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Systematic Literature Review: The Metaphorical Thinking Approach in Mathematics in Indonesia from 2020 to 2025

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Abstract

Metaphorical Thinking has been one of the learning approaches in mathematics education over the past five years. This study aims to analyze research trends on the Metaphorical Thinking Approach in mathematics education and learning through a Systematic Literature Review (SLR) approach. Articles were collected from the Google Scholar database using Publish or Perish 8 and selected based on strict inclusion criteria, resulting in 18 relevant articles. The analysis reveals research trends in the Metaphorical Thinking approach with diverse and effective applications, particularly in supporting 21st-century skills such as mathematical connection abilities, mathematical communication skills, reasoning skills, algebraic problem-solving skills, and the utilization of technology. However, there is a gap in the optimal integration of technology and a more inclusive context in applying the Metaphorical Thinking Approach. This study provides a significant contribution by mapping research trends and identifying future research opportunities to enhance the effectiveness of the Metaphorical Thinking Approach in mathematics education and learning.

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Abstrak

Metaphorical Thinking telah menjadi salah satu pendekatan pembelajaran dalam pendidikan matematika selama lima tahun terakhir. Penelitian ini bertujuan untuk menganalisis tren penelitian tentang Pendekatan Metaphorical Thinking dalam pendidikan dan pembelajaran matematika melalui pendekatan Systematic Literature Review (SLR). Artikel dikumpulkan dari basis data Google Scholar menggunakan Publish or Perish 8 dan dipilih berdasarkan kriteria inklusi yang ketat, sehingga menghasilkan 18 artikel yang relevan. Analisis ini mengungkap tren penelitian dalam pendekatan Metaphorical Thinking dengan aplikasi yang beragam dan efektif, khususnya dalam mendukung keterampilan abad ke-21 seperti kemampuan koneksi matematika, keterampilan komunikasi matematika, keterampilan penalaran, keterampilan pemecahan masalah aljabar, dan pemanfaatan teknologi. Namun, terdapat kesenjangan dalam integrasi teknologi yang optimal dan konteks yang lebih inklusif dalam menerapkan Pendekatan Metaphorical Thinking. Penelitian ini memberikan kontribusi yang signifikan dengan memetakan tren penelitian dan mengidentifikasi peluang penelitian di masa mendatang untuk meningkatkan efektivitas Pendekatan Metaphorical Thinking dalam pendidikan dan pembelajaran matematika.

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PENDAHULUAN

Mathematics is a subject that plays a crucial role in elementary, secondary, and even higher education. It is often perceived as an abstract and difficult discipline for students to comprehend. This is because mathematics learning typically involves memorizing mathematical concepts, often by repeatedly reciting definitions provided by teachers or

written in textbooks, without trying to understand their meaning and significance (Hendriana, 2012). Therefore, an approach is needed to help students grasp mathematical concepts through their own understanding. One such approach is the metaphorical thinking approach.

The Metaphorical Thinking approach is a strategy used to help students understand mathematical concepts more concretely and intuitively. Other studies indicate that the use of metaphors in mathematics learning plays a role in shaping cognitive structures for further mathematical thinking by sharing conceptual structures from non-mathematical everyday life (Hendriana & Rohaeti, 2017). The use of metaphors in mathematics learning can be an effective strategy in enhancing students' skills and abilities. The success of the metaphorical thinking approach is influenced by various factors in the learning process.

Although this approach offers numerous benefits, its effectiveness depends on several factors, including the teaching methods used by teachers, students' readiness to comprehend metaphors, and a supportive learning environment. The analysis of students' development of mathematical metaphors primarily focuses on conceptual understanding (Hendriana & Rohaeti, 2017). Ideally, this approach helps students connect mathematical concepts with their everyday experiences. By utilizing metaphors, mathematics learning is expected to become more engaging, easier to understand, and improve students' problem-solving abilities. Research on this approach is expected to provide new insights for teachers and mathematics education researchers in Indonesia.

Despite its promising potential, the implementation of this approach in Indonesia still faces various challenges, such as teachers' limited understanding, a lack of resources, and the absence of policies that support its widespread adoption. Some studies in Indonesia have begun exploring this approach, but its application remains limited to specific contexts and has not been widely implemented across different educational levels. Therefore, further studies are needed to understand the development, benefits, and challenges of applying Metaphorical Thinking in mathematics learning in Indonesia. Research on metaphorical thinking in Indonesia has undergone significant changes over the past six years.

During this period, the world experienced a major disruption due to the COVID-19 pandemic, which profoundly altered the patterns of teaching and research, shifting them from face-to-face interactions to online-based modalities. This shift triggered a paradigm change in both pedagogical and research practices as an adaptive response to the evolving global landscape. In the post-pandemic era, educational and research practices have once again transformed, with technology integration becoming increasingly prominent. Among the emerging approaches, metaphorical thinking has gained traction as a framework that fosters creative and innovative thinking in the design and implementation of learning processes.

This study aims to conduct a systematic review of studies carried out in Indonesia from 2020 to 2025 on the Metaphorical Thinking approach in mathematics. This review will identify research trends, achievements, and obstacles encountered in implementing this approach. The findings of this study are expected to provide recommendations for developing more effective mathematics learning strategies in Indonesia.

METODE

The method employed in this study is the Systematic Literature Review (SLR). SLR is also used to identify gaps in existing literature, provide guidance for future research, and assist practitioners and policymakers in making more informed decisions. The researchers aim to utilize this method by identifying, reviewing, evaluating, and interpreting all relevant studies related to the research problem. Through this approach, the researchers systematically examine and identify various scholarly journals by following established steps in each stage of the process (Triandini et al., 2019).

The identification and data collection stage was initially conducted using the Publish or Perish 8 desktop application. The search was performed using keywords such as "*metaphorical thinking*" AND "*mathematics*", "*pendekatan metaphorical thinking*", or "*metaphorical thinking approach*". Quotation marks were used in the search queries to ensure that the results included the complete keyword phrases rather than separate words. This approach aimed to obtain more precise and relevant search results.

In the review stage, articles were selected based on specific inclusion criteria. The criteria for literature selection included studies related to mathematics education, articles published in SINTA-indexed journals (SINTA 1 to SINTA 4), and publications from the years 2020 to 2025. The research questions to be addressed in this study are as follows:

Table 1. Research Questions

Q1	**:**	What are the research trends regarding the metaphorical thinking approach from 2020 to 2025?
Q2	**:**	In which regions has research on the metaphorical thinking approach been conducted from 2020 to 2025?
Q3	**:**	What variables have been examined in studies utilizing the metaphorical thinking approach in mathematics education from 2020 to 2025?
Q4	**:**	What mathematical topics have been explored in studies using the metaphorical thinking approach in mathematics education from 2020 to 2025?
Q5	**:**	What instructional approaches have been employed in studies using the metaphorical thinking approach in mathematics education from 2020 to 2025?

In the evaluation stage, the collected literature was selected based on the inclusion criteria. As a result, 18 studies met the inclusion criteria after undergoing multiple selection phases.

Table 2. Research Findings on the Metaphorical Thinking Approach

No	Penulis	Tahun	Judul	Rank Sinta
1	Sudarsono & Nurrohmah	2020	Upaya meningkatkan kompetensi strategis matematis melalui pendekatan metaphorical thinking peserta didik kelas VIIA SMP Negeri 11 Yogyakarta	Sinta4
2	Sundary et al.	2020	Metaphorical thinking approach with google classroom: its effect towards students' understanding of mathematical concept skills	Sinta2
3	Febriyanti & Putra	2020	Mathematics learning interest of elementary school students in using metaphorical thinking learning model	Sinta2
4	Lestari & Andinny	2020	Kemampuan penalaran matematika melalui model pembelajaran metaphorical thinking ditinjau dari disposisi matematis	Sinta3
5	Aidah et al.	2020	Pemahaman matematis melalui metaphorical thinking berbantuan aplikasi powtoon	Sinta4
6	Ghifari et al.	2022	Pengembangan video pembelajaran bentuk aljabar dengan pendekatan metaphorical thinking	Sinta2
7	Wahid et al.	2024	Kemampuan koneksi matematis peserta didik dengan pendekatan pembelajaran metaphorical thinking	Sinta4
8	Abdillah et al.	2023	Pengaruh pendekatan metaphorical thinking kemampuan berpikir kritis matematis peserta didik	Sinta4
9	Fatmawati et al.	2023	Meta analisis pengaruh pendekatan metaphorical thinking terhadap hasil pembelajaran matematika	Sinta4
10	Rahmawati et al.	2022	Eksperimentasi model pembelajaran POE dengan pendekatan metaphorical thinking terhadap kemampuan	Sinta3

No	Penulis	Tahun	Judul	Rank Sinta
			berpikir tingkat tinggi peserta didik	
11	Muthmainnah et al.	2021	Metaphorical thinking of students in solving algebraic problems based on their cognitive styles	Sinta2
12	Purba & Sirait	2024	Pengaruh kemampuan komunikasi matematik peserta didik menggunakan pembelajaran metaphorical think mathematics berbatuan Quizizz di kelas X MAS Qur'an Kisaran	Sinta4
13	Noviani	2022	Metaphorical thinking of junior high school students in solving algebra problems	Sinta3
14	Yanto & Wardono	2020	Analysis of students' mathematical literacy skills in TAPPS model learning with metaphorical thinking approach assisted by Class Dojo	Sinta3
15	Wahyuningtyas & Amir	2025	Can metaphorical thinking learning model enhance students' mathematical literacy in area conservation?	Sinta2
16	Pantaleon et al.	2024	Metaphorical thinking intervention in learning and its impact on mathematical reasoning ability	Sinta2
17	Kowi & Fakhriyana	2024	Kemampuan metaphorical thinking dalam menyelesaikan soal HOTS SPLDV ditinjau tipe gaya belajar	Sinta3
18	Relawati & Lukito	2020	Metaphorical thinking of students with different sensing personality types in solving algebra problems	Sinta4

HASIL DAN PEMBAHASAN

This section presents the results of an analysis of scholarly publications that explore the Metaphorical Thinking approach in mathematics education over the period from 2020 to 2025. The analysis encompasses five key aspects: (1) research trends over time (2020–2025), (2) the geographical distribution of research in Indonesia, (3) variables associated with the Metaphorical Thinking approach, (4) instructional materials utilized in related studies, and (5) the types of research methods employed. The findings are presented through visualizations and descriptive explanations to provide a comprehensive understanding of the development, distribution, and research focus related to the Metaphorical Thinking approach over the past six years.

1. Trends in the Metaphorical Thinking Approach

The graph illustrates the trend in the number of scientific articles discussing the Metaphorical Thinking approach from 2020 to 2025. The data indicate fluctuations in the number of publications on this topic. In 2020, the number of articles peaked at eight publications, possibly due to increasing interest in Metaphorical Thinking in educational research or cognitive psychology. However, this trend saw a drastic decline in 2021, with only one article published. A possible explanation for this decline is a shift in research focus toward other more relevant approaches at the time or limitations in research resources.

Figure 1. Research Trends on the Metaphorical Thinking Approach by Year

In 2022, the number of publications increased slightly to three, suggesting a resurgence of interest in this topic. This upward trend continued modestly until 2024, reaching four articles, indicating some stability in studies on Metaphorical Thinking in mathematics education. However, in 2025, the trend declined again, with only one article published. This decrease could be attributed to research saturation or a shift in focus toward other teaching methods deemed more effective.

Considering this research trend, it can be concluded that the Metaphorical Thinking approach remains relevant in academic studies, despite fluctuations in the number of publications over the years. Further studies are needed to understand the factors influencing the rise and fall of interest in this research and to explore its potential applications across various disciplines.

2. Distribution of Research on the Metaphorical Thinking Approach in Indonesia

Figure 2. Distribution of Research on the Metaphorical Thinking Approach in Indonesia

Based on the analyzed map, the distribution of research on the Metaphorical Thinking approach in Indonesia from 2020 to 2025 shows an uneven spread. Some regions have a higher concentration of research compared to others. The highlighted areas in red on the map indicate significant research activity, covering several provinces in Indonesia. Key research hubs include Sumatra, Java, Bali and Nusa Tenggara, as well as Sulawesi and Papua. In Sumatra, research activities are mainly concentrated in western provinces, particularly Aceh and West Sumatra. Java serves as the primary research center, with a widespread distribution, especially in DKI Jakarta, West Java, Central Java, and East Java. A smaller number of studies are found in Bali and Nusa Tenggara, while research activity in Sulawesi and Papua is relatively minimal.

Several conclusions can be drawn regarding the distribution of research on the Metaphorical Thinking approach in Indonesia. Java dominates research activities, likely due to the larger number of higher education institutions and better access to research resources. The presence of major universities and research institutions in cities such as Jakarta, Bandung, Yogyakarta, and Surabaya significantly contributes to the high volume of studies in this field. In contrast, research distribution outside Java remains limited. While Sumatra has some research activities, the number is significantly lower than in Java. Eastern Indonesia, including Kalimantan, Sulawesi, and Papua, exhibits minimal research output, possibly due to limited access to research resources and a shortage of academics focusing on this approach.

Several factors influence the distribution of this research, including access to higher education, academic awareness, research trends, and educational policy support. Cities with leading universities tend to have higher research output. Additionally, the Metaphorical Thinking approach may be more popular in certain academic circles. Regions with more innovative educational initiatives are also more likely to have greater research activity on alternative teaching approaches such as Metaphorical Thinking.

Overall, research on the Metaphorical Thinking approach in Indonesia is still predominantly centered in Java, with fewer studies conducted in other regions. To enhance the distribution of this research, greater support for academics outside Java is necessary, including funding, access to scientific journals, and institutional collaboration. Additionally, increased socialization and training on this approach could encourage more research in underrepresented regions.

3. Variables Related to the Metaphorical Thinking Approach

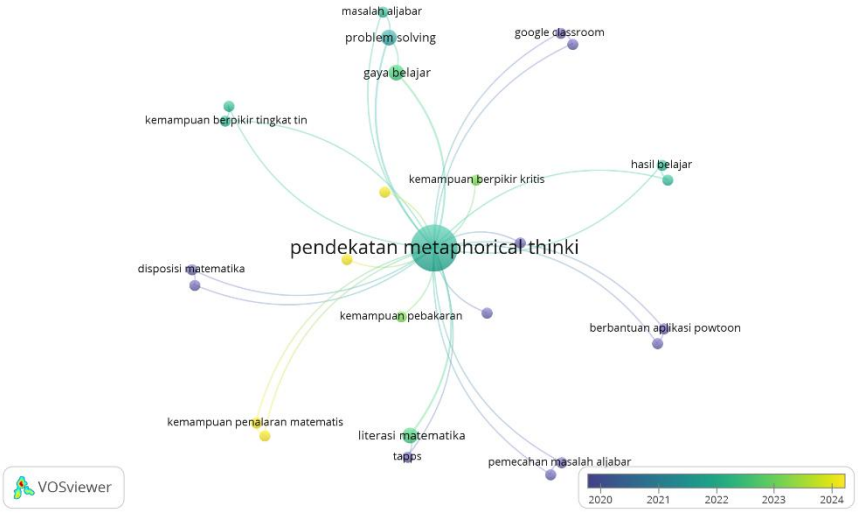

Figure 3. Variables Related to Research on the Metaphorical Thinking Approach

The Metaphorical Thinking approach is a learning strategy that utilizes metaphors to bridge abstract mathematical concepts with students' real-life experiences (Ghifari et al., 2022). By employing analogies and comparisons, students can more easily grasp complex concepts, such as problem-solving in algebra (Relawati & Lukito, 2020). This approach is closely related to higher-order thinking skills and mathematical connection abilities (Rahmawati et al., 2022; Wahid et al., 2024). One of the key advantages of the Metaphorical Thinking approach in mathematics learning is its ability to help students identify relationships between various mathematical concepts. Furthermore, this approach contributes to enhancing analytical thinking skills (Abdillah et al., 2023). Students who use metaphors in understanding mathematics demonstrate improvements in critical thinking skills,

mathematical literacy, problem-solving abilities, reasoning, and mathematical communication (Abdillah et al., 2023; Aidah et al., 2020; Fatmawati et al., 2023; Lestari & Andinny, 2020; Purba & Sirait, 2024).

Studies have shown that the use of Metaphorical Thinking can increase students' interest in learning mathematics (Febriyanti & Putra, 2020). Metaphors help students connect the concepts they learn with their personal experiences, thereby enhancing engagement. Learning outcomes also tend to improve as students better understand metaphorical concepts through the Predict Observe Explain (POE) learning model compared to conventional methods (Rahmawati et al., 2022) and the scientific approach (Abdillah et al., 2023). In mathematical problem-solving, the metaphorical approach can assist students in recognizing patterns and comprehending problem-solving steps more effectively (Muthmainnah et al., 2021). For instance, in algebra problem-solving, students provided with concrete analogies find solutions more easily than those who are only given procedural explanations (Kowi & Fakhriyana, 2024; Noviani, 2022).

Overall, the Metaphorical Thinking approach in mathematics learning has a positive impact on various cognitive and affective aspects of students, including critical thinking skills, problem-solving abilities, learning styles, mathematical literacy, mathematical connection skills, mathematical communication skills, reasoning abilities, and algebraic problem-solving skills. The integration of technology can further enhance the effectiveness of this method in the learning process.

4. Learning Materials Utilizing the Metaphorical Thinking Approach

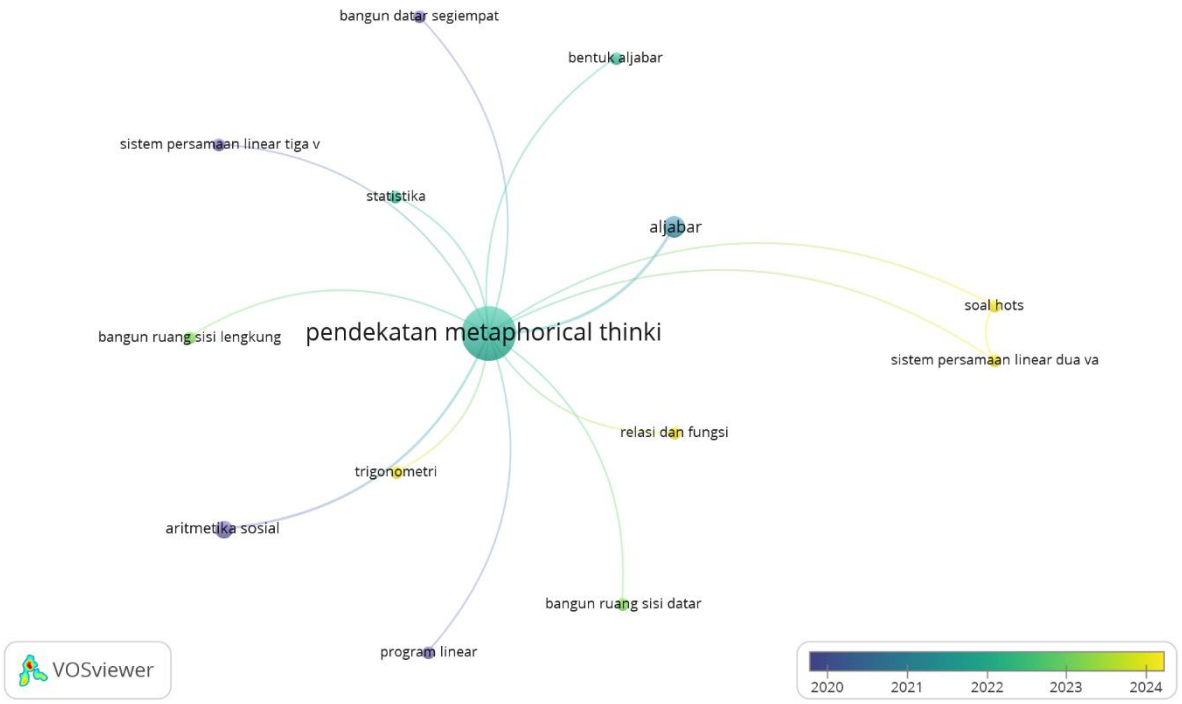

Figure 4. Research Materials on the Metaphorical Thinking Approach

The Metaphorical Thinking approach is a learning strategy that employs metaphors to help students understand abstract mathematical concepts by connecting them to concrete everyday experiences. This method aims to enhance students' conceptual understanding by utilizing familiar analogies. In mathematics learning, Metaphorical Thinking involves the use of conceptual comparisons between abstract ideas and real-world phenomena. Examples of the application of this approach include teaching algebraic concepts by associating them with

plant growth patterns or illustrating a system of linear equations as an intersection of roads. Based on network analysis presented in the figure, several topics frequently associated with the Metaphorical Thinking approach in mathematics include algebra, systems of linear equations, statistics, linear programming, and geometry. In algebra learning, this approach is applied by illustrating equations as a balance scale to explain the concept of equality. Meanwhile, systems of linear equations can be depicted as road intersections to help students understand the point of intersection between two lines. In statistics, the concept of data distribution can be likened to population balance, while linear programming is often explained through resource optimization in industrial or business contexts (Lestari & Andinny, 2020).

Several studies have shown that the Metaphorical Thinking approach enhances students' understanding of mathematics. According to (Hendriana & Rohaeti, 2017), the use of metaphors in mathematics enables students to grasp abstract concepts more easily. A study by Abdillah et al. (2023) found that students who received metaphor-based instruction demonstrated a deeper understanding of mathematical concepts. Research conducted by Ghifari et al. (2022) and Relawati & Lukito (2020) in algebra learning revealed that the use of metaphors can increase students' motivation and interest in mathematics. Based on these research findings, it can be concluded that the Metaphorical Thinking approach is an effective strategy for improving students' understanding of abstract mathematical concepts. By connecting mathematical concepts to real-life experiences, students can internalize the ideas being taught more effectively. Therefore, this approach can be integrated into mathematics instruction to support students' conceptual thinking skills.

5. Research Types in the Metaphorical Thinking Approach

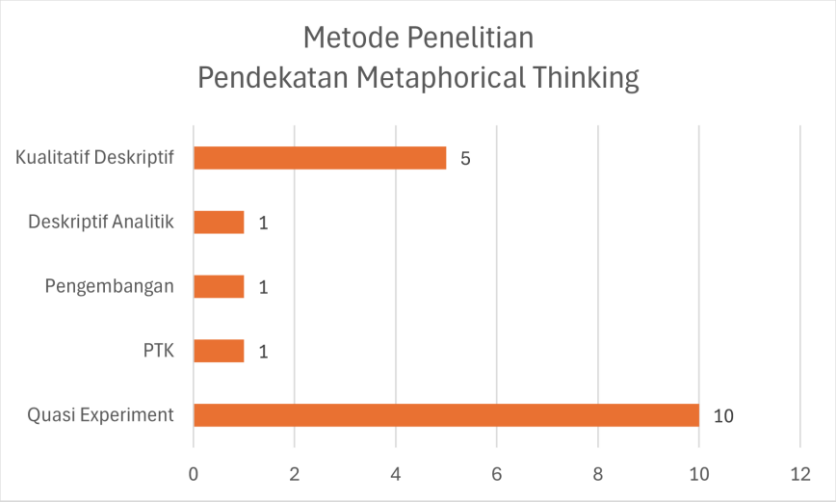

Figure 5. Research Types in the Metaphorical Thinking Approach

Based on Figure 5, it is evident that the Quasi-Experimental method is the primary choice in research implementing the Metaphorical Thinking approach. This indicates that many studies in this field tend to adopt a quantitative approach with more rigorous variable control. As explained by Creswell (2019), experimental research allows for a clearer examination of cause-and-effect relationships compared to descriptive methods.

Descriptive Qualitative Methods also have a significant proportion in this research. This indicates that a deep understanding of the Metaphorical Thinking concept remains an important focus for researchers. According to (Miles et al., 2014), the qualitative approach can provide richer insights into individual experiences and the meaning they attach to a concept or phenomenon.

Meanwhile, Descriptive Analytical, Development, and Classroom Action Research (CAR) methods show a smaller proportion, which may indicate that these approaches are less popular or less frequently used in studies on Metaphorical Thinking. However, development research plays an important role in producing instruments or learning models based on Metaphorical Thinking that can be widely applied in the field of education.

KESIMPULAN

Based on the research findings, it can be concluded that the Metaphorical Thinking approach remains relevant in the academic world, particularly in mathematics education. However, the number of studies addressing this approach has fluctuated over the years. While it peaked in 2020, the publication trend experienced a significant decline in the following years, with slight increases in certain years. Factors influencing this trend may include shifts in academic interest, limitations in research resources, and a shift in focus towards other educational approaches. More research is needed to understand the factors influencing the fluctuations in the number of publications related to Metaphorical Thinking. Longitudinal studies could be conducted to assess the long-term impact of this approach in learning.

In the context of research dissemination in Indonesia, it was found that Java Island dominates the number of studies conducted, especially in cities with a high concentration of universities, such as Jakarta, Bandung, Yogyakarta, and Surabaya. Outside Java, there are fewer studies, with some research points in Sumatra, Bali, Nusa Tenggara, Sulawesi, and Papua. This gap is likely due to limited access to research resources and academic focus on this approach. Academics outside Java need to be supported in Metaphorical Thinking research through funding, access to journals, and inter-institutional collaboration.

The variables associated with the Metaphorical Thinking approach indicate that this strategy has a strong correlation with the enhancement of higher-order thinking skills, problem-solving abilities, mathematical literacy, as well as mathematical connection and communication skills. Additionally, multimedia-based learning technology can increase the effectiveness of this approach in education. More development research is needed to create more applicable and effective Metaphorical Thinking learning models. The integration of technology in metaphor-based learning, such as the use of interactive multimedia and artificial intelligence, could be a promising area for further research.

In terms of learning materials, this approach is widely applied to abstract concepts such as algebra, systems of linear equations, statistics, and linear programming. The use of metaphors has been proven to help students better understand these concepts. Exploratory studies could be conducted to discover new materials for the use of metaphors in education.

Among the types of research used, the Quasi-Experimental method is the most frequently employed, indicating the dominance of the quantitative approach in testing the effectiveness of Metaphorical Thinking. Descriptive qualitative methods are also widely used, while developmental research and classroom action research (CAR) remain limited. There is a need to increase the use of other research methods, such as Research and Development (R&D) and classroom action research (CAR), to foster innovation in metaphor-based learning. Further qualitative research is needed to explore the experiences of students and teachers in applying this strategy in the classroom.

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