Beta: Jurnal Tadris Matematika, 18(2) 2025: 130-142
DOI 10.20414/betajtm.v18i2.712

Research articles

Embedding realistic mathematics education within STEM to promote creative thinking skills

Adinda Aulia Rahmania[1], Ali Shodikin[1]

Abstrak Berpikir kreatif merupakan keterampilan penting abad ke-21 yang perlu dikembangkan melalui pembelajaran bermakna dan kontekstual. Penelitian ini menganalisis penerapan pendekatan pendidikan matematika realistik yang terintegrasi dengan *Science, Technology, Engineering, and Mathematics* (STEM) dalam membangun kemampuan berpikir kreatif siswa SMP. Penelitian ini menggunakan pendekatan deskriptif kualitatif dengan subjek siswa kelas VIII tahun ajaran 2025. Instrumen yang digunakan adalah tes bentuk soal butir terbuka berbasis konteks STEM yang diberikan tanpa pembelajaran pendahuluan untuk mengamati respons alami siswa. Hasil penelitian menunjukkan bahwa mayoritas siswa belum mampu mengidentifikasi informasi kontekstual secara tepat dan belum mampu mengelaborasi langkah penyelesaian, sehingga indikator elaborasi masih sangat rendah. Namun beberapa siswa menunjukkan ciri berpikir kreatif, seperti penggunaan strategi visual, fleksibilitas dalam memilih metode, serta keaslian dalam menyusun langkah alternatif. Temuan ini mengindikasikan bahwa integrasi pendidikan matematika realistik-STEM mampu memunculkan kelancaran, fleksibilitas, dan keaslian, meskipun diperlukan pembiasaan dan dukungan pedagogis agar seluruh indikator berpikir kreatif berkembang secara optimal.

Kata kunci *Kemampuan berpikir kreatif, Pendidikan matematika realistik, STEM*

Abstract Creative thinking is an important 21st-century skill that needs to be developed through meaningful and contextual learning. This study analyzes the application of realistic mathematics education approach integrated within Science, Technology, Engineering, and Mathematics (STEM) in building the creative thinking abilities of junior high school students. The research employs qualitative descriptive design with the subjects being eighth-grade students in the 2025 academic year. The instrument used was STEM-contextualized open-ended tests without prior instruction to observe students' natural responses. The research results indicate that most students are not yet able to accurately identify contextual information and are not yet able to elaborate on the steps to solve problems, resulting in a very low elaboration indicator. However, some students began to show characteristics of creative thinking, such as using visual strategies, flexibility in choosing methods, and originality in devising alternative steps. These findings indicate that integrating realistic mathematics education-STEM can foster fluency, flexibility, and originality, although habituation and pedagogical support are needed for all creative thinking indicators to develop optimally.

Keywords *Creative thinking skills, Realistic mathematics education, STEM*

[1]Universitas Negeri Surabaya, Surabaya, Indonesia alishodikin@unesa.ac.id

Introduction

Students in the 21st century require critical thinking, creative problem solving, and teamwork skills in order to confront the increasing intricacy of the world's problems (Eshaq, 2024; Othman et al., 2022). In the teaching of mathematics, the creative ability to construct and transform problems is important (Ndiung et al., 2021). It must also be recognized that creativity stems from and is the primary target of instruction to assist students in appreciating mathematics as a lively and rich, human endeavor filled with opportunities for exploration (Nurmasari et al., 2024). Unfortunately, weak creative thinking ability of Indonesian students has been well documented, and this is attributable to an educational environment that is dominated by rote learning, a fixation on standardized procedures, and a lack of opportunities for students to freely explore a range of ideas and methods (Kartikasari et al., 2022; Palinussa et al., 2021; Wulandari et al., 2020).

The realistic mathematics education (RME) approach may be able to address this concern since it works on cognitive tasks based on real situations (Armiati et al., 2022; Palinussa et al., 2024; Yilmaz, 2020). In real situations, learners are inspired to build models, discover links among concepts, and think about how to achieve solutions in their own way. This kind of education helps learners connect practical and experience and helps in the development of creativity and does deep cognitive comprehension.

In addition, it becomes more appropriate on its own or along with STEM education in teaching students to solve 21st century problems (Prasertsang et al., 2022). While the RME approach gives students the conceptual and contextual understanding of the mathematical meaning of the phenomenon, STEM education focuses on the integration of various disciplines to solve real-world problems (Palinussa et al., 2024). The combination of RME and STEM would probably improve students' creative thinking ability through purposeful and real-world learning activities.

Empirical studies that integrate the RME approach within a STEM framework in Indonesia remain limited. Prior research has largely focused on the development of instructional materials or intervention-based studies conducted in highly innovative school settings (Pramudiani et al., 2022; Putri et al., 2024). Consequently, little is known about how students demonstrate creative thinking within RME–STEM contexts in the absence of direct interventions, particularly in schools characterized by low levels of pedagogical innovation. To address this gap, the present study undertakes an in-depth examination of students' creative thinking processes in RME-based mathematics learning situated within a STEM perspective (Asunda et al., 2023; Othman et al., 2022). Rather than emphasizing structured instructional treatments, this research foregrounds students' reasoning in more naturalistic and less constrained learning situations. A qualitative methodology is employed to capture the complex ways in which students interpret problems, connect diverse concepts, and construct logical yet original solutions. This approach underscores the importance of implementing RME-STEM learning as a contextual and innovative strategy for fostering mathematical creative thinking skills in Indonesia.

The purpose of this study is to apply RME within a STEM framework to nurture students' creative abilities. Its primary objective is to examine how RME–STEM influences changes in students' creative thinking when engaging with complex mathematical concepts. This research is grounded in Torrance's (1974) theory of creative thinking, which conceptualizes creativity in four dimensions: fluency, flexibility, originality, and elaboration, and serves as theoretical foundation of the study.

Theoretical review

Science, Technology, Engineering, and Mathematics

Nearly every nation is prioritizing and emphasizing STEM-related research level (Al Darayseh & Mersin, 2025; Anabousy & Daher, 2022; Kulegel & Topsakal, 2021). To address social, cultural, and economic challenges, certain countries make investments in STEM. In addition to the four disciplines, STEM is a creative teaching strategy that combines these fields to solve problems in the actual world (Alali et al., 2024). However, there is still uncertainty and unresolved definitional and contextual criteria surrounding the material (Every et al., 2025; Kristensen et al., 2023). In general, STEM is applied in either a single field or in regions and disciplines that are interconnected (Sarwi et al., 2024). This innovative teaching approach encourages students to think critically, assess, and come up with original ideas rather than only memorizing facts. By helping students connect science to everyday life, the goal is to increase STEM literacy and get them ready for college or the workforce.

The three primary goals of STEM education are to boost STEM literacy in society, raise the number of innovators, and grow the STEM workforce (Anabousy & Daher, 2022). This paradigm has evolved into variants like STEM-R and STREAM (Anabousy & Daher, 2022; Sarwi et al., 2024). STEM includes three primary components, according to the Next Generation Science Standards (NGSS): Discipline Core Ideas, Cross-Disciplinary Concepts, and Science and Engineering Practices (Alali et al., 2024).

Realistic mathematics education

Realistic Mathematics Education (RME) constitutes a comprehensive pedagogical framework designed to support mathematics learning across a wide range of student abilities and is recognized as a distinctive instructional theory within the field of mathematics education (Listiawati et al., 2023). Central to this approach is the use of rich, meaningful real-life situations as the foundation of instruction. Such contexts function as sources for the development of mathematical concepts, tools, and procedures, which students can subsequently apply to everyday problems (Do et al., 2021). These situations also serve as entry points for eliciting students' prior knowledge and progressively guiding them toward more formal mathematical understanding. Consistent with Freudenthal's view of mathematics as a human activity involving discovery, organization, and problem solving, RME seeks to present mathematics as something students actively construct rather than passively receive (Wulandari et al., 2020). Accordingly, RME aims to make mathematics learning engaging and relevant by situating problems within authentic contexts, thereby enhancing students' mathematical competencies (Putri et al., 2024).

In practice, RME begins with students' engagement in realistic scenarios and everyday challenges, through which they attempt to reconstruct mathematical ideas with the support and guidance of the teacher. Within this framework, the teacher assumes the role of a facilitator who helps students identify problems, explore strategies, and move toward viable solutions. In contrast to traditional instruction that prioritizes abstract theory and textbook procedures, RME brings mathematics closer to students' life experiences (Chau Nguyen & Hai Pham, 2023).

Moreover, when integrated with STEM education, RME exposes learners to the discovery of mathematical ideas through practical, real-world applications, while the STEM framework equips them with competencies related to science, technology, and engineering challenges (Gun Sahin & Gurbuz, 2022). These two approaches complement one another by guiding students toward meaningful learning and the generation of innovative solutions to real-life problems. The present study therefore examines how authentic contexts and inquiry within the RME–STEM model supports the development of fluency, flexibility, originality, and the elaboration of students' ideas (Juana et al., 2022).

Creative thinking in mathematics

Creative thinking is widely recognized as a core component of higher-order thinking skills (HOTS) in the context of globalization and rapid socio-technological change (Kwangpukieo & Sawangboon, 2024). In contemporary education and professional environments, the capacity to generate novel ideas or produce original works represents a valuable asset that enhances an individual's intellectual and practical repertoire (Othman et al., 2022). This form of thinking involves more than spontaneous creativity; it reflects a purposeful cognitive process that enables individuals to approach situations from multiple perspectives and construct innovative responses to emerging challenges.

Conceptually, creative thinking integrates divergent and imaginative modes of reasoning, characterized by the generation of varied, flexible, and non-linear ideas that are guided by intention and contextual logic (Setiadi, 2020). The process typically entails identifying a problem, exploring alternative solution pathways, evaluating and refining possibilities, and articulating coherent outcomes. Within mathematics education, creative thinking plays a crucial role in linking conceptual understanding with real-world application, thereby supporting learners in using mathematical knowledge and skills to address everyday problems effectively (Furner, 2024).

RME integrated with STEM enhances students' creative thinking by situating mathematical concepts in meaningful, real-world contexts that require exploration and innovation. Through RME, learners engage with authentic problems that encourage them to interpret situations, generate multiple solution strategies, and construct their own mathematical models. When combined with STEM, this approach promotes interdisciplinary reasoning, where students connect mathematics with science, technology, and engineering practices. Such integration stimulates divergent thinking, flexibility, and originality as students test ideas, design solutions, and refine them collaboratively. As a result, students move beyond routine procedures and develop the capacity to think creatively and apply mathematics in novel and purposeful ways.

Methods

This research adopts a primarily qualitative design, complemented by quantitative analysis to more comprehensively examine students' interest in solving RME-STEM based problems. The participants consisted of 15 eighth-grade students from MTs Muhammadiyah Palang, Tuban, Indonesia, in the 2025 academic year.

The research procedure was carried out in three main stages: administering open-ended tests, completing questionnaires, and conducting interviews. All data obtained were analyzed using the interactive analysis model of Miles and Huberman, which includes the processes of data reduction, data presentation, and drawing conclusions. The triangulation technique is used by comparing the results of tests, questionnaires, and interviews to ensure the validity of the findings.

All students completed the test and questionnaire phases, and 7 out of 15 students were subsequently selected for in-depth interviews. Students' creative thinking abilities were evaluated using Torrance's (1974) four indicators, i.e., fluency, flexibility, originality, and elaboration. Further details are seen in Table 1.

Table 1. Scoring criteria for students' creative thinking ability

Torrance indicator (1974)	Description for the test instrument	Assessment criteria (Score 1-4)
Fluency: the ability to generate many ideas or solutions in responding to a mathematical problem fluently)	This is evident in the question section that asks students to calculate the number of melon plants and the harvest yield, where students can generate various calculation ideas based on planting distance, number of rows, or land area.	1: Only one simple and incomplete idea or calculation. 2: Generates one correct but limited idea. 3: Generates more than one relevant idea or calculation step. 4: Generates many correct and mutually supportive ideas/calculations.
Flexibility: the ability to see a problem from various perspectives or use various approaches in solving problems.	This emerges when students choose different solution strategies, such as calculating based on effective land area, the number of plants per row, or accounting for the presence of plot roads and mulch.	1: Using only one method without alternatives. 2: Changing the method but still not quite right. 3: Using more than one relevant approach 4: Using several different and effective approaches.
Originality: the ability to produce ideas that are unique, uncommon, and rarely used by others in solving a problem.	It is evident from the question about determining the location of water storage for maximum results that students can provide diverse answers with different reasons based on their considerations.	1: Common answer without reasoning. 2: Answer is quite different but still follows the general pattern. 3: Answer is different with logical reasoning. 4: Answer is unique, creative, and supported by strong arguments.
Elaboration: the ability to develop, detail, or explain an idea in detail and completely	This was evident when the students detailed the calculation steps, sketched the land, labeled the planting distances, and explained the reasons for choosing the water storage location.	1: The explanation is very brief and not coherent. 2: The explanation is present but lacks detail. 3: The explanation is quite detailed and logical. 4: The explanation is very complete, systematic, and easy to understand.

Data were collected using multiple instruments. First, a set of context-based STEM open-ended tests (see Figure 1) was administered to students prior to any instructional intervention. The test was designed to capture students' spontaneous responses to contextualized mathematical problems, requiring them to connect relevant mathematical concepts with real-life situations.

The assessment for the test outcomes is conducted according to the criteria in Table 1. Second, semi-structured interview protocols were employed to explore students' reasoning processes, strategies, and the rationale underlying their chosen solutions. Third, an RME–STEM interest and understanding questionnaire was distributed to all participants to obtain data on their perceptions of real-world, context-based learning and the ways they relate mathematics to everyday experiences. The questionnaire was constructed according to the indicators shown in Table 2.

Melon is a fruit that often grows in tropical regions, including Indonesia. Melons are usually ready to harvest after 60-90 days. The right planting time is during the dry season. The recommended planting distance for melon trees is 50 x 70 cm, where 50 cm is the distance between plants and 70 cm is the distance between two rows of trees on mulch. Before planting, planting holes 7-9 cm deep are made first, and at the same time, equilateral triangle-shaped stakes are installed. Transplanting, weeding, and watering were done as needed. Generally, one melon plant can produce 2 melons. Melon plants need enough water, but not too much.
Regular watering, especially during the early growth phase until just before the fruit begins to ripen, is very important. However, overwatering can cause the fruit to split or its quality to decline, and can even lead to root rot. This melon planting is done with plastic mulch 1.5 meters long and a spacing of 50 cm for one path for farmers to check the growth and water the melons, meaning each mulch will be given one path. Mr. Andi is a melon farmer who owns a melon garden measuring 800 m x 500 m. He wants to build a square-shaped water reservoir for irrigation with dimensions of 5 m x 2 m. Calculate the number of melons Mr. Andi will produce after the reservoir is built and where Mr. Andi should build the water reservoir to maximize his yield.

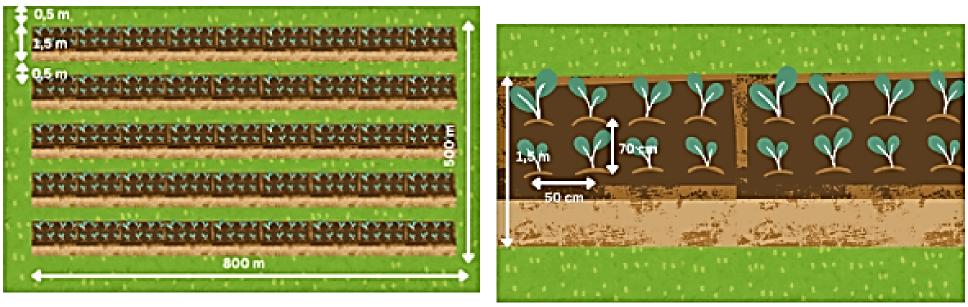


Figure 1. Test instrument

The creative thinking score for each student was then determined by calculating the average score of the four indicators using the following formula:

$$\overline{X} = \frac{F+X+O+E}{4}$$

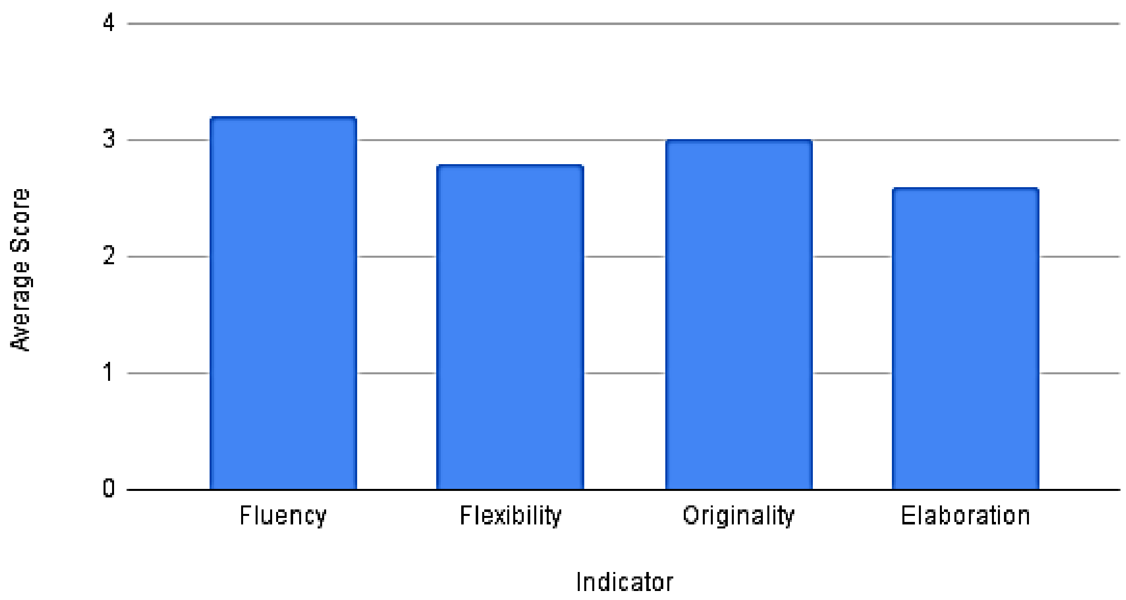
where $\overline{X}$ is the student's average creative thinking score, F = fluency, X = flexibility, O = originality, and E = elaboration. The value 4 represents the total number of assessed indicators. This scoring procedure ensures that the final score reflects students' overall creative thinking performance for each problem.

Table 2. Indicator for questionnaire

No	Indicator	Example of questionnaire statement
1	Students understand the content of the questions based on real-life contexts.	I can understand the meaning of the math problem presented in the form of a story.
2	Students can relate the questions to everyday life.	The math problem I worked on is related to a situation I have experienced.
3	Students feel interested in solving problems using the RME and STEM approaches.	I am interested in solving math problems related to real life.
4	Students find it easier to understand mathematics with the RME and STEM approaches.	I find it easier to understand mathematical concepts through contextual problems.
5	Students feel motivated to think creatively in solving problems.	Questions like this make me want to try various ways to solve them.

Findings and Discussion

Students' performance



Graph 1. The average score $\overline{X}$ outcomes for students' creative thinking ability

Graph 1 shows the results of students' creative thinking ability, analyzed through the Torrance indicators. The average scores obtained are fluency is 3.2 (high category), originality is 3.0 (fairly high category), flexibility is 2.8 (fair category), and elaboration is 2.6 (fair category). The greatest score obtained is fluency which shows that the students can produce a fair number of ideas or answers, while elaboration, the lowest score, shows that students' ability to elaborate, clarify, and elaborate ideas in a logical and structural way is low.

Analysis of students' answers in solving mathematics problems based on Realistic Mathematics Education (RME) in the context of STEM shows that this approach can stimulate various aspects of students' creative thinking skills. Most students were able to identify important information from the problem (Given), find the purpose of the solution (Asked), and develop a structured problem-solving strategy. The "Given-Asked-Solution-Answer" pattern of solving problems shows the emergence of creative thinking skills in terms of fluency, as students can generate several logical and contextually relevant ideas for solving problems.

Additionally, the emergence of various student strategies in solving context-based problems, such as first calculating the area per plant, estimating the number of rows of plants from the total land length, or determining the optimal position for building a water reservoir, demonstrates good thinking flexibility. In that question, students were asked to connect the planting distance of 50 × 70 cm, the presence of 50 cm wide pathways between the mulch, and the location of a 5 m × 2 m water reservoir to determine the total number of melon plants that could be planted. Some students chose the strategy of calculating the area per plant unit, while others chose to calculate the number of rows based on the length of the land and then adjust it according to the width of the rows and plot paths. This diversity of strategies demonstrates that students are not fixed on a single procedure but are able to connect mathematical concepts with real-world planting space needs, in accordance with the RME-STEM principle.

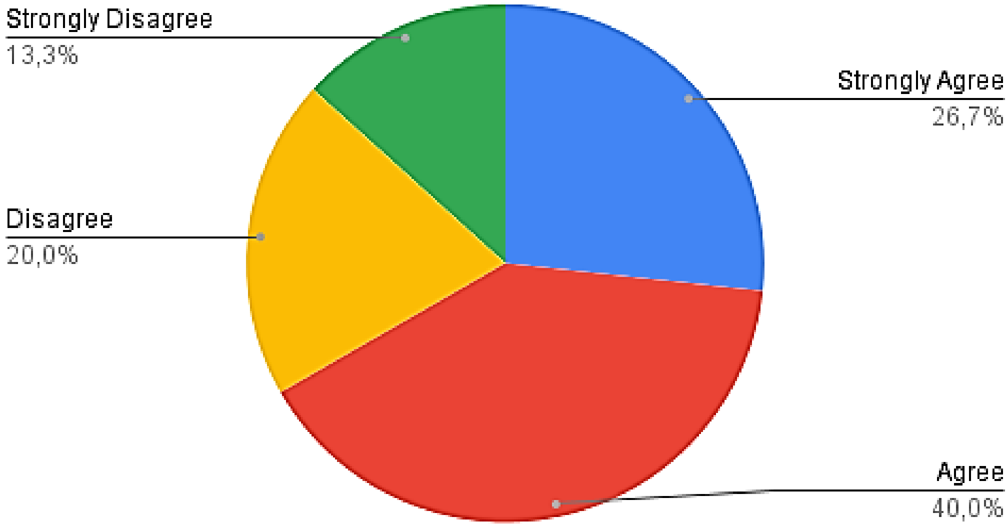
The phenomenon of rounding results, for example, when some students score 1142.857 and then round it to 1142 or 1143, illustrates creative thinking ability in the dimensions of originality and logical decision-making. They must determine which rounding makes the most contextual sense, considering whether the water storage reduces planting space or not. The real-world context in the melon problem naturally forces students to analyze situations that don't result in whole numbers, requiring them to consider practical factors such as space availability, row spacing, and the physical boundaries of the land. This reflects reflective ability, which is weighing several possibilities and choosing the most rational solution based on field conditions.

Meanwhile, the students' ability to arrange the sequence of steps to solve the problem with sufficient detail shows the development of elaboration. However, some students still show weaknesses in explaining the reasons or justifications behind their calculations, such as in the reservoir question where there is a discrepancy between the calculation process and the final solution. This indicates that the aspect of elaboration the ability to describe and explain ideas in depth still needs to be strengthened through the habit of reflection and justification in RME-STEM learning.

Overall, the RME-STEM approach has been shown to simultaneously promote all four indicators of creative thinking. The real-world context of RME stimulates fluency and flexibility in generating mathematical ideas, while STEM integration demands originality and elaboration in connecting cross-disciplinary concepts to solve real-world problems creatively and meaningfully.

Students' interest in RME-STEM tasks

Graph 2 depicts the results of the student interest survey towards RME-STEM-based problem, indicating that most students are interested in that typical problem. Six students (40%) agreed, four students (26.7%) strongly agreed, three students (20%) disagreed, and two students (13.3%) strongly disagreed that RME-STEM-based learning improved their understanding of mathematical concepts. These results show that most students view the RME-STEM approach favorably because it can enhance conceptual understanding and connect mathematical ideas to practical applications. To ensure that every student can benefit as much as possible from this approach, guidance and modifications to learning strategies are necessary because a small percentage of students still express doubts.



Graph 2. Questionnaire results on the interest of RME-STEM problem

The results of the study show that the RME approach in the context of STEM not only helps students develop creative ideas, but also encourages cognitive engagement through analysis, interpretation, and evaluation of results. In the future, learning needs to strengthen the aspect of student self-regulation, for example through metacognitive reflection exercises and justification of the chosen strategies. In addition, contextual project-based learning and interactive digital media can be effective strategies for improving critical and creative thinking skills.

This study also reveals that the creative thinking abilities of students in schools that have not implemented the RME approach are still relatively low. Students tend to be passive, have difficulty relating mathematical concepts to real-world contexts, and produce fewer original ideas. This condition indicates an important "pre-intervention" situation as a basis for comparison with the implementation of RME-STEM. This low level of creativity is closely related to the dominance of traditional teacher-centered teaching methods, which limit students' active participation in learning (Palinussa et al., 2024).

To delve into how students developed creative thinking while working on RME-based problems in a STEM context, we conducted semi-structured interviews. It was found that most of the students exhibited creative thinking abilities, although at first, they appeared to be unsure of the context of the problems.

The results of the semi-structured interviews provided a clearer picture of how students developed creative thinking skills when solving RME-based problems in a STEM context. At the beginning of the interview, the researcher asked, "How did you solve the problem? Was it difficult?" **Student A** replied that at first, he did not know how to solve the problem because the format was different from the problems in the book. However, he explained that he began drawing the shape of the land as a representation of the real situation after being asked to explain his initial steps. He said, “At first, I was confused because the question was not like the ones in the book, but after I drew the shape, I knew how to calculate it.” This answer shows the use of visual strategies as a form of elaboration, which is the tendency of students to clarify a concept through pictorial representation.

In the next conversation, the researcher asked **Student B**, “Do drawings or learning aids make the questions easier for you to understand?” Student B replied, “Yes, when I use drawings and learning aids, I can see the relationship between sides and angles. So, it's easier to understand.” This demonstrates flexibility, as students can move from abstract strategies to visual strategies to understand the relationships between concepts.

Meanwhile, when the researcher asked **Student C**, “Did you just use the formula, or did you try other methods?” Student C replied, “I tried other methods besides the formula. I made an estimate first, then checked the results.” This response demonstrates originality, as the student showed initiative in trying non-standard strategies before verifying the answer mathematically.

Overall, this interview data confirms that although students initially experienced confusion regarding the context of the question, they began to demonstrate creative thinking processes when given the opportunity to explain their strategies, use visual representations, and try alternative solutions. The interviews also show that verbal support from the interviewer encouraged students to articulate their reasoning and strategies, thereby clarifying indicators of fluency, flexibility, originality, and elaboration when solving RME-STEM-based problems.

In line with the literature, these findings confirm general issues of mathematics and STEM education in Indonesia. Teaching practices in Indonesia have not provided adequate opportunities for students to develop creativity and learning performance. Students' low ability to identify complex information, apply knowledge, and solve problems which are indicators of creative thinking shows a gap in the national learning system (Ndiung et al., 2021). An excessive emphasis on knowledge transfer in traditional methods also has a negative impact on the development of creative thinking skills (Varlık, 2024). A learning environment that does not encourage exploration and active contextualization tends to result in low levels of creativity.

The limited educational technology available in schools can further result in low creative thinking ability of students. The instructors’ lack of confidence, experience, and educational resources can hinder teachers from practicing technology-oriented STEM teaching. Consequently, the teaching and learning process continues to default to the less innovative, traditional methods which are less likely to foster creative thinking in students’ minds (Listiawati et al., 2023).

While prior research confirms the effectiveness of RME, STEM, PMRI, Treffinger, 5E inquiry-based learning approaches in stimulating creative thinking ability (Prasertsang et al., 2022; Uredi & Doganay, 2023; Syutaridho et al., 2023; Ndiung et al., 2021; Kwangpukieo & Sawangboon, 2024; Juandi et al., 2022), the present findings show the students’ creative thinking skills remain at a low level. Therefore, the need for pedagogical strategies such as RME-STEM is essential to address the creativity blockages that come with traditional settings and the findings from previous studies that were reviewed. The context-free learning stunts the growth of higher-order thinking; therefore, the lack of context in the findings from the RME and STEM studies should be considered. These findings, in a practical sense, highlight the need for teacher training in context-based learning, active discourse, and the integration of digital tools and media, even with minimal resources. From the policy side, supporting the professional growth of teachers is necessary for the successful practice of RME and STEM, especially in under-resourced schools (Pramudiani et al., 2022).

Within this research, it might be possible to extend the boundaries of the school context. From this, opportunities for comparative, longitudinal, and case study research on the implementation of RME-STEM within different contexts and conditions might arise. Subsequent research might engage with the training of educators and the epistemological relevance concerning the cultivating of students' creative thinking (Varlık, 2024). Therefore, this study points out the importance of the implementation of RME and STEM as innovative approaches in teaching, and as a result, the formation of a creative and adaptive generation of learners.

Conclusion

The results of this study indicate that students' creative thinking skills in schools characterized by conventional instructional systems and limited technological resources remain amenable to further development. Although students are generally able to generate initial ideas, their ability to expand, elaborate, and refine these ideas requires substantial improvement. This limitation is reflected in response patterns that are frequently incomplete or underdeveloped, particularly when students are required to make decisions or reason using non-integer values.

Nevertheless, these findings also reveal a promising aspect: most students demonstrate a strong interest in problems situated in real-life contexts, especially when such tasks are presented through conditions aligned with RME and STEM approaches. This interest represents a valuable entry point for teachers and schools to design learning environments that are more active, relevant, and engaging. By employing contextualized methods that encourage discussion, collaboration, exploration of ideas, and reflective thinking, educators can create meaningful opportunities for the growth of students' creative capacities. Overall, this study provides a solid foundation for planning and evaluating the future implementation of RME and STEM approaches to enhance students' creative thinking skills.

Acknowledgment

The author expresses the deepest gratitude to MTs Muhammadiyah 2 Palang Tuban for the permission and support provided during the data collection process. The willingness of the school to provide access and opportunities for the author to be directly involved in classroom learning activities greatly helped in obtaining relevant and necessary information for this research. Without that support, this research would not be able to be carried out effectively.

References

Al Darayseh, A., & Mersin, N. (2025). Integrating generative AI into STEM education: Insights from science and mathematics teachers. *International Electronic Journal of Mathematics Education* , *20*(3). Doi: https://doi.org/10.29333/iejme/16232

Alali, R., Wardat, Y., Saleh, S., & Alshraifin, N. (2024). Evaluation of STEM-aligned teaching practices for gifted mathematics Teachers. *European Journal of STEM Education*, *9*(1), 1–24. Doi: https://doi.org/10.20897/ejsteme/14625

Anabousy, A., & Daher, W. (2022). Pre-service teachers' design of steam learning units: STEAM capabilites' analysis. *Journal of Technology and Science Education*, *12*(2), 529–546. Doi: https://doi.org/10.3926/jotse.1621

Armiati, Fauzan, A., Harisman, Y., & Sya'Bani, F. (2022). Local instructional theory of probability topics based on realistic mathematics education for eight-grade students. *Journal on Mathematics Education*, *13*(4), 703–722. Doi: https://doi.org/10.22342/jme.v13i4.pp703-722

Asunda, P., Faezipour, M., Tolemy, J., & Do Engel, M. T. (2023). Embracing computational thinking as an impetus for artificial intelligence in integrated STEM disciplines through engineering and technology education. *Journal of Technology Education*, *34*(2), 43–63. Doi: https://doi.org/10.21061/jte.v34i2.a.3

Chau Nguyen, G. T., & Hai Pham, C. T. (2023). An empirical study of factors influencing primary school teachers' long-term commitment to realistic mathematics education. *Journal on Mathematics Education*, *14*(1), 1–18. Doi: https://doi.org/10.22342/JME.V14I1.PP1-18

Do, T. T., Hoang, K. C., Do, T., Trinh, T. P. T., Nguyen, D. N., Tran, T., Le, T. T. B. T., Nguyen, T. C., & Nguyen, T. T. (2021). Factors influencing teachers' intentions to use realistic mathematics education in Vietnam: An extension of the theory of planned behavior. *Journal on Mathematics Education*, *12*(2), 331–348. Doi: https://doi.org/10.22342/JME.12.2.14094.331-348

Eshaq, H. A. (2024). The effect of using STEM education on students' mathematics achievement. *Journal of Pedagogical Research*, *8*(1), 75–82. Doi: https://doi.org/10.33902/JPR.202423476

Every, E., Ball, L., & van Driel, J. (2025). Mathematics teachers' perceptions of teaching strategies when adopting a STEM approach. *Mathematics Education Research Journal*. Doi: https://doi.org/10.1007/s13394-025-00520-9

Furner, J. M. (2024). Creating connections: Using problem-based instruction with mathematics and technology like GeoGebra for STEM integration. *International Journal of Education in Mathematics, Science and Technology*, *12*(4), 957–970. Doi: https://doi.org/10.46328/ijemst.4018

Gun Sahin, Z., & Gurbuz, R. (2022). The effect of supported realistic mathematics education with short films on conceptual and procedural knowledge. *Acta Didactica Napocensia*, *15*(2), 83–110. Doi: https://doi.org/10.24193/adn.15.2.6

Juana, N. A., Kaswoto, J., Sugiman, S., & Hidayat, A. A. A. (2022). The learning trajectory of set concept using realistic mathematics education (RME). *Jurnal Pendidikan Matematika*, *17*(1), 89–102. Doi: https://doi.org/10.22342/jpm.17.1.19077.89-102

Juandi, D., Kusumah, Y. S., & Tamur, M. (2022). A meta-analysis of the last two decades of realistic mathematics education approaches. *International Journal of Instruction*, *15*(1), 381–400. Doi: https://doi.org/10.29333/iji.2022.15122a

Kartikasari, I. A., Usodo, B., & Riyadi. (2022). The effectiveness open-ended learning and creative problem solving models to teach creative thinking skills. *Pegem Egitim ve Ogretim Dergisi*, *12*(4), 29–38. Doi: https://doi.org/10.47750/pegegog.12.04.04

Kristensen, M. A., Larsen, D. M., Seidelin, L., & Svabo, C. (2023). The role of mathematics in STEM activities: Syntheses and a framework from a literature review. *International Journal of Education in Mathematics, Science and Technology*, *12*(2), 418–431. Doi: https://doi.org/10.46328/ijemst.3357

Kulegel, S., & Topsakal, U. U. (2021). Investigating perceptions and skills of gifted students in STEM education. *World Journal of Education*, *11*(3), 39. Doi: https://doi.org/10.5430/wje.v11n3p39

Kwangpukieo, C., & Sawangboon, T. (2024). Fostering mathematical proficiency and creative thinking skills in 10th grade students through the 5E inquiry-based learning approach with supplementary media. *International Education Studies*, *17*(3), 1. Doi: https://doi.org/10.5539/ies.v17n3p1

Listiawati, N., Sabon, S. S., Siswantari, Subijanto, Wibowo, S., Zulkardi, & Riyanto, B. (2023). Analysis of implementing realistic mathematics education principles to enhance mathematics competence of slow learner students. *Journal on Mathematics Education*, *14*(4), 683–700. Doi: https://doi.org/10.22342/jme.v14i4.pp683-700

Ndiung, S., Sariyasa, Jehadus, E., & Apsari, R. A. (2021). The effect of treffinger creative learning model with the use rme principles on creative thinking skill and mathematics learning outcome. *International Journal of Instruction*, *14*(2), 873–888. Doi: https://doi.org/10.29333/iji.2021.14249a

Nurmasari, L., Budiyono, Nurkamto, J., & Ramli, M. (2024). Realistic mathematics engineering for improving elementary school students' mathematical literacy. *Journal on Mathematics Education*, *15*(1), 1–26. Doi: https://doi.org/10.22342/jme.v15i1.pp1-26

Othman, O., Iksan, Z. H., & Yasin, R. M. (2022). Creative teaching STEM module: High school students' perception. *European Journal of Educational Research*, *11*(4), 2127–2137. Doi: https://doi.org/10.12973/eu-jer.11.4.2127

Palinussa, A. L., Molle, J. S., & Gaspersz, M. (2021). Realistic mathematics education: Mathematical reasoning and communication skills in rural contexts. *International Journal of Evaluation and*

Research in Education, *10*(2), 522–534. Doi: https://doi.org/10.11591/ijere.v10i2.20640

Palinussa, A. L., Tupamahu, P. Z., Sabandar, V. P., Makaruku, Y. H., & Sabandar, J. (2024). Realistic mathematics education: Mathematics e-modules in improving student learning outcomes. *Infinity Journal*, *14*(1), 45–64. Doi: https://doi.org/10.22460/infinity.v14i1.p45-64

Pramudiani, P., Herman, T., Turmudi, T., Dolk, M., & Terlouw, B. (2022). What do Indonesian and Dutch teachers find challenging when implementing realistic mathematics education? *Jurnal Pendidikan Matematika*, *17*(1), 103–120. Doi: https://doi.org/10.22342/jpm.17.1.20097.103-120

Prasertsang, P., Komal, A., Nilvon, S., Worapun, W., & Lamjuanjit, Y. (2022). STEM education-based learning management for creative thinking development: Length measurement lessons of Grade 3 Students. *Journal of Educational Issues*, *8*(2), 603. Doi: https://doi.org/10.5296/jei.v8i2.20093

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

Sarwi, S., Marwoto, P., Susilaningsih, E., Lathif, Y. F., & Winarto, W. (2024). Science learning STEM-R approach: A study of students' reflective and critical thinking. *Journal of Education and Learning*, *18*(2), 462–470. Doi: https://doi.org/10.11591/edulearn.v18i2.21080

Setiadi, N. (2020). The implementation of realistic mathematics education (RME) to support Indonesian 5 th-grade students to learn multiplication and division. *Southeast Asia Mathematics Education Journal*, *10*(1), 41–53. Doi: https://doi.org/10.46517/seamej.v10i1.98

Syutaridho, Ramury, F., & Nurhijah. (2023). The influence of indonesia's realistic mathematics education approach on students' creative thinking ability. *Jurnal Ilmiah Ilmu Terapan Universitas Jambi*, *7*(2), 99–111. Doi: https://doi.org/10.22437/jiituj.v7i2.28700

Üredi, P., & Doganay, A. (2023). Developing the skill of associating mathematics with real life through realistic mathematics education: An action research. *Kuramsal Eğitimbilim*, *16*(2), 394–422. Doi: https://doi.org/10.30831/akukeg.1214339

Varlık, S. (2024). Critical and creative thinking in science teachers: The moderating role of epistemology. *Journal of Baltic Science Education*, *23*(5), 964–978. Doi: https://doi.org/10.33225/jbse/24.23.964

Wulandari, I. P., Rochmad, R., & Sugianto, S. (2020). Integrated between DAPIC problem solving model and RME approach to enhance critical thinking ability and self confidence. *Anatolian Journal of Education*, *5*(2), 73–84. Doi: https://doi.org/10.29333/aje.2020.526a

Yilmaz, R. (2020). Prospective mathematics teachers' cognitive competencies on realistic mathematics education. *Journal on Mathematics Education*, *11*(1), 17–44. Doi: https://doi.org/10.22342/jme.11.1.8690.17-44