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A thematic mapping study of mathematical creativity: Bridging creative thinking and attitude toward mathematics

Adinda Salshabilla Yudha *, Raden Rosnawati

Department of Mathematics Education, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

* Correspondence: adindasalshabilla.2023@student.uny.ac.id

Abstract

Creativity is a key 21st-century competence, especially vital in mathematics education. This study presents a systematic literature review and thematic mapping analysis of mathematical creativity from 2016 to 2025, using data from the Scopus database analyzed via RStudio Biblioshiny and the PRISMA framework. It explores three core questions: the evolution of research themes in mathematical creativity, the thematic linkage between creative thinking and attitudes toward mathematics, and pedagogical approaches that connect both constructs. Bibliometric analysis reveals mathematical creativity as a central and evolving theme, prominently positioned in co-occurrence networks and thematic quadrants. Creative thinking and attitudes toward mathematics appear within the same thematic cluster, indicating a strong cognitive-affective connection. Emerging research also identifies ethnic factors and environmental literacy as potential mediators in this relationship. These findings suggest that Realistic Mathematics Education (RME), particularly models incorporating ethnic contexts and environmental themes, may serve as effective pedagogical strategies. Such approaches have the potential to enhance both creative thinking and positive attitudes toward mathematics, contributing meaningfully to the broader discourse on mathematical creativity.

Keywords: attitudes toward mathematics; bibliometric analysis; mathematical creativity; thematic mapping

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Introduction

The mastery of 21st-century competencies is imperative for individuals navigating the complexities of contemporary society. According to the (OECD, 2023), 21st-century competencies encompass a comprehensive educational framework that encompasses the knowledge, skills, and attitudes essential for effective engagement in community life. The cultivation of these competencies enables individuals to compete and thrive in today's dynamic environment (Adeoye & Jimoh, 2023). Furthermore, these competencies can be classified into several categories, including critical thinking, creativity, communication, and collaboration (WEF, 2015).

Among these skills, creativity stands out as a critical competence, enabling individuals to generate original, flexible, and valuable ideas (Guilford, 1967). In mathematics education, creativity is not only relevant but also fundamental for fostering deep understanding and innovative problem-solving (Muzaini et al., 2023). Mathematical creativity is nurtured through non-linear and explorative thinking processes that allow for multiple representations and open-ended solutions. Bicer et al. (2023) proposed that mathematical creativity is the capacity to think and act in innovative ways.

Central to this is creative thinking, a cognitive capacity involving fluency, flexibility, originality, and elaboration in generating mathematical ideas (Yudha et al., 2023). Creative thinking within mathematics is a pivotal competency that students must cultivate, as the majority of mathematics education involves addressing problems that necessitate innovative solutions (Suherman & Vidákovich, 2024a). This concept aligns with the perspectives of Casing and Roble (2021), who assert that mathematical creative thinking equips students with the ability to approach complex problems from multiple angles and to generate an array of solutions. It is supported by Murtafiah et al. (2023) who argued that mathematical creative thinking refers to the ability of an individual to create or discover new, original, different, or unusual ideas, with definite results. This competency not only enhances students' problem-solving capabilities in academic contexts but also prepares them for effective problem-solving in real-world scenarios (Ferdiani et al., 2021; Gan, 2023).

However, the development of mathematical creativity is not solely a cognitive endeavor. It is also significantly influenced by affective factors such as an attitude. Learners with a positive attitude toward mathematics tend to demonstrate higher motivation, persistence, openness to challenges, and greater confidence in expressing creative ideas. (Ibrahim et al., 2023). According to (Suherman & Vidákovich, 2024c), students with positive attitude tend to exhibit higher levels of creative thinking.

Recent research also suggests that this integration is shaped by mediating factors such as ethnicity and environmental literacy (Suherman & Vidákovich, 2024b, 2025). These cultural factors influence how students perceive mathematical problems and how they choose to creatively engage with them (Suherman & Vidákovich, 2024c). Ethnicity relevance, for instance, supports meaningful learning experiences (Smith et al., 2022), while environmental awareness provides real-world contexts that stimulate imaginative reasoning (Wong et al., 2024). These mediators serve as thematic connectors between creative thinking and attitude toward mathematics.

Research on mathematical creativity has developed significantly and will continue to progress over time. Various research themes discuss mathematical creative thinking. The studies of Nufus et al. (2024) and Schindler and Lilienthal (2020) examined students' mathematical creative thinking abilities.. The results showed that this ability is still relatively low. Erfana et al. (2023) argued that students experienced difficulties in solving application problems, especially those involving creative steps in the solution process. They face various difficulties in applying mathematical creative thinking due to several reasons such as their attitude toward mathematics learning (Prastya et al., 2023) or could not elaborate other ways to solve the problem creatively (Li & Yu, 2025).

This issue has evolved with the support of research on pedagogical practices needed to facilitate students' creative thinking skills. Researches by Ndiung et al. (2021), Dhayanti et al. (2018), and Payadnya et al. (2023) explore more deepen Realistic Mathematics Education (RME) theory with other approaches for cultivating mathematical creative thinking. Ndiung et al. (2019) works integrated the Treffinger learning model, which was used explicitly to enhance creativity learning. In these works, by combining the stages in Treffinger learning model with RME principles gave a positive effect and promoted meaningful learning of mathematics. Besides, Dhayanti et al. (2018) and Payadnya et al. (2023) utilitized learning media which integrated in the RME theory. Furthermore, Payadnya provided a virtual exhibition as an integrated learning media which engaged students in a designed real-world situation virtually. That not only fills the gap of integrating RME with other approaches as an innovation but also utilizing the nowadays meaningful environmental digital era.

In the context of utilizing cultural factors in RME, a broad range of topics, especially in Indonesia. The article by Umasugi et al. (2022) utilized the Yogyakarta cuisine context in the RME approach for learning social arithmetic. The context of cuisine was provided in terms of determining the purchase price of Lumpia Samijaya, discount ads of Gudeg, and buying-selling price of Bakpia Tugu. Palinussa et al. (2021) integrated cultural life of Maluku Province in RME learning design which fasilitated students' mathematical understanding. Lore, traditional games from Minangkabau were presented in the form of carvings on the ground with a combination of several squares, were utilized in the RME approach for the geometry classroom (Cesaria et al., 2022). Most of the studies employ ethnic identity as a context of learning, and it is rare to find RME-based learning which proposes environmental literacy as a scope of cultural context.

Given the rapid development of research on mathematical creative thinking, it is crucial for teachers and education practitioners to understand the direction of research in this field (Saefudin et al., 2023). This understanding is valuable in preparing students for the future by equipping them with creative thinking that can be nurtured through learning. For tracing the development of creative thinking research in nowadays, bibliometric analysis could be employed. Bibliometric analysis is utilized for tracking and analysing scholarly literature related to certain topics (Aria & Cuccurullo, 2017; Susilawati et al., 2025). According to Donthu et al. (2021) bibliometric analysis could give us broad information about certain topic and its development nowadays.

In mathematical creativity and related topics, several bibliometric studies were employed. Panglipur et al. (2024) traced the research trends in creative thinking behavior in learning for over the last 10 years. Their work provided a general overview of research in the field of creative thinking behavior, such as the documents and sources that could be cited and determined to fill the research gap. Aligning with that study, Saefudin et al. (2023) also traced the trend topic of mathematical creativity in instructional practices for the last 20 years. They analysed the trend by impacted-author, prominent keywords, and influential affiliations.

However, few studies have systematically analyzed the thematic evolution of research on mathematical creativity, and examining how creative thinking and attitudes toward mathematics are positioned and interconnected within the scholarly landscape. Although prior research acknowledges the importance of both creative thinking and attitude in shaping mathematical creativity, there remains a lack of comprehensive bibliometric studies in the field, providing a broad analysis. This study aims to address these gaps by conducting a thematic mapping and evolution analysis of the literature on mathematical creativity. Specifically, the objective of this study is to identify the positioning and interrelation of creative thinking and attitude toward mathematics within the broader research landscape, while also highlighting instructional strategies that support the simultaneous development of both dimensions in mathematics education. We thus formulated the following research questions: (1) how research themes on mathematical creativity have evolved and mapped over time? (2) how creative thinking and attitude toward mathematics are thematically linked and clustered? (3) how creative thinking and attitude toward mathematics are addressed pedagogically through the identified thematic factors?

Methods

This study combined bibliometric analysis and systematic literature review for answering the research questions. Bibliometric analysis is an approach that uses a set of quantitative methods to measure, track, and analyse scholarly literature and can be applied in all studies that aim to quantify the process of written communication (Jamil et al., 2023; Marzi et al., 2025). It was used for answering the first question. In this study, the Scopus database was used as a search engine which is compatible with Biblioshiny software by RStudio, used for data analysis. This application provides a website interface for bibliometric software and provides the data in graphical format (Aria & Cuccurullo, 2017). After that, a systematic literature review was conducted to answer the two last questions, which were intended to explore strategies for cultivating mathematical creative thinking in instructional practices and how to measure it by identifying its indicators.

Initially, data was gathered from Scopus database with the search string TITLE-ABS-KEY ("Mathematical Creative Thinking" OR "Mathematical Creativity") and PUBYEAR >2016. The document was also restricted by subject area, which are social science, psychology, arts and humanities, as well as mathematics. From this restriction, 230 documents were included for bibliometric analysis. The second analysis was used for answering the last two questions using Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). PRISMA framework was design to help systematic reviewers transparently report why the review was done, what the authors did, and what they found (Page et al., 2021). Based on the framework, the study was conducted by four processes, namely identification, screening, eligibility, and including.

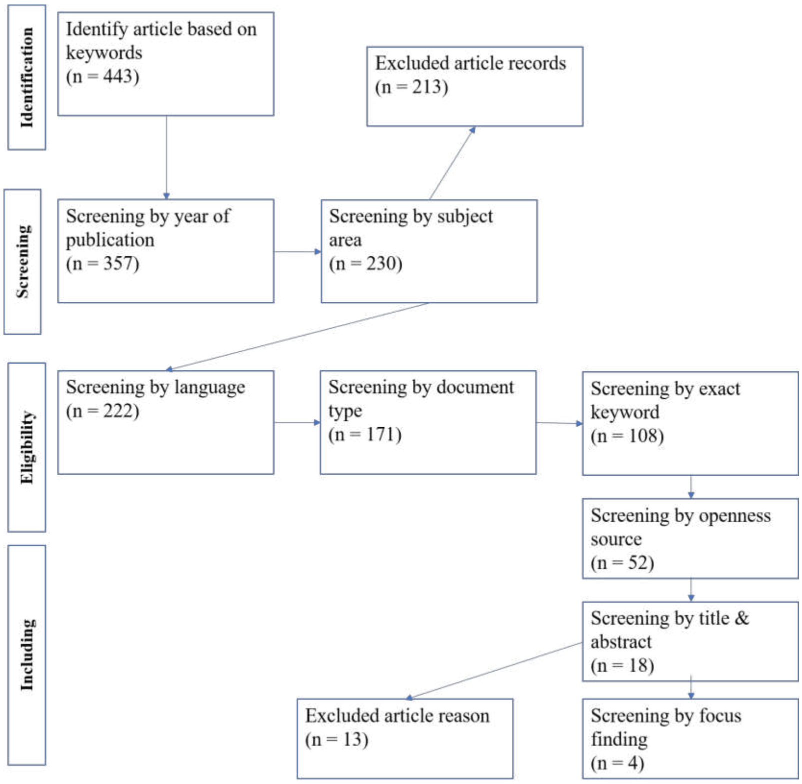

Figure 1. PRISMA stages of the study

Through the identification process, 443 documents were retrieved with the terms "Mathematical Creativity" or "Mathematical Creative Thinking". This data, furthermore, filtered by second process, namely screening. In the screening process, documents were restricted by year of publication (2016-2025) and screened by subject area. This data was conducted as bibliometric study. After the screening process, it could be continued to the third process, namely eligibility. This process was conducted for leading the systematic literature review. In this process, the initial database was restricted until met the desired-condition. The following Table 1 provides restricted method for obtaining eligible paper for reviewing.

Table 1. Inclustion criteria for bibliometric analysis

Topic	Inclusion Criteria
Year of Publication	2016-2025
Subject Area	Social science, psychology, arts and humanities, mathematics
Doc Type	Article
Source Type	Journal
Language	English
Exact Keyword	Mathematical Creativity, Mathematical Creative Thinking Divergent Thinking, Creativity In Mathematics, Task Design, Attitude To Mathematics, Classroom Mathematics Creativity, Attitude Toward

Topic	Inclusion Criteria
	Mathematics, Creative Self-efficacy, Fostering Creativity, Creativity-directed Tasks, Collaborative Creativity, Creative Problem-solving, Creative Thinking In Mathematics, Creative Thinking Skill
Title & Abstract	Capturing the topic of Mathematical Creative Thinking and Attitude Toward Mathematics.
Finding Focus	How creative thinking and attitude toward mathematics are interconnected and addressed pedagogically in field of mathematical creativity.

After reviewing the documents by including the criteria, four articles related to the study were obtained. The selected four articles were analysed based on the focus of this study.

Results

A bibliometric analysis

The 230 documents from Scopus database were analysed through Biblioshiny packages. The following Figure 2 provides main information of the meta-data.

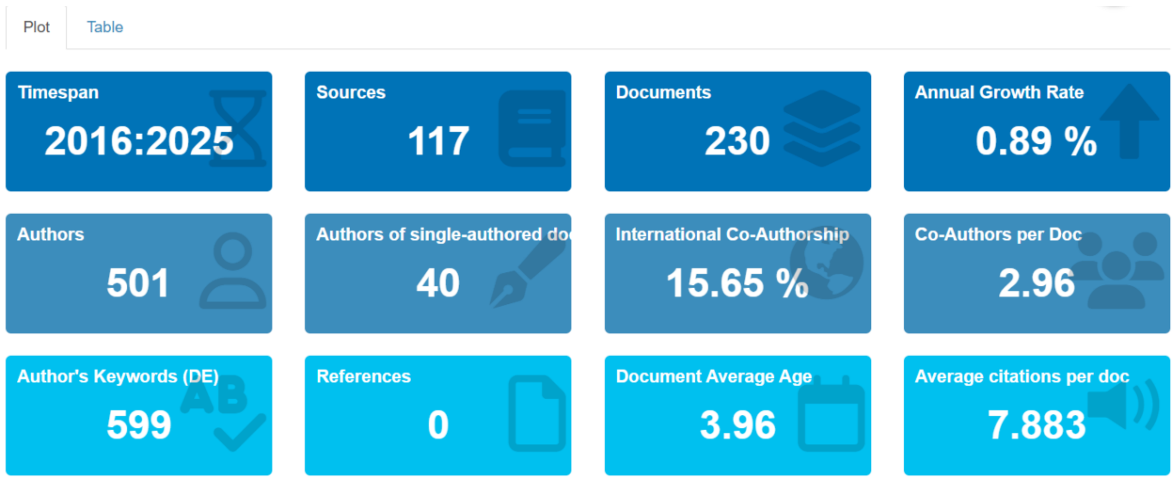

Figure 1. Main information

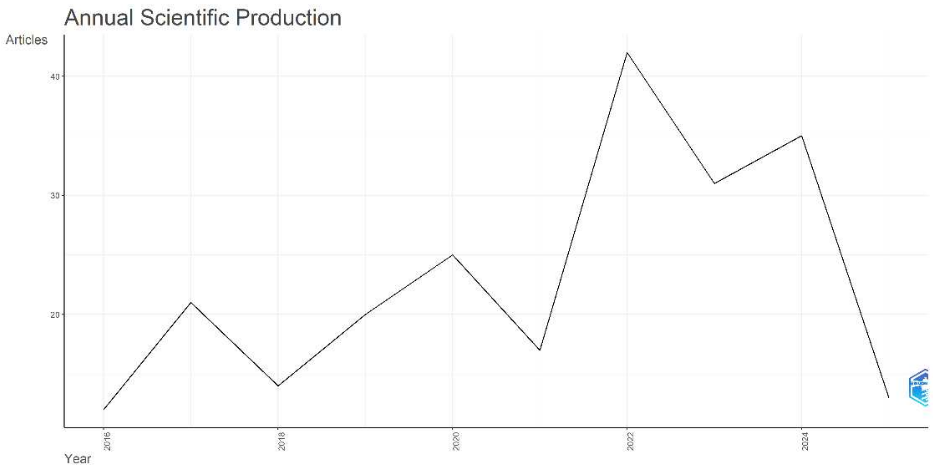

Figure 2. Annual scientific production

Figure 3 indicates that the peak in article production occurred in 2022, with the trend of mathematical creativity research showing fluctuations over time. As we look ahead to 2025, it's likely that this trend will persist since the year is still in its early stages. However, there is potential for a significant increase in document production by the end of 2025.

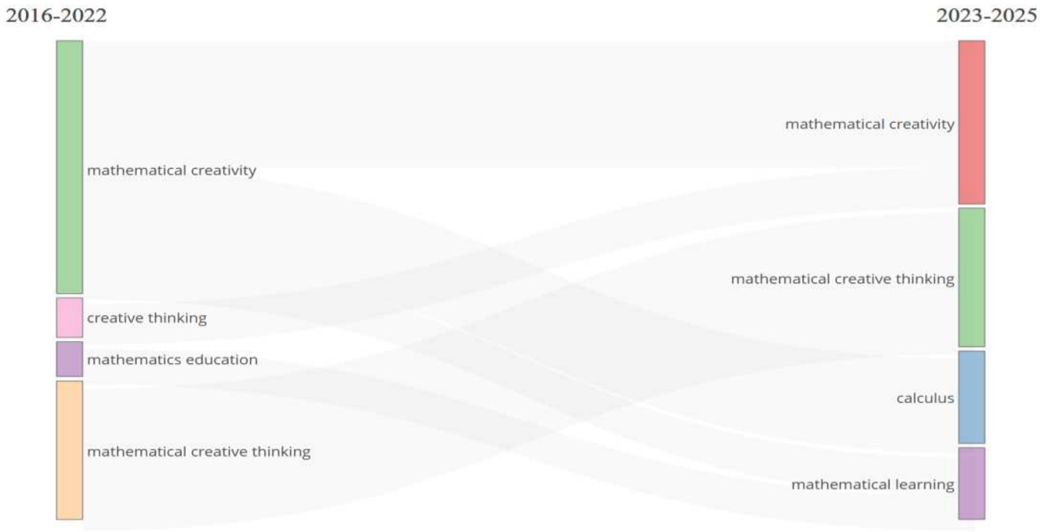

Figure 3. A Thematic evolution of mathematical creativity

Figure 4 presents a representation of the thematic evolution in research related to creativity and mathematical learning based on the bibliometric analysis conducted over two time frames: the 2016–2022 period and the projection of the main themes for the 2023–2025 period. This visualization shows the transition and continuity of research themes that illustrate the direction of the development of scientific discourse in the field. The themes of mathematical creativity and mathematical creative thinking appear to dominate in both periods, indicating the consistency and centrality of both as the main focus in the study of mathematical creativity. Themes such as creative thinking and mathematics education that emerged in the early period also contributed to channeling the focus of research towards the development of creative thinking skills in the context of mathematics education.

During the 2023–2025 period, two additional themes emerged: calculus and mathematics learning, which had not been major focal points in the previous years. The emergence of the calculus theme signifies a shift toward embracing creativity in advanced or specialized mathematics education, while mathematics learning indicates a growing interest in broader pedagogical approaches. The transition of themes from creative thinking and mathematics education to these new areas demonstrates that the study of creativity has evolved beyond a mere conceptual focus, moving towards practical applications in specific learning contexts. Consequently, this development reflects a strengthening of the integration of cognitive, affective, and pedagogical elements within contemporary mathematics research.

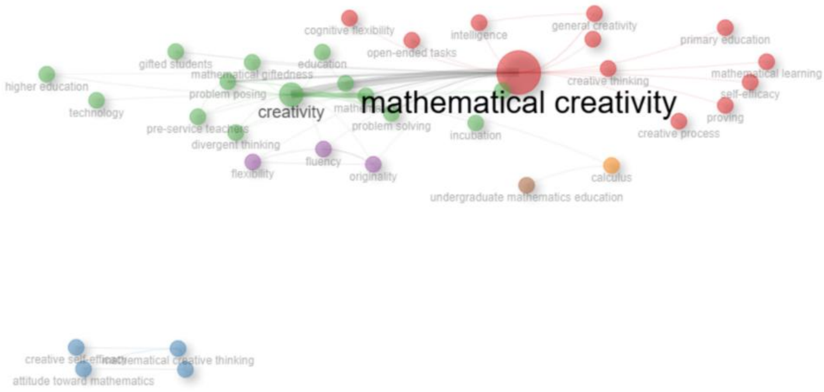

Figure 4. Co-occurence network

Co-occurrence network refers to the frequency of occurrence of two different keywords in the same document. In this network, there is one main cluster that is the pivot, mathematical creativity. Figure 5 presents a visualization map of the co-occurrence network of keywords that frequently appear together in the literature on mathematical creativity. The keyword "mathematical creativity" is the most prominent node, characterized by its larger size, which indicates a high frequency of occurrence and its connections to various other concepts. Closely associated nodes such as creativity, problem solving, problem posing, divergent thinking, and fluency highlight the cognitive aspects of creativity in mathematics. Furthermore, there are connections to educational contexts, including primary education, undergraduate mathematics education, and pre-service teachers, signifying the application of this concept across different levels of learning. Notably, a distinct theme cluster appears in the lower left, encompassing mathematical creative thinking, creative self-efficacy, and attitude toward mathematics. This suggests that these topics are still emerging as specialized themes and have yet to be fully integrated into the broader discourse on mathematical creativity. Overall, this visualization illustrates that research on mathematical creativity has evolved in multiple directions—conceptually, psychologically, and pedagogically.

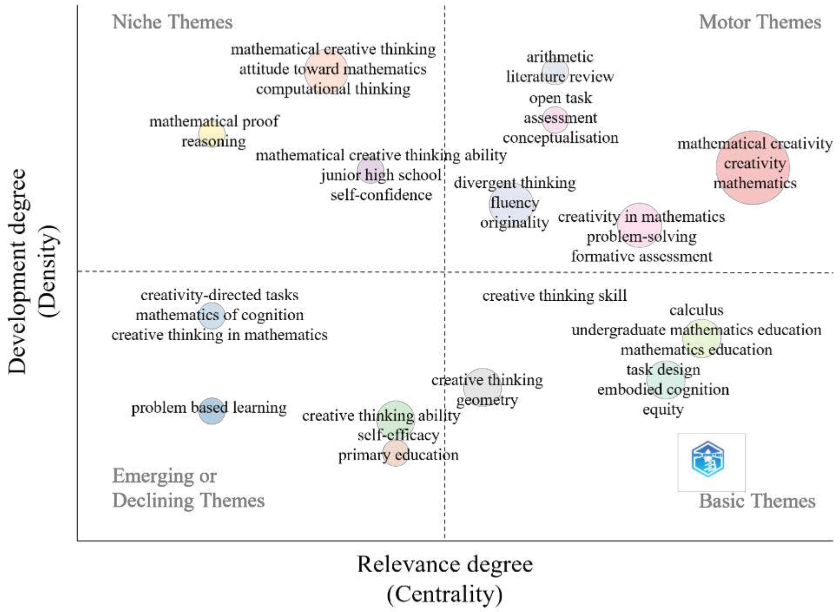

Figure 5. Thematic map

Figure 6 shows is a thematic map that provides an illustration of the structure of themes in certain topics (Tawiah et al., 2024). It illustrates research themes in the domain of mathematical creativity during 2016-2025, utilizing two primary indicators: the level of theme development (density) and the level of theme relevance (centrality). It could also be seen that the map is divided into four quadrants, namely basic theme, motor theme, niche theme, and emerging declining theme which explain different meanings (Madsen et al., 2023).

The upper right quadrant (motor themes) highlights themes that are both highly relevant and well-developed in research, such as mathematical creativity, creativity itself, and mathematics, these are the dominant and most influential areas of study. Additionally, supporting themes like problem-solving, formative assessment, and conceptualization are located within this quadrant, reflecting their role in reinforcing the core aspects of creativity in mathematics education. This indicates a significant connection between the conceptual and assessment dimensions of mathematics education and the ongoing discourse surrounding creativity.

The upper left quadrant, known as niche themes, features themes that are well-developed yet not widely disseminated within the broader network. For instance, topics like mathematical creative thinking, attitudes toward mathematics, and computational thinking exhibit significant potential but remain confined to a limited community. In contrast, the lower left quadrant, labeled emerging or declining themes, presents subjects such as problem-based learning and creative thinking in mathematics, which currently show low relevance and minimal development. This suggests that these topics may be experiencing declining interest or are just beginning to emerge. Meanwhile, the lower right quadrant, referred to as basic themes, encompasses crucial yet less intensively developed themes, such as calculus, undergraduate mathematics education, and self-efficacy. These themes provide essential conceptual foundations for research but have not yet attained the depth seen in other quadrants. This overall map serves as a valuable tool for identifying established, emerging, and potential areas for future research.

According to thematic maps which built the conseptual structure of this topic, it seems to be suggestion for many scholars who would like to develop research in field of mathematical creativity and explore more deepen based on this structure.

A systematic literature review

Thematic maps lead many scholars for developing or exploring more deepen about certain topic (Naeem et al., 2023; Schaab et al., 2022). In this study, an exploration of the theme related to mathematical creativity was conducted using the PRISMA process to answer the second and third research questions. Four papers fulfilling the inclusion criteria were reviewed to explore more deeply how creative thinking and attitude toward mathematics are linked in terms of mathematics. Table 2 provides general information of each papers which were selected.

Table 1. Summary of findings on four selected papers for literature review

Article info (Title; Author; Journal Name; Year of Publication	**Research aims**
Relationship between ethnic identity, attitude, and mathematical creative thinking among secondary school students Suherman Suherman & Tibor Vidakovich Thinking Skills and Creativity Journal 2024	Employed a descriptive correlational structural equation model to examine a hypothetical model of relationship between attitude, ethnicity, and mathematical creative thinking among secondary school students.
Mathematical Creative Thinking-Ethnomathematics based Test: Role of Attitude toward Mathematics, Creative Style, Ethnic Identity, and Parents' Educational Level Suherman Suherman & Tibor Vidakovich RED. Revista de Educación a Distancia Journal 2024	Explored relationships of parental education, ethnic identity, attitude towards mathematics, and creative style on mathematical creative thinking through MCT-ethnomathematics based test and questionnaires.
Predicting multidimensionality of mathematical creativity among students: Do mathematics self-efficacy, attitude to mathematics and motivation to mathematics matter? Sylvia Victor Ovat, Usani Joseph Ofem, Eunice Ngozi Ajuluchukwu , Eno Ndarake Asuquo , Stephen Bepeh Undie, Eme Orok Iban Amanso , Ene I. Ene, Joseph Udo Idung, Joy Joseph Obi, Eno E. Elogbo, Caroline Ita Iserom, Emeka Samuel Nnaji, Evelyn Ijeoma Orji , Okri John Arikpo 2024	Modelled the predictive effect of mathematics self-efficacy, motivation for mathematics, and attitude towards mathematics on mathematical creativity from a multidimensional perspective.
Creative self-efficacy, attitudes, creative style, and environmental literacy: Promoting mathematical creative thinking Suherman Suherman & Tibor Vidakovich The Journal of Educational Research 2025	Explored the mediating roles of Creative Style and Environmental Literacy in the relationship between Creative Self-Efficacy, Attitude Toward Mathematics, and Mathematical Creative Thinking.

Research conducted by Suherman and Vidákovich (2024a) as well as Ovat et al. (2024) consistently demonstrates that attitude toward mathematics significantly influences several key aspects of mathematical creative thinking. Both studies emphasize that attitude toward mathematics is closely linked to the three primary components of mathematical creative thinking: fluency, flexibility, and originality. However, the elaboration aspect does not exhibit a significant relationship (Suherman & Vidákovich, 2024a). These findings reinforce the notion that a positive attitude toward mathematics can serve as a crucial catalyst for enhancing one's capacity for mathematical creative thinking, particularly in generating numerous ideas, adopting varied approaches, and presenting original concepts.

In terms of creative thinking, fluency refers to the ability to generate multiple ideas and solutions, flexibility refers to the approach that leads to solving a task, and originality is defined by the creation of unique and new ideas (Assmus & Fritzlar, 2018). Furthermore, elaboration involves more detailed descriptions while solving problems (Schindler & Lilienthal, 2020). For specific discussion in mathematics, students are fluent if they can produce multiple ideas and solutions (Elgrably & Leikin, 2021). Based on Suherman and Vidákovich (2024a) and Ovat et al. (2024), students who appreciate and enjoy mathematics are often more inclined to explore new methods for generating multiple solutions. They engage persistently with mathematical tasks that foster the exploration of various problem-solving techniques, which in turn helps them develop a broader range of ideas (Kiwanuka et al., 2022). Furthermore, students who are flexible in view of mathematics, tend to approach mathematics in diverse ways and constantly do not follow traditional methods and present multiple solutions. Moreover, students are also more likely to devise innovative and unique solutions to mathematical challenges. They are more willing to take intellectual risks that not only lead to problem-solving but also encourage new discoveries, which is a fundamental aspect of originality (Dowker et al., 2019).

Interestingly, the elaboration aspect did not significantly impact by students' attitude toward mathematics. It means that although they have a positive attitude toward mathematics, they still struggle to elaborate on ideas or ways to solve mathematical problems. This is also found in Putri et al. (2024), which stated that students can face limited performance in the elaboration process although they have a positive attitude toward mathematics. This finding leads to provide a comprehensive learning for acquiring all aspects of creative thinking related to the attitude toward mathematics.

Beyond the direct relationship between attitude and creative thinking, recent studies have identified mediating factors that influence this connection. The research which conducted by Suherman and Vidákovich (2024b) emphasized that ethnic factors can moderate the relationship between attitude toward mathematics and mathematical creative thinking. Students who have a positive attitude toward their ethnicity tend to be creative in mathematics learning (Uekawa et al., 2007). Cultural attitudes that encourage or discourage risk-taking and unconventional thinking affect one's willingness to engage in creative problem-solving (Al-Mamary & Alshallaqi, 2022). Furthermore, Suherman and Vidákovich (2025) continued their research and revealed that the relationship between attitude toward mathematics and mathematical creative thinking is positively mediated by environmental literacy. Environmental literacy is the capacity to utilize environmental knowledge in practical actions and behaviors (Atabek-Yiğit et al., 2014). By having positive environmental literacy, students are more aware of their surroundings, which can promote independent thinking, curiosity, and diverse problem-solving approaches in mathematics. It aligns with the goals of environmental literacy, which are awareness, knowledge, attitudes, skills, and participation (Fang et al., 2023).

Together, these findings suggest that the relationship between attitude toward mathematics and creative thinking is multifaceted and context dependent. These two studies illustrate how the cultural backgrounds of students can shape mathematical creativity. The cultural term in this discussion is not only about the authenticity of local wisdom but also the social environment with which students engage. It implies that mathematical creativity can be fostered by considering students' cultural background and how to bring it in the classroom. As educator, creating learning designs that incorporate students' cultural backgrounds can be an effective approach to bridge mathematical creative thinking and attitudes toward mathematics.

The findings above underscore the dynamic interplay between creative thinking and attitude toward mathematics, both conceptually and affectively. The emergence of niche and basic themes such as mathematical creative thinking, attitude towards mathematics, and cultural context, which accompany ethnicity and environmental literacy, highlights the growing awareness that fostering mathematical creativity requires not only cognitive activation but also affective engagement and contextual relevance (Ibrahim et al., 2023; Suherman & Vidákovich, 2024b, 2025). While the thematic analysis did not reveal specific pedagogical frameworks, the interplay among cultural context, environmental literacy, and affective-cognitive domains suggests the potential relevance of pedagogical approaches like Realistic Mathematics Education (RME), whose principles align closely with the identified thematic factors.

RME is the theory employed by Freudenthal, who believed that mathematics is a human activity. Through various activities, humans are interconnected by cultural backgrounds, such as ethnicity and environmental issues. Gravemeijer (1994) proposed three principles of RME theory, which are didactical phenomenology, emergent model, and guided-reinvention. Didactical phenomenology stresses the use of rich contexts as a starting point for learning. It aims to engage students in relevant concepts in everyday activity (Van Den Heuvel-Panhuizen, 2020). The emergent model refers to the transition process from an informal model in a realistic context to a formal model. It aims to bridge the gap between students' thinking abilities and their understanding of mathematical concepts (Gravemeijer, 2020; Van Den Heuvel-Panhuizen, 2020). Furthermore, in RME lessons, students are guided in reinventing mathematical ideas through the context. It suggests that the teachers guide their students in developing mathematical understanding (Solomon et al., 2021).

These principles of RME are prominent in implementing learning design that could be identified as RME-based learning. It also aligns with the thematic structures which are identified in this study. Each principle of RME can be pedagogically addressed by bridging creative thinking and attitude toward mathematics through its mediator factors: ethnicity and environmental literacy. By didactical phenomenology principles, ethnicity and environmental context could be addressed as a starting point of learning as utilizes as Palinussa et al. (2021), Cesaria et al. (2022), and Payadnya et al. (2023)' works. Engaging students with these context, makes them to creatively view and approach the problems. They could also use various models for bridging real-life contexts in terms of cultural context into more formal mathematics. It also could embrace their creativity through reinventing mathematical concepts by engaging cultural context and being guided by the teacher. Therefore, RME could be viewed as a prominent pedagogical practice that cultivate students' creative thinking and attitude towards mathematics simultaneously.

Discussion

Through a bibliometric analysis, this study elucidates the evolution and thematic framework of mathematical creativity research within the 2016–2025 timeframe. The findings indicate that mathematical creativity has undergone significant development, establishing itself as a stable primary theme. This aligns with the conclusions drawn by Saefudin et al. (2023) and Andriyono et al. (2024), who mapped research in the field of mathematical creativity based on leading academic journals, prevalent articles, and contributions from various nations. However, the current study does not delve deeply into the interconnected factors that shape mathematical creativity, such as creative thinking and attitudes toward mathematics, which constitute the central focus of this investigation.

The thematic mapping results reveal that creative thinking and attitudes toward mathematics exhibit clusters that are both conceptually and affectively intertwined, with each contributing to the advancement of mathematical creativity (Ovat et al., 2024; Suherman & Vidákovich, 2024b, 2025). Moreover, factors such as ethnicity and environmental literacy emerge as significant mediators in the relationship between attitudes toward mathematics and creative thinking skills (Suherman & Vidákovich, 2024a, 2024b). These findings suggest that initiatives aimed at fostering mathematical creativity must extend beyond cognitive and affective domains, incorporating the socio-cultural contexts and environments in which students engage in learning.

In light of these mediating factors, the Realistic Mathematics Education (RME) approach exhibits substantial potential as a pertinent pedagogical practice. Grounded in Freudenthal's conceptualization of mathematics as a human activity, RME underscores meaningful learning through real-world contexts, including cultural and environmental experiences (Gravemeijer, 2020; Van Den Heuvel-Panhuizen, 2020). A number of studies have investigated the application of RME within ethnic contexts, such as those conducted by Palinussa et al. (2021), Cesaria et al. (2022), and Payadnya et al. (2023), utilizing local wisdom as a foundational element in mathematics education. However, these works predominantly focus on the development of cognitive aspects, lacking explicit designs aimed at simultaneously enhancing creative thinking and fostering positive attitudes toward mathematics.

This identified gap presents an opportunity for further research to design RME-based learning frameworks that not only engage the cognitive domain but also stimulate the affective and creative dimensions of students through culturally relevant contexts. Such designs have the potential to enrich students' understanding and perceptions of mathematics education, while promoting active participation in exploration and problem-solving endeavors.

Conversely, despite environmental literacy emerging as a potential mediating factor, there appears to be a dearth of reputable research examining the explicit integration of environmental contexts in RME-based instruction. As noted by Fang et al. (2023), environmental literacy encompasses awareness, knowledge, attitudes, skills, and engagement in responsible environmental management. By incorporating environmental issues as realistic contexts in mathematics education, students can be encouraged to think critically, cultivate diverse problem-solving strategies, and foster an attitude of environmental stewardship. Furthermore, integrating environmental issues aligns with the principles of didactical phenomenology in RME, which advocates the utilization of real contexts as a foundation for learning.

Consequently, this study advocates for further exploration into the role of RME-based learning as a pedagogical bridge connecting creative thinking and attitudes toward mathematics through the lens of ethnicity and environmental literacy. This approach is anticipated to yield learning practices that are more holistic and pertinent to the needs and backgrounds of contemporary learners.

Conclusion

By conducting a bibliometric analysis, it has been determined that mathematical creativity remains an evolving topic within the period of 2016 to 2025. This is evidenced by its prominence in discussions, forming a central cluster within both the co-occurrence network and thematic map quadrant. Moreover, the thematic map illustrates that creative thinking and attitudes toward mathematics are situated within the same cluster, contributing to the thematic structure of mathematical creativity. This indicates a connection between the cognitive and affective domains.

Additionally, research has identified ethnic factors and environmental literacy as mediators between creative thinking and attitudes toward mathematics, warranting further investigation. Implementing RME-based learning that incorporates ethnic contexts and environmental literacy could serve as an innovative pedagogical approach to connect creative thinking and attitudes toward mathematics within the framework of mathematical creativity.

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Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this manuscript. In addition, the authors have addressed the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies.

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Author Contributions

Adinda Salshabilla Yudha: Conceptualization, writing - original draft, revision draft, methodology, editing, and visualization; **Raden Rosnawati:** Review, formal analysis, methodology, validation, and supervision.

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