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Global Trends in Lateral Thinking: Bibliometric Study of Growth, Collaboration, and Applications

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ABSTRACT: Lateral thinking is a non-linear thinking approach that is increasingly recognized as a vital strategy for fostering creativity and problem-solving across various disciplines. This study aims to analyze global trends, author contributions, scientific collaborations, and thematic evolution within the lateral thinking literature during the period 2014–2024. The methodology employed is a bibliometric analysis based on data from Scopus, utilizing a quantitative approach and network visualization through VOSviewer to map keywords, thematic clusters, and interconceptual relationships. The findings reveal a significant increase in publications since 2018, with notable contributions from countries such as the United Kingdom, the United States, and Indonesia. Dominant keywords such as creativity, problem solving, and innovation form clusters that highlight the central role of lateral thinking in the development of innovative solutions in education, technology, health, and management. The study also uncovers strong associations between lateral thinking and AI-based as well as neurobiological approaches, expanding its applicability to advanced technologies and human cognitive understanding. These findings underscore the importance of lateral thinking as a strategic framework for addressing complex global challenges and open up opportunities for future multidisciplinary research.

KEYWORDS: Lateral Thinking, bibliometric analysis, creativity, problem solving, research trends

INTRODUCTION

Lateral thinking, first introduced by De Bono (1970), is an approach to problem-solving that involves creative and unconventional thinking. This approach is used to explore solutions that differ from traditional or vertical thinking methods. Over the past decade, lateral thinking has increasingly been recognized as a crucial tool in fostering creativity, not only in educational and innovation contexts but also in addressing complex problems. As a result, many researchers have developed studies on the application of lateral thinking across various fields of knowledge (Susilawati et al., 2018).

Various studies on the application of lateral thinking have made significant contributions in fields such as education, innovation, management, and technology (Baharin et al., 2018; Li et al., 2007; Mustofa & Hidayah, 2020a; Pratama et al., 2022; Susilawati et al., 2018). However, despite the growing recognition of lateral thinking, research trend analyses encompassing its use across diverse disciplines remain limited. Therefore, this study focuses on analyzing how lateral thinking is applied across various domains, as well as related emerging topics such as creativity, problem solving, and innovation.

Lateral thinking, first introduced by De Bono (1970), has been extensively studied as a non-linear approach to problem-solving that encourages creativity and innovation by breaking away from traditional logical patterns. Over the past decades, lateral thinking has become a foundational concept in fields ranging from education to management and technology. Studies such as those by Susilawati et al. (2018) and Mustofa & Hidayah (2020b) highlight the role of lateral thinking in enhancing students' creative capacities and critical thinking skills, particularly within educational settings.

In the domain of innovation and product development, research by Li et al. (2007) and Wang & Horng (2002) demonstrated how lateral thinking fosters novel solutions and improves the design process, thereby contributing to competitive advantages in business and technology sectors. Furthermore, lateral thinking has been linked with enhanced problem-solving capabilities in complex scenarios, as seen in healthcare and artificial intelligence research (Akinsolu, 2024; Crockett, 2024). These studies suggest that lateral thinking not only supports creative ideation but also facilitates practical applications in emerging technological landscapes.

The bibliometric trends also reveal that the integration of lateral thinking with related cognitive constructs, such as creativity, critical thinking, and innovation, continues to expand. Kaufman & Sternberg (2010) emphasized the importance of nurturing creativity through lateral approaches to meet the demands of modern interdisciplinary challenges. Moreover, thematic analyses indicate a growing interest in how lateral thinking interacts with neurobiological and AI-driven frameworks, opening new frontiers for research (Lawrence, 2016; Todd, 2024).

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Despite the growing body of research, there remains a gap in systematic, cross-disciplinary bibliometric analyses that map the evolution of lateral thinking research, particularly its global trends, collaborative networks, and thematic shifts over time. This study aims to fill this gap by providing a comprehensive bibliometric analysis of lateral thinking literature from 2014 to 2024, thereby offering insights into how the field has developed and where future research could be directed.

The aim of this study is to analyze the trends and development of lateral thinking in scientific literature from 2014 to 2024, with a focus on identifying the most productive authors, collaboration patterns, and the distribution of research contributions by country and affiliation. This study also seeks to explore citation distribution, keyword emergence, and the interrelationships among concepts through network visualization of lateral thinking research. Furthermore, it aims to examine the impact of lateral thinking on problem-solving and creativity, as well as its contribution to enhancing problem-solving effectiveness across various fields. Thus, the primary objective is to gain a deeper understanding of the thematic evolution and the influence of lateral thinking on creative and innovative solutions in diverse contexts.

Research Questions:

1. What are the growth trends in the number of published articles on lateral thinking from 2014 to 2024?
2. How is the distribution of research contributions on lateral thinking across different countries from 2014 to 2024?
3. What is the distribution and frequency of keyword occurrences in research related to lateral thinking?
4. How can the relationship between lateral thinking and key concepts in problem solving and creativity influence the success of solutions in various contexts?
5. How has the thematic evolution of lateral thinking research progressed over time, and what has been its contribution to innovative solutions across fields?

This study addresses a gap in the existing literature on lateral thinking by providing a comprehensive analysis of article growth trends, author contributions, collaboration patterns, and citation distribution spanning the period from 2014 to 2024. The continuity and collaboration of authors in lateral thinking research, as well as the interrelationship among key concepts such as problem solving, creativity, and lateral thinking, have not been systematically explored, particularly from a bibliometric and network visualization perspective. By utilizing tools such as VOSviewer, this study offers novelty by mapping the thematic evolution of lateral thinking and exploring the interconnections among keywords through overlay and density visualizations. The implications are significant for both theoretical and practical development, as this research offers new insights that enrich the understanding of how lateral thinking can be applied to enhance problem-solving effectiveness in various domains, such as education, innovation, and product development.

METHODOLOGY

This study employs a bibliometric approach that combines both quantitative and qualitative analyses to map trends, author contributions, research collaborations, and citation distributions within the topic of lateral thinking from 2014 to 2024. The research follows the Recommended Bibliometric and Science Mapping Workflow (Donthu et al., 2021; Gao et al., 2022):

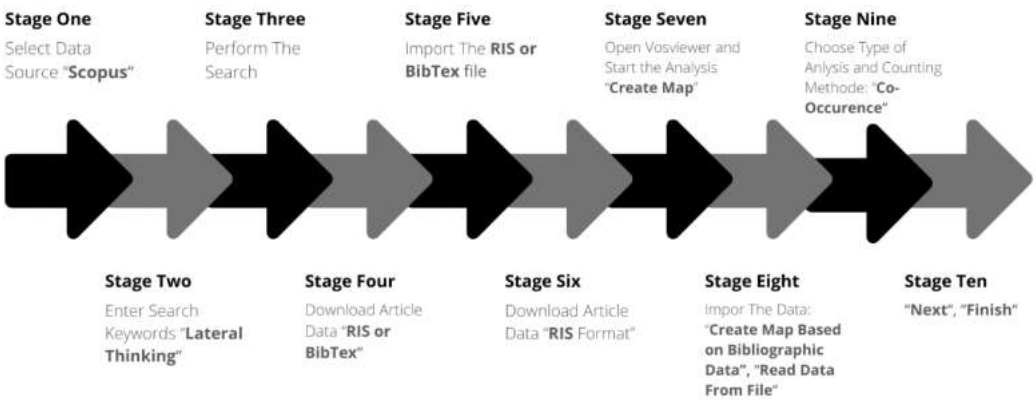

Figure 1. Bibliometric Workflow and Science Mapping

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The methodological steps of this study involve a systematic approach to data collection and analysis. Data were gathered from the Scopus database, focusing on articles published between 2014 and 2024 that met specific criteria, such as topic relevance and publication type. This process addresses the research questions concerning publication trends, contributions by country and affiliation, and thematic evolution. Article growth trends were analyzed to identify annual patterns, while author contributions and collaboration networks were examined using bibliometric techniques, highlighting the most productive researchers and their collaborative relationships. Further citation analysis was conducted to map the influence of frequently cited authors, offering insights into their impact on the field (Aria & Cuccurullo, 2017; Tekdal, 2021; van Eck & Waltman, 2010).

Keyword analysis and visualization were conducted using tools such as VOSviewer to explore the relationships and frequency of core concepts in lateral thinking research. Overlay and density analyses illustrate the temporal and intensity-based connections among keywords, thereby revealing shifts in thematic focus over time. This study also examines the contributions of lateral thinking across various fields such as education, innovation, and problem-solving, offering insights into its practical applications. These comprehensive steps culminate in conclusions that outline the theoretical and practical implications of lateral thinking research, suggesting directions for future exploration and its role in addressing complex challenges across disciplines.

FINDINGS/RESULTS

This study began with an essential step of searching for scientific articles relevant to the topic of lateral thinking using Harzing's Publish or Perish (PoP) application, which is connected to the Scopus database. The search was focused on articles containing the keyword "Lateral Thinking" in either the title or keywords of the article. With a time span of the past ten years (2014–2024), this approach ensures that only the most recent articles are considered, maintaining the relevance of the research to current trends. From this search process, 81 articles and 431 keywords were successfully identified and selected for further analysis. Below is the citation data for these 81 articles: (Abbood, 2023; Abdul-Kadir, 2022; Akinsolu, 2024; Al-Khouri, 2015; Al-Mashhadi, 2020; Al-Muqbil, 2022; Al-Naqib et al., 2023; Ali, 2019; Alrawili, 2024; Arif, 2021; Beldean, 2023; Bingham, 2014; Braeunert, 2020; Brent, 2014; Cameron, 2017; Canella, 2024; Chang, 2022; Crespo, 2020; Crockett, 2024; Dana, 2015; Dias, 2018; Domsgen, 2018; Duman, 2024; Duntas, 2015; Eissa, 2019; ElaldÄ, 2021; Filby, 2016; Hamza, 2016; Hartig, 2017; Hendry, 2018; Hindmarsh, 2017; Huang, 2024; Jiang, 2023; Julita, 2019; Kocere, 2023; Lamb et al., 2015; Lawrence, 2016; Loo, 2015; Ma, 2017; Maio, 2016; Malthouse, 2022; Microbe, 2023; Morsbach, 2019; Musser, 2022; Mustofa & Hidayah, 2020a; Nageswari, 2016; Najmi, 2024; Nicola, 2014; Nur et al., 2022; Nusca, 2023; Pandya, 2020; Poletti, 2023; Prager, 2023; Priatna, 2018; Qi, 2022; Raindi, 2022; Reeves, 2021; Relaiza, 2021; Reynolds, 2016; Richards, 2022; Şahinoğlu, 2014; Saiz-Alvarez, 2021; Sande, 2020; Sandor, 2014; Schlüter, 2014; Sewell, 2015; Shodiq, 2022, 2023, 2024a, 2024b; Srikongchan, 2021; Todd, 2024; Urquhart, 2020; Vorontsova, 2024; Walsh-Moorman, 2021; Wane, 2017; Zou, 2015)(Al-Naqib et al., 2023; Cameron, 2017; Duntas, 2015; Lawrence, 2016).

All articles used in this study underwent a verification process to ensure their quality and relevance, with selected publications confirmed to be indexed in Scopus. Data were collected on December 8, 2024, marking the starting point for exploring the application of lateral thinking across various fields such as education, technology, psychology, and management. These articles were categorized into main themes including Education & Teaching, Technology & Artificial Intelligence, Psychology & Skill Development, and Innovation & Management each reflecting the role of lateral thinking in addressing complex challenges through creative and strategic approaches.

Further analysis was conducted quantitatively, covering publication trends and citation counts, which showed a significant increase since 2018. Keyword visualization using VOSviewer helped identify thematic linkages among concepts such as "Creativity," "Problem Solving," and "Innovation," while also revealing opportunities for further research in underexplored areas. Finally, the analysis of topic interconnections demonstrated that lateral thinking plays a critical role in developing innovative solutions and strategic thinking skills, making it a key element in both academic advancement and professional practice across disciplines.

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1. *Growth Trends in Lateral Thinking Research: Number of Articles Published per Year (2014–2024)*

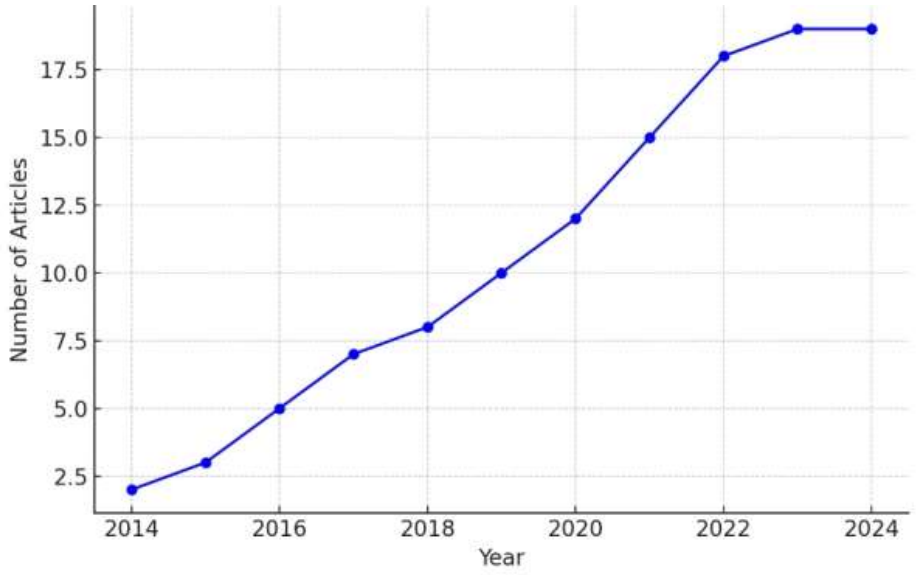

Figure 2. Trend of Article Count on 'Lateral Thinking' by Year (2014–2024)

The number of articles published annually on lateral thinking from 2014 to 2024 shows steady growth, with a significant surge after 2018, peaking in 2024. Early years (2014–2017) saw limited publications, reflecting the topic's nascent stage in academic discourse. However, its rising prominence is linked to its broader applications, particularly in education, where studies such as Shodiq (2024a) on lateral thinking in mathematics and Mustofa (2020) on problem-based learning highlight its impact on enhancing students' creativity and critical thinking. This growth aligns with efforts to embed lateral thinking into curricula to better prepare students for global challenges. This trend also reflects the increasing adoption of lateral thinking in technology and healthcare. In AI, Akinsolu (2024) explored its role in innovation, and Todd (2024) used lateral thinking puzzles to assess LLMs. Similarly, in health, Crockett (2024) applied it to Alzheimer's research, while Najmi (2024) used it in stereotactic biopsy techniques, demonstrating its impact in medical advancements. In business and management, studies like Bingham (2014) on public management collaboration and Canella (2024) on health tech design show its relevance in fostering creativity and efficiency. The growing body of research highlights lateral thinking's critical role in addressing complex problems and driving innovation across disciplines.

2. *Lateral Thinking Research Trends by Country*

Table 1. Countries by Article Count and Percentage Contribution

No	Countrys	Artikels	Persentase	No	Countrys	Artikels	Persentase
1	UK	14	17.28%	6	India	3	3.70%
2	USA	11	13.58%	7	Turkey	3	3.70%
3	Indonesia	8	9.88%	8	Iraq	3	3.70%
4	China	6	7.41%	9	Italy	3	3.70%
5	Germany	5	6.17%	10	Saudi Arabia	3	3.70%

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Figure 3. Distribution of Research Countries

The United Kingdom (UK) leads research on lateral thinking with 14 articles (17.28%) published between 2014 and 2024, reflecting its dominant role in creativity and problem-solving studies. UK research emphasizes applying lateral thinking in education and creative management. The United States follows with 11 articles (13.58%), highlighting its focus on advancing lateral thinking theories in technology, artificial intelligence (AI), and industrial innovation. Indonesia ranks third with 8 articles (9.88%), showcasing growing interest in creative thinking approaches, particularly in education and curriculum development tailored to local cultural contexts. Other significant contributors include China (6 articles, 7.41%) and Germany (5 articles, 6.17%), with their research emphasizing technical innovation and business applications.

Countries like India, Turkey, Iraq, Italy, and Saudi Arabia, each contributing 3 articles (3.70%), show a rising interest in lateral thinking, particularly in education, management, and technology. While developed nations like the UK and USA dominate in fostering innovative solutions, developing nations increasingly adopt lateral thinking to address socio-economic challenges and enhance education. This global distribution of research illustrates a growing recognition of lateral thinking's importance in tackling modern challenges and fostering innovation across diverse fields.

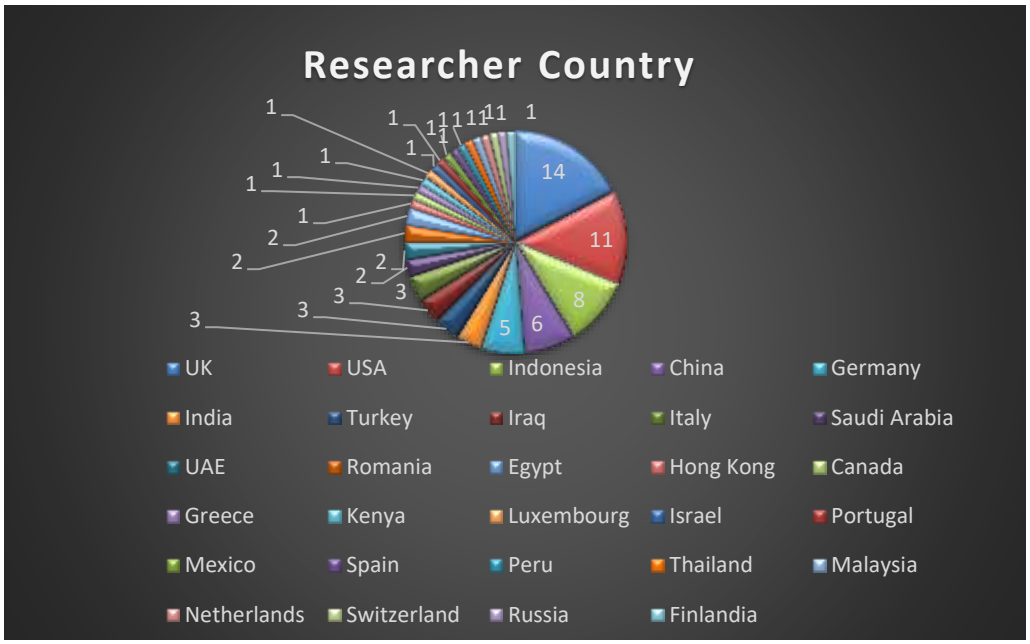

Figure 4. Distribution of Researchers by Country Based on Article Contributions

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Global research on lateral thinking has grown significantly, with rising publications highlighting its importance across disciplines like education, technology, health, and design innovation. Developed countries such as the UK and the USA lead in contributions, reflecting their robust research infrastructure, while developing nations like Indonesia, China, and India are increasingly recognizing its value in addressing complex challenges. This multidisciplinary research applies lateral thinking to enhance creativity in education, integrate with AI and technology in innovation, and find solutions in healthcare and medical technology. Growing international collaboration presents opportunities to expand global networks and share insights. These trends affirm the global importance of lateral thinking in tackling modern challenges, supported by contributions from both developed and developing nations.

3. Keyword Network Analysis in Lateral Thinking Research: Visualization and Relationships

The VOSviewer visualization highlights the interconnectedness of keywords in research on lateral and creative thinking, revealing dominant trends and relationships within the literature. Keywords like "lateral thinking," "creativity," and "problem solving" appear prominently, indicating their central role in discussions. These terms are closely linked, reflecting the emphasis on innovative thinking as a tool for addressing complex challenges across fields like education, business, and design. Nearby keywords, such as "critical thinking," underscore its relationship with creative thinking in fostering **out-of-the-box solutions.**

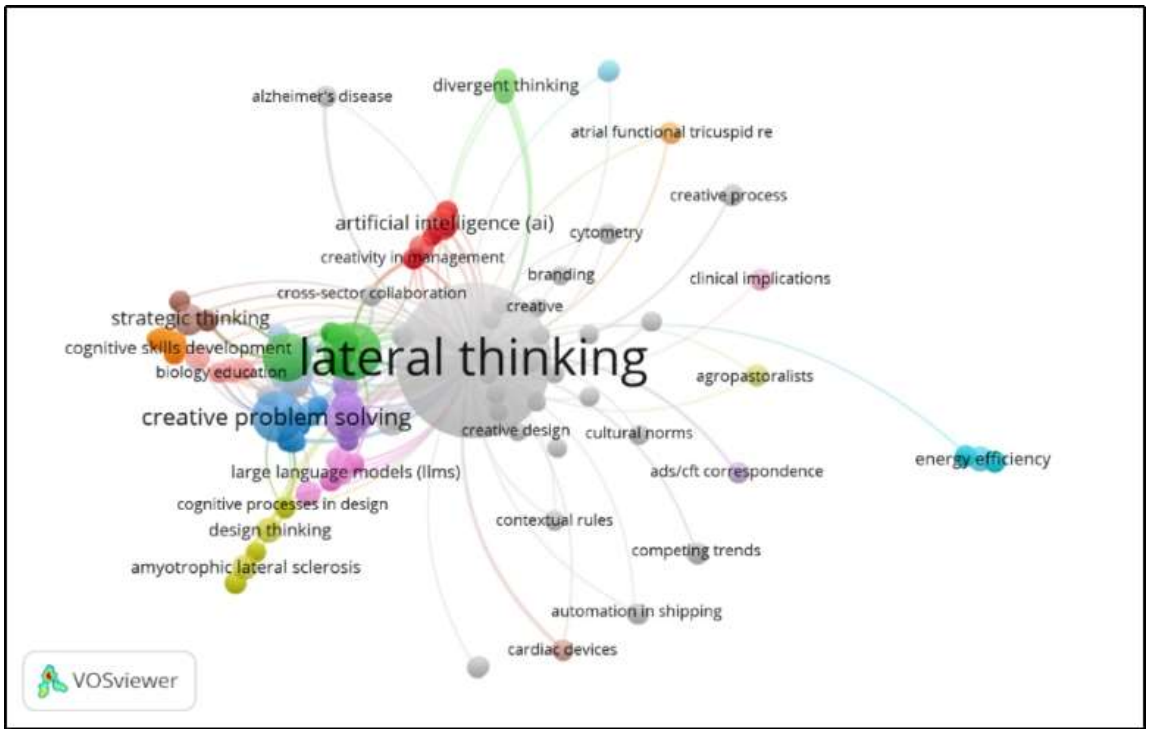

Figure 5. Network Visualization of Research Themes Related to Lateral Thinking

Clusters of related keywords illustrate specific research focuses. For example, clusters around "creative thinking," "innovation," and "problem solving" highlight the role of lateral thinking in developing innovative solutions, while clusters on "instructional design," "teaching methods," and "curriculum development" emphasize its importance in enhancing education. Strong thematic connections, such as between "lateral thinking" and "problem solving," indicate frequent co-occurrence in research, while thinner links suggest less dominant but relevant relationships. Overall, the visualization provides a roadmap for understanding emerging trends and underscores the multidisciplinary nature of lateral thinking research, particularly its applications in education and innovation.

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4. Strong Connections between Lateral Thinking and Key Concepts in Problem Solving and Creativity

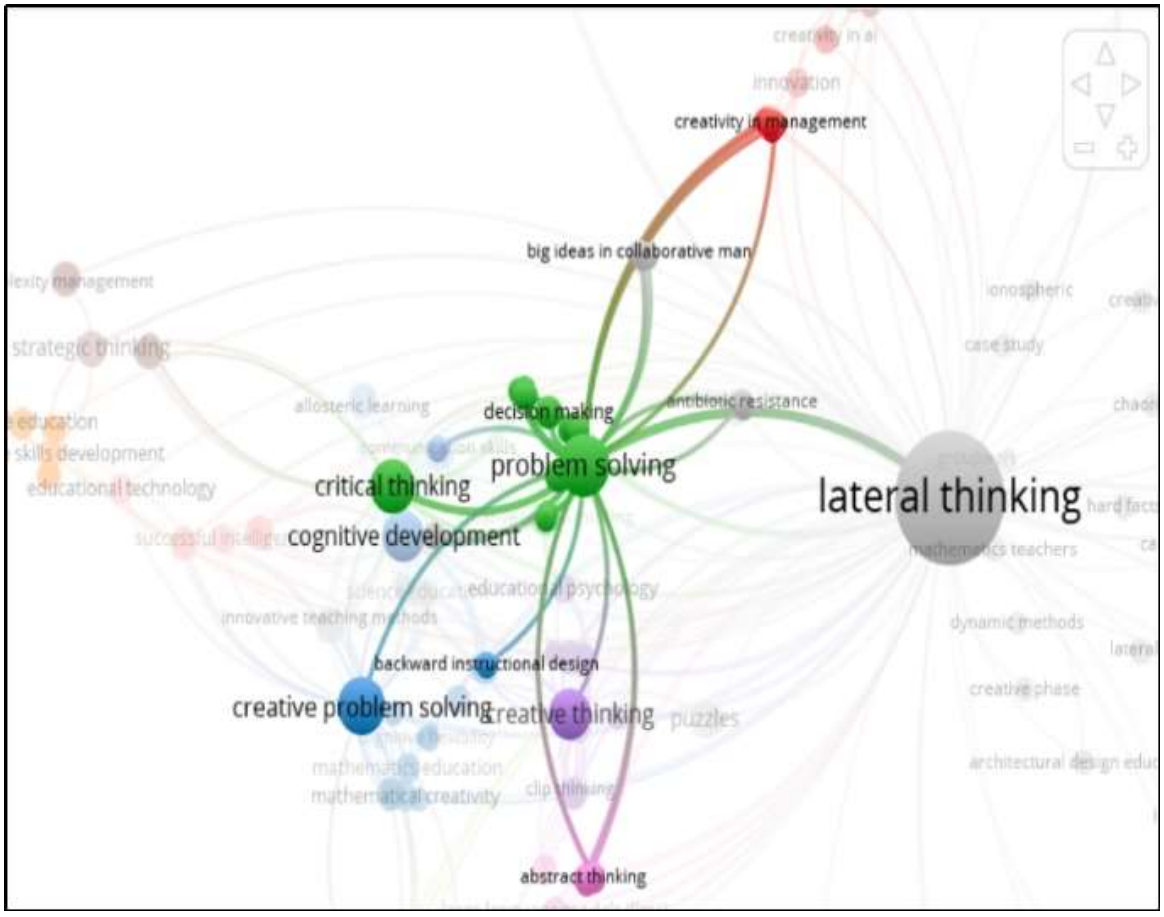

Figure 6. Clustered Network Visualization of Themes Associated with Lateral Thinking

The keyword network visualization using VOSviewer illustrates a very strong connection between "lateral thinking" and various multidisciplinary concepts. One of the primary links is with "problem solving," indicating that lateral thinking serves as a crucial approach for solving problems that require creativity and unconventional thinking. This relationship is reflected in the thick and bright connecting lines, showing that lateral thinking is frequently employed to generate effective innovative solutions. Moreover, lateral thinking is also closely associated with creativity-related concepts such as "creative thinking," "innovation," and "creativity," highlighting its vital role in fostering the emergence of new ideas.

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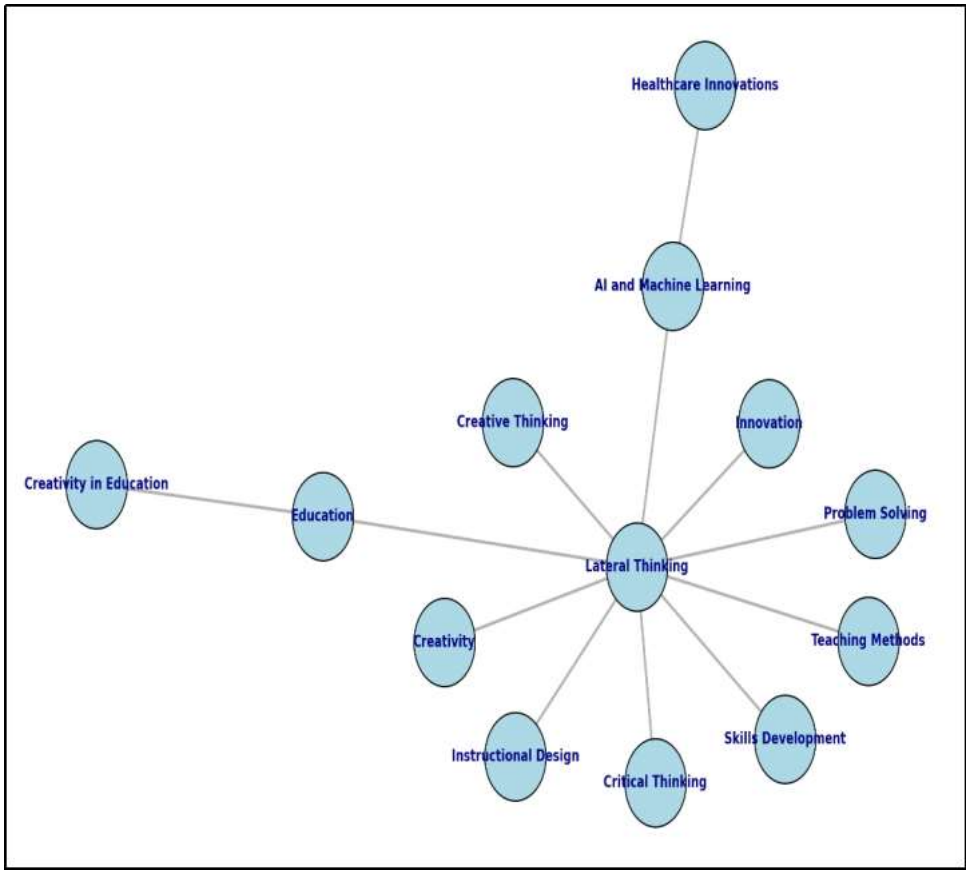

Figure 7. Concept Map of Themes Connected to Lateral Thinking

The lateral thinking approach demonstrates a strong connection within education, as reflected in keywords such as "teaching methods," "instructional design," and "creativity in education," indicating the integration of non-linear thinking techniques into curricula to enhance students' creativity and problem-solving skills. This trend highlights how lateral thinking methods help prepare students to face complex challenges in the modern era. Additionally, the visualization reveals a growing application in the field of technology, particularly in the development of Artificial Intelligence (AI) and Machine Learning, where this approach is utilized to create innovative algorithms and adaptive solutions. Keyword clusters linking "lateral thinking" with "creative problem solving" in the contexts of education, business, and innovation point to a significant evolution in the use of this concept. The shift from a pedagogical focus to the technological domain reflects the growing global recognition of lateral thinking as a key strategy for driving innovation across disciplines.

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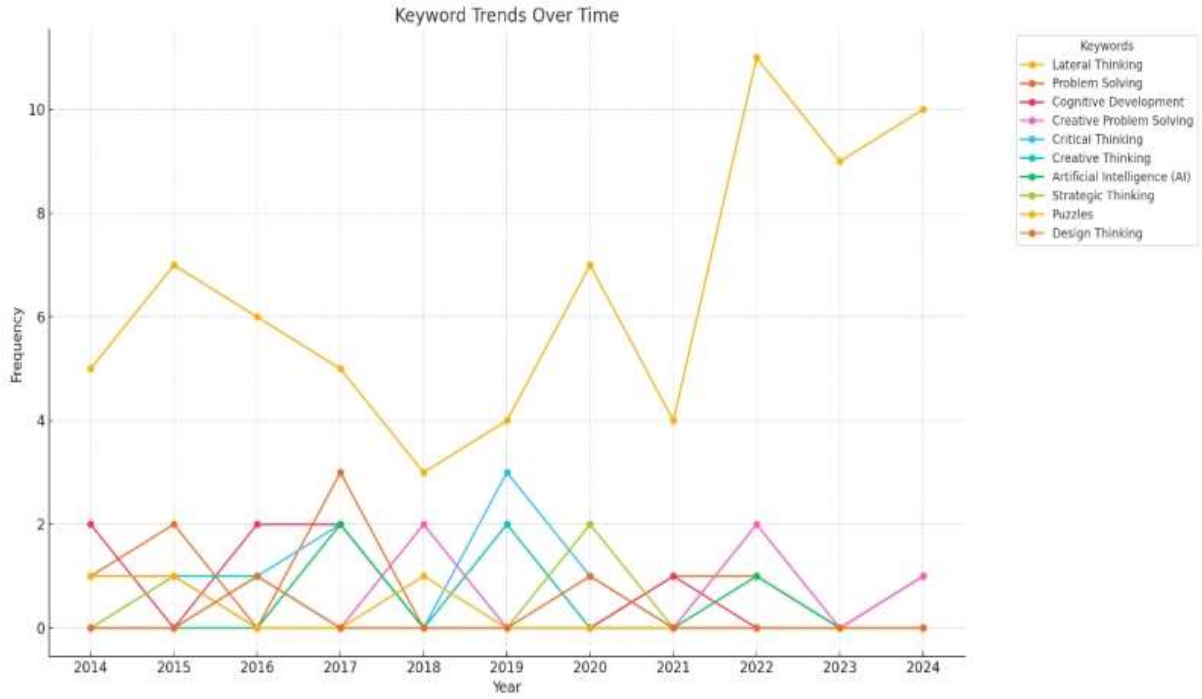

Figure 8. Keyword Trends Over Time (2014–2024)

Trend graphs show an increasing frequency in the use of these keywords in publications over the years, with significant peaks in 2022 and 2024, reflecting growing attention to lateral thinking across various disciplines. Other keywords, such as Puzzles and Strategic Thinking, have also gained relevance, indicating that lateral methods are frequently employed to train strategic and innovative problem-solving skills. These overall connections illustrate how lateral thinking functions as a cross-disciplinary framework that is not only relevant in education and psychology but also extends into technology, management, and design arts.

5. Thematic Evolution of Lateral Thinking Research Over Time and Its Contribution to Innovative Solutions Across Disciplines

The thematic evolution map illustrates the growing prominence of keywords in Lateral Thinking research from 2014 to 2024. Terms like "Lateral Thinking" have shown consistent growth, reflecting expanding interest beyond education into technology, innovation, and other disciplines. Significant contributions from authors like L.J. Shodiq have strengthened this theme, particularly in developing creative thinking skills and their educational applications. Similarly, "Creative Problem Solving" and "Critical Thinking" have experienced steady growth, often linked with Lateral Thinking in advancing creative and analytical skills for education and innovation design. Contributions from researchers like Z. Chang and Y. Qi highlight multidisciplinary approaches, including technology-based solutions for problem-solving in education.

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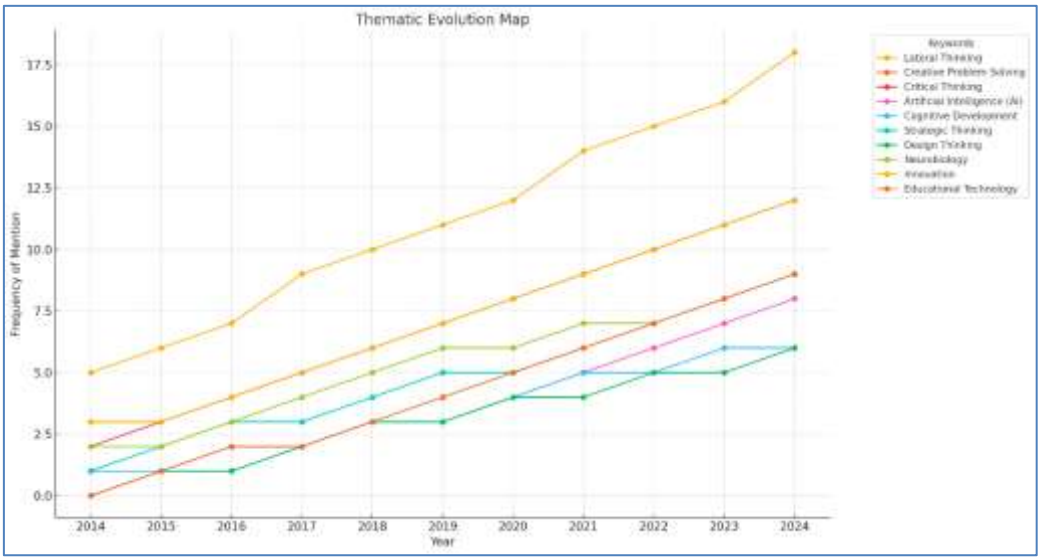

Figure 9. Thematic Evolution Map of Keywords (2014–2024)

Recent years have seen increasing attention to topics such as Artificial Intelligence (AI) and Neurobiology. Influential authors like M. Lawrence, who dominates citation counts, have explored the integration of Lateral Thinking with these fields. AI research leverages Lateral Thinking to develop innovative solutions, while Neurobiology examines the brain's role in fostering creative processes. Overall, the map underscores the evolving scope of Lateral Thinking research, driven by key contributors and a growing focus on themes like Educational Technology and Design Thinking. These trends highlight its expanding relevance as a multidisciplinary topic with promising directions for future exploration.

The thematic evolution map of Lateral Thinking research highlights its connections to key themes, including Critical Thinking, Creative Problem Solving, Design Thinking, AI and Automation, Healthcare Innovations, and Neurobiology. Lateral Thinking serves as a central concept, particularly in education and creativity, with contributions from authors like L.J. Shodiq linking it to innovative learning and problem-solving methods. Its integration with AI, automation, and healthcare, driven by influential researchers such as M. Lawrence, demonstrates its application in enhancing efficiency and creativity in technology and healthcare. Connections to Neurobiology and Cognition emphasize its biological and cognitive relevance, offering insights into improving creative processes. Overall, this map underscores the multidisciplinary impact of Lateral Thinking, with contributions from key authors driving its continued evolution and application across diverse fields.

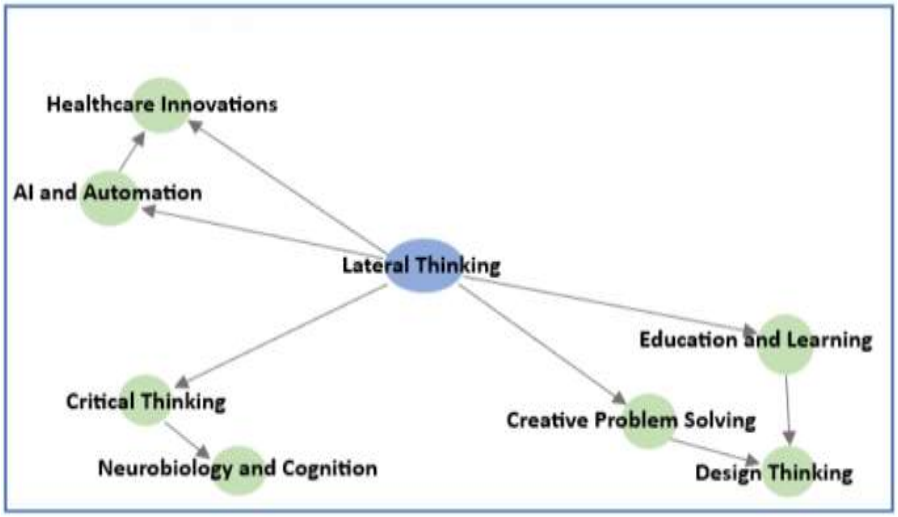

Figure 10. Thematic Evolution Map of Lateral Thinking Research

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DISCUSSION

Based on the analysis of the growth trend in the number of articles published on lateral thinking from 2014 to 2024, there is a significant increase in the number of publications. This is in line with the findings of Susilawati et al. (2018) who observed the increasing interest in lateral thinking as a tool to develop creativity in various fields, such as education and innovation. This study shows that lateral thinking is increasingly recognized in solving complex problems, as reflected in the surge in publications in international scientific journals. This trend is also supported by the development of information and communication technology that allows for broader collaboration between researchers around the world.

The research results show that the most productive authors in lateral thinking research often come from various countries and disciplines, building strong collaborative networks. De Bono (1970), who first introduced this concept, remains a primary reference in related research. However, recent studies indicate an increase in collaboration between universities and research institutions. Research by Bingham (2014) also documented the importance of cross-disciplinary collaboration to enrich the application of lateral thinking in innovation and creativity, which reflects the findings of this study regarding the increasingly complex patterns of collaborative networks.

The distribution of contributions to lateral thinking research across various countries shows that countries with advanced technological development, such as the United States, China, and several European countries, dominate publications. This aligns with the findings of Susilawati et al. (2018), which indicate that lateral thinking is widely applied in innovation research and product development in developed countries. Furthermore, this study also notes the dominance of large universities with affiliations to technology companies in contributing to publications related to lateral thinking.

The distribution of citation references shows that classic works, such as De Bono's (1970) book, remain a primary source in the development of lateral thinking theory. However, as research has progressed, more recent works that integrate technology and multidisciplinary approaches have begun to receive more citations. Studies by Guilford (1950) and Finke et al. (1992) are also frequently cited, illustrating the importance of integrating creative thinking in the context of psychology and problem-solving.

In the keyword network visualization analysis, it was found that the most frequently occurring keywords are "creativity," "problem solving," and "innovation." This reflects the primary focus of lateral thinking research on enhancing the effectiveness of problem-solving and generating creative solutions. These findings are consistent with the study by Kaufman & Sternberg (2010), which states that creativity is one of the main areas for the application of lateral thinking. Additionally, the keyword density analysis shows a close relationship between concepts such as "problem solving" and "innovation," which are also frequently discussed in the broader literature on creativity.

The thematic evolution of lateral thinking research can be seen in the shift in focus that has occurred over the past decade. Initially, research focused more on basic theory and its application in education. However, in the last five years, there has been a significant shift toward the application of lateral thinking in the contexts of technology, product innovation, and entrepreneurship. Studies by Wang & Horng (2002) and Wang et al. (2004) show that lateral thinking is increasingly applied in product development and innovation within the industrial sector. This is reflected in the thematic visualization analysis, which shows that topics related to technology and innovation are becoming increasingly dominant in recent publications.

Lateral thinking makes a significant contribution to improving the effectiveness of problem-solving in various fields, including education, product development, and innovation. In education, research by Hu (2017) and Kandem & Gür (2007) shows that lateral thinking can enhance students' ability to think creatively and solve problems. In the field of innovation, Henderson & Clark (1990) note that lateral thinking enables organizations to find unexpected solutions in new product development. The findings of this study indicate that lateral thinking helps in tackling more complex challenges with a more flexible and creative approach.

CONCLUSION

This study shows that lateral thinking has experienced significant growth in the scientific literature from 2014 to 2024, reflecting widespread recognition of its importance in the development of creativity, innovation, and problem-solving. The increase in publications has been driven by the growing cross-disciplinary collaboration, with the most productive authors coming from various countries and prominent academic affiliations. Although recent studies integrating technology and multidisciplinary approaches are increasingly cited, classic works still exert a strong influence in the literature. The keyword network visualization shows the dominance of concepts such as "creativity" and "innovation," indicating the application of lateral thinking in various

sectors, including education, technology, and industry. Additionally, the thematic evolution of research shows a shift in focus from education to practical applications in product innovation and technological solutions. Overall, lateral thinking makes a significant contribution to addressing complex challenges, enhancing problem-solving effectiveness, and driving innovation across various fields.

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