explore), strive to achieve victory (conquer), plan and organize their lives (in order to live), breathe (breathe), and improve their quality of life (move better in it) (Afgani, 2021). Mathematics functions as an essential tool for humans and supports various fields of science, both for theoretical and practical purposes (Weintrop et al., 2022). The values in mathematics include practical aspects, where every individual cannot be separated from the application of mathematics in everyday life, such as in the activities of counting, adding, subtracting, multiplying, and dividing. Applications of mathematics, such as understanding numbers for measurement, show its enormous role in human life. Therefore, Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System stipulates that the curriculum of primary and secondary education must include mathematics subjects. The importance of teaching mathematics at all levels of primary education is intended to equip students with the ability to think logically, analytically, systematically, critically, creatively, and the ability to work together (Tong et al., 2020).

The scope of mathematics subjects at the elementary school/Islamic elementary school level includes: (1) numbers; (2) geometry and measurement; (3) data processing. These aspects are stated in the Competency Standards (SK) and Basic Competencies (KD), which are the basis for teachers in planning and implementing learning to achieve and develop the expected abilities to the maximum. Mathematics is one of the subjects that has unique characteristics and is always applied in solving various everyday problems

(Sepriyanti & Julisra, 2019). This science is abstract, meaning that mathematical concepts do not always appear in concrete form, but rather exist in the realm of thought. The abstraction process is needed to transform real problems into mathematical models that can be analyzed and solved. These abstract characteristics have an impact on students' mathematical literacy skills, which require skills in understanding, applying, and solving problems through mathematical models. In other words, effective mastery of mathematics requires the ability to transform real-world situations into relevant mathematical forms, so that students can use their mathematical knowledge in broader and more complex contexts (Silahuddin, 2017).

This study focuses on exploring the implementation of the Realistic Mathematics Education (RME) approach in geometry learning in secondary schools and evaluating its impact on students' conceptual understanding and practical skills in geometry. Various aspects will be studied, starting from learning planning, the use of real contexts in presenting materials, to evaluation techniques that are in accordance with the principles of RME. Emphasizing learning that is relevant to students' daily lives, this study seeks to reveal the extent to which the RME approach can improve students' understanding of geometric concepts that are often considered abstract and complex (Noviani, 2020). Evaluating the impact of RME on learning outcomes, this study will also identify effective strategies in its implementation. These strategies include selecting an appropriate context, designing interesting and meaningful learning activities, and implementing teaching techniques that support active and participatory learning processes. Students' low mathematical literacy skills can be influenced by various factors. One of the main factors is the lack of teacher habits in dealing with problems related to mathematical literacy (Madyaratri, 2019; Busyra & Sani, 2020). Teachers are expected to understand the characteristics of mathematics well so that they can deliver learning that is easy for students to understand.

The use of problems related to everyday life as part of the learning process is very important, because it can connect mathematical concepts with students' real experiences. This is in accordance with the Realistic Mathematics Education (RME) approach, which was first developed in the Netherlands. RME is a mathematics learning approach that teaches mathematical concepts through students' experiences, so that the material becomes more solid and meaningful (Fauzan, 2020). In the study of mathematical literacy, modeling or mathematization is considered a key phase. The RME approach integrates the use of models in the learning process. At the elementary school level, the models used are often real objects. For example, for material about cylinders, it is recommended that students be given the opportunity to interact with cylindrical objects directly. The use of this real model makes it easier for students to observe the properties of cylinders and helps the abstraction process from physical objects into the form of sketches of cylinders (models for). Thus, students can understand mathematical concepts better and improve their mathematical literacy. This study also aims to understand the challenges that may arise during the RME implementation process, such as time constraints, limited resources or relevant learning materials, and difficulties in changing traditional teaching methods to more contextual and student-centered approaches.

The results of this study are expected to provide important contributions to the development of more effective, innovative, and context-based geometry learning methods in secondary schools (Sutaphan, 2019). This study is expected to provide practical guidance for educators in designing and implementing learning strategies that integrate RME, which in turn can increase student engagement and motivation in learning geometry (Tumangger et al., 2024). The findings of this study can also be the basis for the development of

educational policies that support the use of a broader real-context-based learning approach at various levels of education. The potential for research to have a significant impact on improving the quality of mathematics education, especially in the field of geometry, and encourage the development of students' critical thinking and problem-solving skills in the future. Realistic Mathematics Education (RME) has been recognized as an effective approach in improving students' mathematical understanding, but research related to its implementation in geometry learning at the secondary school level is still limited (Noviani, 2021). Most of the existing studies focus more on the application of RME in basic mathematical concepts such as arithmetic and algebra. Meanwhile, the application of RME in geometry learning, which is known to be more abstract and challenging, has not been explored comprehensively.

Geometry is one of the areas of mathematics that requires a contextual approach to improve students' understanding, especially at the secondary school level where students often have difficulty in understanding more complex geometric concepts. In addition, existing research provides little insight into concrete strategies that can be used by teachers to effectively integrate RME in geometry learning. Information on how to overcome obstacles that may arise during the implementation of RME, such as limited time, resources, or difficulties in changing traditional teaching methods to a more contextual approach, is also still minimal. The lack of in-depth empirical studies on contextual factors, such as cultural background, students' learning experiences, and the availability of resources in schools, which may affect the success of RME implementation in geometry classes, indicates the need for further research. This study aims to fill the gap in the existing literature by exploring how the RME approach can be effectively implemented in geometry learning in secondary schools. This study will evaluate its impact on students' understanding and skills, and identify effective implementation strategies and challenges that educators may face. The results of this study are expected to provide significant contributions to the development of more effective, contextual, and relevant geometry learning methods to students' needs and learning conditions in secondary schools. Contextual learning approaches, such as Realistic Mathematics Education (RME), offer a more effective and engaging way to teach geometry (Human, 2022).

This approach utilizes real-world contexts and everyday situations that are relevant to students to facilitate deeper understanding of mathematical concepts. Although RME has been proven effective in improving mathematical understanding at various levels and contexts, its implementation in geometry learning in secondary schools has rarely been studied in depth. Many teachers do not fully understand how to integrate RME into the geometry curriculum and utilize learning strategies that can overcome various obstacles that may arise, such as time constraints, the availability of contextual learning materials, and adaptation of traditional teaching methods. This phenomenon indicates an urgent need to explore how RME can be effectively implemented in geometry learning in secondary schools. By understanding the appropriate implementation strategies and the challenges that may be faced, this study can provide deeper insights into how to improve the quality of geometry learning. This is important so that students can not only understand geometric concepts more deeply, but also develop critical thinking, analytical, and problem-solving skills that are relevant to real life.

METHODOLOGY

This study uses a literature study method to analyze the implementation of the Realistic Mathematics Education (RME) Approach in geometry learning in secondary

schools. This method was chosen because it allows researchers to collect and evaluate various relevant scientific literature without the need to collect primary data. This study was designed with a qualitative descriptive approach to describe the application of RME in geometry learning and assess its effectiveness based on existing research results. Data sources used include scientific journals, textbooks, theses, dissertations, and scientific articles that discuss the topic of RME and geometry learning. The selection of literature was carried out based on certain criteria, namely publications in the last ten years, empirical and theoretical research, and relevance to mathematics education in secondary schools. Data collection was carried out by searching academic databases such as Google Scholar using the keywords Realistic Mathematics Education, RME, geometry learning, and secondary schools. The data obtained were then analyzed using the content analysis method, where each literature was identified for its themes, grouped by categories such as learning strategies, implementation challenges, and student learning outcomes. Researchers synthesized from various sources to draw deeper conclusions regarding the implementation of RME. To ensure validity and reliability, this study used source triangulation by comparing the results of various different literatures. Through this approach, it is hoped that the research can provide a comprehensive picture of the implementation of RME in geometry learning and provide practical recommendations to improve the quality of mathematics learning in secondary schools.

RESULTS AND DISCUSSION

Based on the results of the literature review that has been conducted, the implementation of the Realistic Mathematics Education (RME) Approach in geometry learning in secondary schools shows a number of important findings related to the effectiveness and challenges of implementing this method. The RME approach has been proven to be able to improve students' conceptual understanding of geometry more significantly than conventional methods. This is because RME emphasizes contextual learning, where students are faced with real situations that are relevant to geometric concepts (Rabbani, 2020). Thus, students are invited to understand abstract concepts by linking material to everyday experiences. For example, students can be asked to identify geometric shapes in real life, such as in buildings or objects around them. The reviewed studies show that students who learn with the RME approach tend to find it easier to understand abstract concepts such as points, lines, planes, and spaces, compared to students who are taught using conventional methods that focus more on memorizing formulas. The RME approach has also been shown to increase students' active involvement in the learning process. By implementing problem-based learning, students act as problem solvers, while teachers act as facilitators.

This process not only develops students' critical thinking skills but also encourages them to find solutions independently, which ultimately increases learning independence. This active involvement also has a positive impact on students' learning motivation. Students feel more interested and involved because learning becomes more relevant to their real lives (Downes, 2022). RME also helps reduce students' anxiety about mathematics, because they understand the material better with an applied approach, not just theoretical. Based on the research analysis, it is clear that Realistic Mathematics Education (RME) shows significant effectiveness in improving students' problem-solving skills and learning outcomes. This approach integrates students' daily realities and experiences into the learning process, allowing students to construct their knowledge independently. This is in line with Freudenthal's view (Rosneli, 2022), which states that mathematics should not be given as a

finished product, but as a dynamic activity or process. The RME approach allows students to understand the relationship between mathematical concepts and real situations in everyday life and their relevance to human needs.

Students can build and develop their own mathematical knowledge. This approach emphasizes that there is no single way to solve a problem, so students are encouraged to explore and find various methods of solving. In addition, RME encourages students to develop their own mathematical concepts, which increases their engagement and interest in learning. In-depth analysis in designing mathematics learning on geometric transformation material using the Realistic Mathematics Education model based on Ethnomathematics is very important. This analysis aims to assess and address the gap between students' current knowledge and the knowledge needed to achieve the expected learning objectives (AH Brown & TD Green, 2019). This process involves identifying strengths and weaknesses in students' understanding and developing effective learning strategies to bridge the gap.

The purpose of the designed learning is for students not only to understand the basic concepts of geometric transformations but also to be able to apply them in relevant and real contexts. The integration of Ethnomathematics in this learning model aims to connect mathematical concepts with the cultural context and students' daily experiences, thereby increasing their engagement and understanding of the material (Fouze et al., 2021). This approach is expected to enable students to solve various problems related to geometric transformations effectively and creatively. Careful analysis and design are expected to provide a more meaningful and applicable learning experience, as well as support the development of mathematical skills that are useful in various real-life situations. The application of RME must consider the individual characteristics of students as well as the conditions of the learning environment. Learning needs to be adjusted to be relevant to students' experiences and learning contexts (Zulkardi, 2022). Thus, RME not only makes the learning process more interesting and meaningful for students but also supports them in developing mathematical skills more effectively and meaningfully. This approach provides a direct learning experience that is connected to real life, which can ultimately improve students' learning outcomes and problem-solving skills. The application of RME also faces several challenges, especially in terms of teacher readiness.

This approach requires teachers who not only master the material but are also able to design contextual and relevant learning (Ralmugiz et al., 2021). Several studies have shown that not all teachers have sufficient skills or training to implement RME effectively. Another challenge is the longer time allocation to complete each topic, because students are invited to explore and discuss in depth. Support from the school, teacher training, and supportive policies are needed so that RME can be implemented optimally. Overall, the RME approach has great potential to improve the quality of geometry learning by emphasizing deep understanding of concepts that are relevant to everyday life. The main success of the Realistic Mathematics Education (RME) approach lies in its ability to actively involve students in the learning process, which creates a dynamic and interactive learning environment. This approach facilitates problem-based learning, where students not only receive information passively but also act as active problem solvers. In the context of geometry learning, students are invited to explore geometric concepts through real situations that they encounter every day. The teacher acts as a facilitator who helps direct students' thinking without providing direct answers, so that they can develop analytical and reflective skills independently. Through problem-based learning, students are encouraged to think critically by identifying, analyzing, and solving given problems. For example, when students are faced with geometric

problems such as calculating the area of a building or designing a floor plan, they are required to apply the principles of geometry they have learned to find a solution.

This not only strengthens students' understanding of the material but also improves their ability to solve problems independently. Teachers need to understand the main principles of Realistic Mathematics Education (RME) to achieve optimal learning outcomes. Ahmad Fauzan & Sari (2017) identified three fundamental principles in RME, namely guided reinvention through progressive mathematization, didactical phenomenology, and self-developed models or emergent models. The first principle, guided reinvention through progressive mathematization, refers to the process by which students gradually build their mathematical concepts through exploration and refinement of mathematical models. The second principle, didactical phenomenology, emphasizes the importance of understanding the phenomenon of mathematics education from the students' perspective, so that learning materials can be adjusted to their experiences and perceptions. The third principle, self-developed models or emergent models, refers to the use of models developed by students themselves in the learning process, which supports a deeper understanding of concepts.

Mathematical literacy ability is a fundamental aspect in education that functions as the center of the mathematics learning process, as expressed by Junaedi et al. (2015) and Rachmat & Krisnadi (nd). In the context of the Program for International Student Assessment (PISA), mathematical literacy is defined as an individual's ability to formulate, use, and interpret mathematics in various real-life situations. This involves the process of mathematical reasoning and the application of mathematical concepts, procedures, facts, and tools appropriately and effectively (Hikmah et al., 2013). This ability allows individuals to describe, explain, and predict the phenomena they encounter, as well as understand the role and application of mathematics in everyday life. Mathematical literacy provides the ability to make informed and constructive decisions, and engage in problem solving with a reflective and systematic approach. This includes an understanding of how mathematics can be used to face and solve challenges that arise in real contexts.

According to A. Fauzan et al. (2020), mathematical literacy involves a deep understanding of mathematical facts, concepts, principles, operations, and problem-solving techniques. These skills enable students to not only master mathematical techniques but also to relate mathematical knowledge to practical contexts and everyday situations. Meanwhile, Ojose emphasized that mathematical literacy is the knowledge that underlies the ability to recognize and apply mathematical principles in everyday life (Ahmad Fauzan & Sari, 2017). Overall, mathematical literacy is more than just mastering mathematical techniques; it includes the ability to translate and apply mathematical knowledge in a broader context, develop critical thinking skills, and make decisions based on mathematical analysis. Mathematical literacy plays an important role in preparing students to face complex challenges in life and the world of work with a structured, reflective, and effective approach. The application of material in a relevant context is essential to improving students' skills in everyday life (Nurvicalesti et al., 2019; Junaedi et al., 2015). By presenting contextual problems, students are encouraged to relate the material they are learning to real situations they face. This allows students to not only understand mathematical concepts theoretically, but also see their practical applications. This approach strengthens their ability to apply mathematics in various everyday situations, thereby enriching their learning experience and increasing the relevance of mathematics learning (Verschaffel, 2020). The RME approach also plays an important role in increasing students' learning independence. With the responsibility to find their own solutions, students learn more confidently in facing challenges and managing the learning process (Laurens et al., 2019). They are no longer

completely dependent on teachers, but are able to take the initiative and develop their own learning strategies.

This independence forms a more adaptive and critical character in various learning situations. Students' learning motivation also increases significantly with the implementation of RME. This approach makes learning more interesting and relevant because students can see firsthand the real applications of the geometry concepts they are learning. For example, when studying geometric shapes, students are invited to identify these shapes in everyday life, such as in buildings or objects around them. This approach makes learning more meaningful because students understand the relevance between theory and practice. The increased motivation is also influenced by the sense of achievement experienced by students when they succeed in solving problems independently (Mega et al., 2024). This feeling fosters satisfaction and self-confidence that encourages them to continue learning. Unlike conventional approaches that tend to emphasize memorizing formulas, the RME approach makes students more motivated because they can relate learning to real-life contexts. This makes learning not only more relevant but also more personally significant for students. Overall, the RME approach has succeeded in changing the way students view learning mathematics, especially geometry.

Students become more active, independent, and able to apply knowledge in various real contexts. This ability is important for the development of problem-solving skills that will continue to be useful in their future lives. The implementation of the Realistic Mathematics Education (RME) Approach in geometry learning faces several significant challenges. The main challenge identified in the literature is the readiness of teachers to implement this approach. RME requires teachers to have special abilities in designing and managing contextual and realistic learning, which often involves designing problem-based learning scenarios that are relevant to students' daily lives (Caraan, 2023). This requires additional skills beyond traditional mathematics teaching skills. Several studies have shown that not all teachers have adequate competence to implement RME effectively. Lack of specific training on the RME approach is one of the main factors. Many teachers may not receive sufficient training on how to design and manage learning with this approach. Inadequate training can result in teachers having difficulty adapting this method into their daily practices, reducing the effectiveness of RME in improving student understanding (Henry, 2020). Time constraints are also a significant obstacle in implementing RME. Problem-based learning requires more time to design and implement activities that involve in-depth exploration and group discussion.

In an already dense curriculum, the time allocated for mathematics is often insufficient to implement RME optimally. Teachers may feel pressured to complete the material within the allotted time, so that the implementation of the problem-based approach is less than optimal. Challenges related to teacher readiness and training, limited resources and facilities in some schools are also obstacles to the implementation of RME. The resources in question include teaching materials, technological devices, and supporting learning facilities. Some schools may not have access to the resources needed to implement contextual learning effectively. The lack of adequate teaching aids or technology can hinder teachers' ability to implement activities that are realistic and relevant to students' daily lives. These limitations not only impact the implementation of RME, but also on student learning outcomes. Without the support of adequate facilities and resources, students may not be able to fully engage in the contextual learning process. Therefore, support from the school and more supportive education policies are needed to overcome these obstacles. Providing adequate training for teachers, allocating sufficient time in the curriculum, and improving school resources and

facilities can help optimize the implementation of RME and increase its effectiveness in geometry learning (Wahyudi, 2021).

The Realistic Mathematics Education (RME) approach requires a longer time allocation to complete each topic because it involves in-depth exploration and intensive discussion (Peters, 2020). In this approach, students not only learn mathematical theory directly but also engage in activities that require time for investigation and application of concepts in real contexts. In geometry learning, students must go through various activities that involve analyzing problems from various perspectives, testing hypotheses, and group discussions. This process, which requires additional time compared to conventional methods, allows students to understand concepts more deeply. However, in many schools, the time allocation for mathematics learning is often limited, and a dense curriculum and tight schedule can hinder the implementation of methods that require more time, such as RME. This lack of time can reduce the effectiveness of this approach, because in-depth exploration and discussion activities cannot be carried out optimally (Baeten, 2020). This obstacle requires broader policy support, including adjustments in curriculum planning and time allocation. The mathematics curriculum must be designed in such a way as to accommodate the need for problem-based learning that requires more time.

Rescheduling or adding time for mathematics learning sessions can provide sufficient space for the implementation of RME. In addition, the provision of adequate resources is also an important aspect in the success of RME implementation. These resources include teaching aids, technological devices, and teaching materials that support contextual learning. Investment in facilities that support exploration and discussion activities, such as mathematics laboratories or learning software, can improve the quality of RME implementation. Support from the government, educational institutions, and the community is essential in this regard. The government can provide guidelines and funds for curriculum development and the provision of resources, while educational institutions can play a role in teacher training and curriculum adjustments (Deng et al., 2021). The community can also support educational initiatives that focus on innovative approaches. With proper time planning and the provision of adequate resources, the implementation of RME can be carried out optimally, so that mathematics learning becomes more relevant, interesting, and beneficial for students. The results of the literature review show that although there are challenges in the implementation of Realistic Mathematics Education (RME), this approach has great potential in improving the quality of geometry learning in secondary schools (Leng et al., 2020).

The potential lies in its ability to make learning more relevant and interesting, and encourage students to be actively involved through in-depth exploration and discussion. RME can strengthen students' conceptual understanding and increase their motivation in learning geometry. Several barriers, such as lack of adequate training for teachers and limited resources, need to be overcome so that the potential of RME can be optimally realized. Lack of specific training can make it difficult for teachers to design and manage contextual and problem-based learning, so additional efforts in providing training that includes effective strategies and techniques are needed. Limited facilities, teaching aids, and technological devices that support problem-based learning must also be addressed. Developing a curriculum that can accommodate the needs of in-depth learning, by providing sufficient time and space for exploration and discussion, is essential for the success of RME (Librizzi et al., 2023). Support from the government, educational institutions, and the community plays a crucial role in overcoming these barriers. Government policies that support the implementation of RME and the provision of funds for development and resources can

provide significant assistance. Educational institutions need to facilitate teacher training and curriculum adjustments, while the community can support innovative educational initiatives. If support in the form of training, resource provision, and curriculum development is strengthened, RME can be implemented more effectively, provide optimal benefits in geometry learning, and improve the overall quality of mathematics education (Agusta et al., 2021).

Many factors influence the low geometry ability of students at various levels of education, one of which is the teaching technique used by the teacher. The quality of teaching is the main factor that influences student achievement in mathematics (Ekmekci et al., 2022). Teachers need to be wise in choosing the appropriate model, approach, or method to teach mathematics material, especially geometry, so that learning is effective and the results obtained by students are maximized. Teachers can utilize research results related to learning theory as a basis for helping students overcome learning difficulties, especially in understanding geometry concepts. One of the influential research results is van Hiele's research in 1959, which revealed that the combination of the right time, appropriate teaching materials, and effective teaching methods is the key to improving students' thinking skills to a higher level. This shows that these three elements must be well designed by teachers in the learning process. Time management must be carefully calculated so that students have enough opportunities to explore the material being studied. Teaching materials need to be arranged systematically and gradually, according to the level of cognitive development of students, so that they can be better understood (Pashler, 2021). The teaching methods used by teachers must be able to encourage active involvement of students in the learning process, so that students can participate in the exploration and solving of geometric problems. The role of teachers in designing structured and balanced learning is very important to support the improvement of students' understanding in geometry (Lehrer et al., 2022). The proper implementation of time, materials, and learning methods is expected to facilitate students to achieve a deeper understanding and improve their thinking skills to a higher level.

CONCLUSION

The implementation of Realistic Mathematics Education (RME) in geometry learning in secondary schools shows significant potential to improve the quality of education. This approach seeks to make geometry learning more relevant and interesting by actively engaging students in in-depth exploration and discussion. Through this method, students not only gain a better conceptual understanding but also understand the practical application of geometric concepts in everyday life. Several challenges need to be overcome so that the potential of RME can be optimally realized. The main challenges include the lack of specific training for teachers, which can hinder their ability to design and implement problem-based learning effectively. Limited resources, such as inadequate facilities, limited teaching aids, and inadequate technology, can also be obstacles. Existing curricula often do not provide enough time and space for the exploration and discussion activities required by this approach. To overcome these obstacles, comprehensive support from various parties is needed. The government must issue policies that support the implementation of RME, including providing funds for resource development and teacher training. Educational institutions need to facilitate appropriate training for teachers and adjust the curriculum to accommodate the needs of problem-based learning. Community support for innovative educational initiatives is also very important. These steps will enable RME to be implemented more effectively, improve the quality of geometry learning, and provide maximum benefits to students. Through careful planning, adequate training, provision of sufficient resources, and

development of appropriate curricula, RME can facilitate higher quality and more relevant mathematics learning, and support the development of student competencies in geometry and mathematics in general.

LITERATURE

Afgani, D. J. (2021). Analisis Kurikulum Matematika, Jakarta: Universitas Terbuk

Agusta, E. S., & Sampoerno, P. D. (2021, December). Enhancement Mathematical Problem Solving Ability Through RME Approach in Distance Learning on Material Building a Squares and Triangles in Class VII-2 MTsN 28 Jakarta. In International Conference on Educational Studies in Mathematics (ICoESM 2021) (pp. 373-383). Atlantis Press. https://doi.org/10.1063/1.4975974

Baeten, M., Kyndt, E., Struyven, K., & Dochy, F. (2020). Using student-centred learning environments to stimulate deep approaches to learning: Factors encouraging or discouraging their effectiveness. Educational Research Review, 5(3), 243–260. https://doi.org/10.1016/j.edurev.2010.06.001

Bray, A., & Tangney, B. (2021). Enhancing student engagement through the affordances of mobile technology: a 21st century learning perspective on Realistic Mathematics Education. Mathematics Education Research Journal, 28(1), 173–197. https://doi.org/10.1007/s13394-015-0158-7

Burry, J. R. (2022). Mindful Spaces: Computational Geometry and the Conceptual Spaces in Which Designers Operate. International Journal of Architectural Computing, 5(4), 611–624. https://doi.org/10.1260/147807707783600799

Caraan, D. R., Dinglasan, J. K., & Ching, D. (2023). Effectiveness of realistic mathematics education approach on problem-solving skills of students. International Journal of Educational Management and Development Studies, 4(2), 64-87. https://doi.org/10.53378/352980

Deng, Z., & Gopinathan, S. (2021). Fostering school-based curriculum development in the context of new educational initiatives in Singapore. Planning and Changing: An Educational Leadership and Policy Journal, 37(1-2), 93-110. https://doi.org/10.1007/978-3-319-58650-2_6

Downes, J. M., & Bishop, P. (2022). Educators Engage Digital Natives and Learn from Their Experiences with Technology. Middle School Journal, 43(5), 6–15. https://doi.org/10.1080/00940771.2012.11461824

Ekmekci, A., & Serrano, D. M. (2022). The Impact of Teacher Quality on Student Motivation, Achievement, and Persistence in Science and Mathematics. Education Sciences, 12(10), 649. https://doi.org/10.3390/educsci12100649

Elwijaya, F., Harun, M., & Helsa, Y. (2021). Implementassi Pendekatan Realistic Mathematics Education (RME) di Sekolah Dasar. Jurnal Basicedu, 5(2), 741–748. https://doi.org/10.31004/basicedu.v5i2.796

Fauzan, A., & Diana, F. (2020). Learning trajectory for teaching number patterns using RME approach in junior high schools. Journal of Physics: Conference Series, 1470(1), 012019. https://doi.org/10.1088/1742-6596/1470/1/012019

Fouze, A. Q., & Amit, M. (2021). Development of Mathematical Thinking through Integration of Ethnomathematic Folklore Game in Math Instruction. EURASIA Journal of Mathematics, Science and Technology Education, 14(2). https://doi.org/10.12973/ejmste/80626

Henry-Burrell, P. L. (2020). Primary Teachers' Mathematical Practices and Self–Efficacy in Implementing Realistic Mathematics Education (Doctoral dissertation, Walden University). https://doi.org/10.30707/etd2023.20240124055108003305.999985

Hikmah, S., Devani, A., Ngazizah, N., Guru, P., Dasar, S., Purworejo, U. M., & Pendahuluan, A. (2013). Hots (High Order Thinking Skills) Dan Kaitannya Dengan. 1, 148–152. https://doi.org/10.33578/jpfkip.v9i2.7888

Human, A., van der Walt, M., & Posthuma, B. (2022). International comparisons of Foundation Phase number domain mathematics knowledge and practice standards. South African Journal of Education, 35(1), 1–13. https://doi.org/10.15700/201503062351

Hwang, W.-Y., & Hu, S.-S. (2023). Analysis of peer learning behaviors using multiple representations in virtual reality and their impacts on geometry problem solving. Computers & Education, 62, 308–319. https://doi.org/10.1016/j.compedu.2012.10.005

Junaedi, I., Asikin, M., & Masrukan, M. (2015). Penerapan Realistic Mathematics Education (Rme) Dengan Konteks Karakter Dan Konservasi Untuk Meningkatkan Kemampuan Mahasiswa Dalam Menyusun Proposal Penelitian. Kreano, Jurnal Matematika Kreatif-Inovatif, 6(2), 177. Https://Doi.Org/10.15294/Kreano.V6i2.4988

Kizito, R. N. (2012). Realistic Mathematics Education (RME) as an instruction design perspective for introducing the relationship between the derivative and integral via distance education (Doctoral dissertation, Stellenbosch: Stellenbosch University). https://doi.org/10.2307/j.ctv1qgnkd8.3

Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2017). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement?. Eurasia Journal of Mathematics, Science and Technology Education, 14(2), 569-578. https://doi.org/10.12973/ejmste/76959

Lavicza, Z., Weinhandl, R., Prodromou, T., Anđić, B., Lieban, D., Hohenwarter, M., Fenyvesi, K., Brownell, C., & Diego-Mantecón, J. M. (2022). Developing and Evaluating Educational Innovations for STEAM Education in Rapidly Changing Digital Technology Environments. Sustainability, 14(12), 7237. https://doi.org/10.3390/su14127237

Lehrer, R., & Chazan, D. (Eds.). (2022). Designing Learning Environments for Developing Understanding of Geometry and Space. Routledge. https://doi.org/10.4324/9780203053461

Leng, K. S., Razali, F., & Ayub, A. F. M. (2020). The effectiveness of realistic mathematics education approach toward students learning: A systematic literature review of empirical evidence. Journal of Critical Reviews, 7(13), 548-552. https://doi.org/10.31838/jcr.07.13.99

Lester, F. K. (2020). On the theoretical, conceptual, and philosophical foundations for research in mathematics education. Zentralblatt Für Didaktik Der Mathematik, 37(6), 457–467. https://doi.org/10.1007/bf02655854

Madyaratri, D. Y. (2019). Kemampuan Literasi Matematika Siswa Pada Pembelajaran Pbl Dengan Tinjauan Gaya Belajar. Prisma, Prosiding Seminar Nasional Matematika, 2, 34–39. https://doi.org/10.33503/prosiding.v1i01.1014

Mega, C., Ronconi, L., & De Beni, R. (2024). What makes a good student? How emotions, self-regulated learning, and motivation contribute to academic achievement.

Journal of Educational Psychology, 106(1), 121–131. https://doi.org/10.1037/a0033546

Noviani, J., Syahputra, E., & Murad, A. (2017). The effect of realistic mathematic education (RME) in improving primary school students' spatial ability in subtopic two dimension shape. JEP, 8(34), 112-126. https://doi.org/10.7176/jep/10-23-10

Pashler, H., Bain, P. M., Bottge, B. A., Graesser, A., Koedinger, K., McDaniel, M., & Metcalfe, J. (2021). Organizing Instruction and Study to Improve Student Learning [dataset]. In PsycEXTRA Dataset. American Psychological As sociation (APA). https://doi.org/10.1037/e607972011-001

Rachmat, A., & Krisnadi, I. (N.D.). Analisis Efektifitas Pembelajaran Daring (Online) Untuk Siswa Smk Negeri 8 Kota Tangerang Pada Saat Pandemi Covid 19. https://doi.org/10.30596/bibliocouns.v5i3.12120

Rabbani, S., & Muftianti, A. (2020). IMPLEMENTATION OF TEACHING MATERIALS USING A REALISTIC MATHEMATICS EDUCATION APPROACH IN PRIMARY STUDENT MATHEMATICS COMMUNICATION. PrimaryEdu - Journal of Primary Education, 4(2), 230. https://doi.org/10.22460/pej.v4i2.1942

Ralmugiz, U., Merliza, P., Sari, D. K., Yusuf, S. M., & Zulfikar, R. N. (2021). Developing Mathematics Learning Kits Using the RME Approach for Students of Marine Vocational High School. Journal of Physics: Conference Series, 1720(1), 012016. https://doi.org/10.1088/1742-6596/1720/1/012016

Rosneli, M. R., & Hidayat, A. (2019). Penerapan Pembelajaran Realistic Mathematics Education (RME) Untuk Meningkatkan Kemampuan Pemecahan Masalah Siswa di Sekolah Dasar. Jurnal on Teacher Education (JOTE), 1, 70–78. https://journal.universitaspahlawan.ac.id/index.php/jote/article/view/369/311. https://doi.org/10.31004/jote.v1i1.506

Sepriyanti, N., & Julisra, W. (2019). KEMAMPUAN LITERASI MATEMATIS PESERTA DIDIK DALAM PERSPEKTIF GENDER DI KELAS X MIA 7 SMAN 10 PADANG. Math Educa Journal, 3(2), 195–206. https://doi.org/10.15548/mej.v3i2.673

Silahuddin, S. (2017). URGENSI MEMBANGUN KARAKTER ANAK SEJAK USIA DINI. Bunayya : Jurnal Pendidikan Anak, 3(2), 18. https://doi.org/10.22373/bunayya.v3i2.1705

Sumiyati, W., Netriwati, N., & Rakhmawati, R. (2018). Penggunaan Media Pembelajaran Geometri Berbasis Etnomatematika. Desimal: Jurnal Matematika, 1(1), 15. https://doi.org/10.24042/djm.v1i1.1907

Sutaphan, S., & Yuenyong, C. (2019). STEM Education Teaching approach: Inquiry from the Context Based. Journal of Physics: Conference Series, 1340(1), 012003. https://doi.org/10.1088/1742-6596/1340/1/012003

Tong, D. H., Loc, N. P., Uyen, B. P., & Son, T. H. (2020). Enhancing Creative and Critical Thinking Skills of Students in Mathematics Classrooms: An Experimental Study of Teaching the Inequality in High Schools. Universal Journal of Educational Research, 8(2), 477–489. https://doi.org/10.13189/ujer.2020.080219

Tumangger, W. R., Khalil, I. A., & Prahmana, R. C. I. (2024). The Impact of Realistic Mathematics Education-based Student Worksheet for Improving Students' Mathematical Problem-Solving Skills. IndoMath: Indonesia Mathematics Education, 7(2), 196. https://doi.org/10.30738/indomath.v7i2.122

Verschaffel, L., De Corte, E., Lasure, S., Van Vaerenbergh, G., Bogaerts, H., & Ratinckx, E. (2022). Learning to Solve Mathematical Application Problems: A Design Experiment With Fifth Graders. Mathematical Thinking and Learning, 1(3), 195–229. https://doi.org/10.1207/s15327833mtl0103_2

Wahyudi, W. (2016). The Development of Realistic Mathematics Education (RME) Model for the Improvement of Mathematics Learnings of Primary Teacher Education Program (PGSD) Students of Teacher Training and Education Faculty (FKIP) of Sebelas Maret University in Kebumen. In Proceeding of the International Conference on Teacher Training and Education (Vol. 2, No. 1, pp. 369-381). https://doi.org/10.29333/iji.2019.12169a

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2022). Defining Computational Thinking for Mathematics and Science Classrooms. Journal of Science Education and Technology, 25(1), 127–147. https://doi.org/10.1007/s10956-015-9581-5

Zulkardi, Z. (2023). Designing Joyful and Meaningful New School Mathematics Using Indonesian Realistic Mathematics Education. Southeast Asian Mathematics Education Journal, 3(1), 17–26. https://doi.org/10.46517/seamej.v3i1.22