International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

INTERNATIONAL JOURNAL OF MODERN EDUCATION (IJMOE)
www.ijmoe.com

MAPPING THE FUTURE OF EDUCATION: A BIBLIOMETRIC ANALYSIS OF DESIGN THINKING, CREATIVE METACOGNITION AND NEUROSCIENCE APPROACHES

Noranyza Zainol[1], Hariyaty Ab Wahid[2*]

[1] Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia
Email: umminurra2020@gmail.com.my
[2] Faculty of Management and Economics, Universiti Pendidikan Sultan Idris, Tanjong Malim, Perak, Malaysia
Email: hariyaty@fpe.upsi.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 22.10.2025
Revised date: 11.11.2025
Accepted date: 01.12.2025
Published date: 16.12.2025

To cite this document:

Zainol, N., & Ab Wahid, H. (2025). Mapping The Future of Education: A Bibliometric Analysis of Design Thinking, Creative Metacognition and Neuroscience Approaches. *International Journal of Modern Education, 7* (28), 736-751.

DOI: 10.35631/IJMOE.728051

Abstract:

The rapid transformation of global education in the era of the Fifth Industrial Revolution (5IR) highlights the need for innovative and human-centered learning paradigms that integrate design thinking, creative metacognition, and neuroscience. While each of these domains has gained scholarly attention, there remains a gap in understanding how they collectively shape the evolution of future education. This study aims to map the intellectual landscape, research trends, and thematic connections among these three key areas. Using a bibliometric approach, data were retrieved from the Scopus database through advanced searching with the keywords "Design Thinking," "Creative Metacognition," and "Neuroscience," resulting in a total of 1,492 documents. The dataset was refined and standardized using Open Refine to ensure data consistency and accuracy. Statistical and graphical analyses were conducted using the Scopus Analyzer to examine publication growth, prolific authors, leading countries, and source distribution, while VOS viewer software was used to visualize co-authorship networks, keyword co-occurrence, and citation relationships. The results show a significant increase in publication output over the past decade, with the United States, the United Kingdom, and China emerging as leading contributors. Four major thematic clusters were identified the design-driven learning innovation, neuro-cognitive approaches to creativity, interdisciplinary education, and technology-enhanced pedagogy and indicating strong research convergence across these domains. These findings reveal that future educational development is shifting toward a 5IR framework that emphasizes the synergy between human intelligence and advanced technology. In conclusion, this study contributes to the growing body of knowledge by illustrating how the integration of design thinking, creative metacognition, and neuroscience can support adaptive, empathetic, and

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

innovation-driven education systems aligned with the transformative goals of the Fifth Industrial Revolution.

Keywords:

Design Thinking, Creative Metacognition, Neuroscience, Future Education

Introduction

The integration of neuroscience, creative metacognition, and design thinking into educational practices represents a transformative approach to future education. This interdisciplinary convergence aims to enhance learning outcomes by leveraging insights from brain science, cognitive psychology, and innovative problem-solving methodologies. Neuroscience provides a deeper understanding of how the brain learns, adapts, and processes information, which is crucial for developing effective educational strategies (Amran et al., 2019; Arias Salegio & Batista Mainegra, 2021). Creative metacognition, the awareness and regulation of one's own creative processes, plays a pivotal role in fostering innovation and critical thinking skills among students (Pastén, 2021; von Thienen et al., 2023). Design thinking, a human-centered approach to problem-solving, encourages empathy, creativity, and iterative learning, making it a valuable tool in educational settings (Brady & Katre, 2021; Latorre-Cosculluela et al., 2020; Yusuf et al., 2026). This paper explores the synergies between these fields and their potential to revolutionize education.

The field of educational neuroscience, also known as Mind, Brain, and Education (MBE), seeks to bridge the gap between neuroscience and educational practice. This interdisciplinary effort aims to apply neuroscientific research to classroom settings to promote better learning outcomes (Amran et al., 2019; Christodoulou et al., 2013). Educational neuroscience emphasizes the complex, bidirectional relationship between brain development and learning, highlighting the importance of understanding neurodevelopmental processes to design effective educational strategies (Maldonado-Arbogast, 2024; Massonnié & Thomas, 2022). Research in this field has shown that factors such as brain health, socio-emotional learning, and executive functions significantly influence educational outcomes (Kelleher & Whitman, 2018; Massonnié & Thomas, 2022).

Creative metacognition, which involves the awareness and regulation of one's creative processes, is essential for fostering innovation and critical thinking in education. Design thinking, a well-established approach to creativity and innovation, emphasizes empathy, iterative learning, and problem-solving (Brady & Katre, 2021; Latorre-Cosculluela et al., 2020; von Thienen et al., 2023). Studies have shown that design thinking can enhance students' creative capacities and metacognitive skills, leading to improved academic performance and innovative problem-solving abilities (Pastén, 2021)(Yusuf et al., 2026)(Bourgeois-Bougrine et al., 2018). The integration of design thinking into educational curricula has been shown to boost students' confidence in their creative abilities and develop their empathic skills, which are crucial for addressing real-world problems (Latorre-Cosculluela et al., 2020)(Brady & Katre, 2021).

The convergence of neuroscience, creative metacognition, and design thinking in education offers a holistic approach to learning. Neuroscience provides insights into the brain's mechanisms that impact learning, such as neuroplasticity, memory, and the effects of stress

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

(Arias Salegio & Batista Mainegra, 2021) (Maldonado-Arbogast, 2024). Creative metacognition enables students to regulate their creative processes, enhancing their ability to generate innovative solutions (von Thienen et al., 2023) (Pastén, 2021). Design thinking fosters a human-centered approach to problem-solving, encouraging students to empathize with users, iterate on solutions, and develop practical, innovative outcomes (Latorre-Cosculluela et al., 2020) (Brady & Katre, 2021) (Yusuf et al., 2026). This interdisciplinary approach can create a more engaging and effective learning environment, preparing students for the challenges of the 21st century.

Despite the potential benefits, the integration of neuroscience, creative metacognition, and design thinking into education faces several challenges. One major challenge is the need for collaboration between neuroscientists, educators, and policymakers to translate research findings into practical educational strategies (Amran et al., 2019; Kelleher & Whitman, 2018). Additionally, there is a need to address the differences in how neuroscience and education conceptualize knowledge and goals, which can hinder effective collaboration (Maldonado-Arbogast, 2024; Samuels, 2009). To overcome these challenges, it is essential to foster a transdisciplinary research environment that encourages collaboration and the integration of diverse perspectives (Samuels, 2009; Stringer & Tommerdahl, 2015). By addressing these challenges, the field of educational neuroscience can continue to evolve and contribute to the development of innovative educational practices.

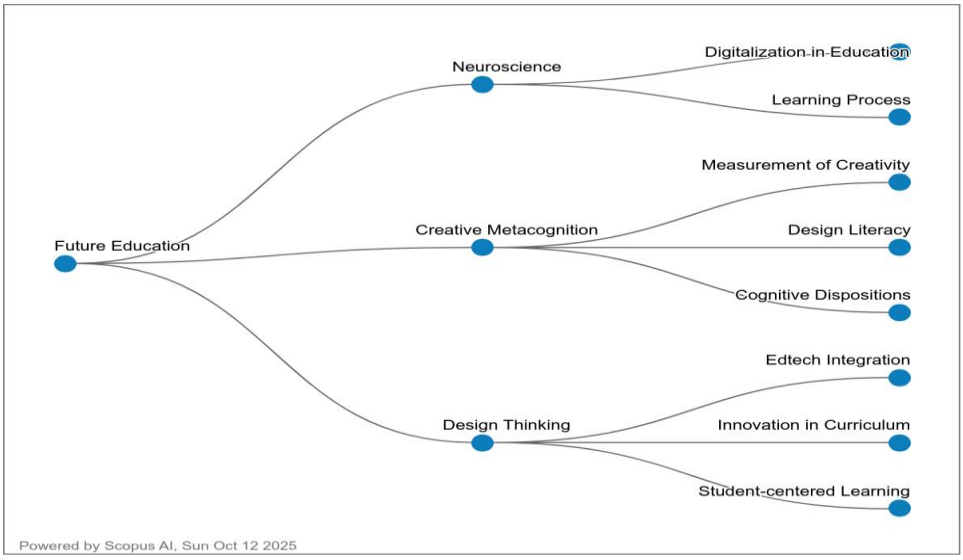

Figure 1: The Concept Map for integration of Neuroscience, creative metacognition, and design thinking in Future Education

Figure 1 illustrates the interconnection between design thinking, creative metacognition, and neuroscience as foundational pillars shaping the future of education. The concept map highlights how neuroscience informs the learning process and supports digitalization in education, while creative metacognition contributes to understanding cognitive dispositions, measuring creativity, and enhancing design literacy among learners. Meanwhile, design thinking emerges as a key driver for innovation in curriculum development, EdTech integration, and student-centered learning approaches. Together, these three domains form a synergistic framework that aligns with the principles of adaptive and innovation-driven education envisioned in the era of the Fifth Industrial Revolution. This integration signifies a

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

shift from traditional, content-based learning to a holistic model that values creativity, cognitive awareness, and human-centered design. Overall, the conceptual relationship depicted in the map underscores how blending brain-based learning, metacognitive strategies, and design-driven methodologies can cultivate more empathetic, technologically fluent, and future-ready learners capable of navigating complex global challenges.

In conclusion, the alignment of neuroscience, creative metacognition, and design thinking into education holds significant promise for enhancing learning outcomes and fostering innovation. By leveraging insights from brain science, cognitive psychology, and design thinking methodologies, educators can create more effective and engaging learning environments. However, successful integration requires collaboration between researchers, educators, and policymakers, as well as a commitment to addressing the challenges and differences between these fields. As the field of educational neuroscience continues to grow, it has the potential to revolutionize education and prepare students for the complexities of the modern world.

The findings highlight that the integration of design thinking, creative metacognition, and neuroscience provides a comprehensive framework for advancing 21st-century education. By harnessing the strengths of these approaches, educators can cultivate learning environments that nurture creativity, critical thinking, and self-regulation. This integrative paradigm not only equips students to navigate the complexities of the modern world but also empowers them to become autonomous, reflective learners capable of leading innovation and meaningful change.

Research Question

RQ1: What are the global publication trends of design thinking, creative metacognitive and neuroscience in education?
RQ2: What are the most cited authors and articles?
RQ3: Where are the top ten countries based on the number of publications?
RQ4: What are the popular keywords and themes related to the study?
RQ5: What is co-authorship by countries' collaboration?

Methodology

Bibliometrics involves gathering, organizing, and analyzing bibliographic data from scientific publications (Alves et al., 2021; Assyakur & Rosa, 2022; Verbeek et al., 2002). Beyond basic statistics, such as identifying publishing journals, publication years, and leading authors (Wu & Wu, 2017), bibliometrics includes more sophisticated techniques like document co-citation analysis. Conducting a successful literature review requires a careful, iterative process to select suitable keywords, search the literature, and perform an in-depth analysis. This approach helps to compile a comprehensive bibliography and achieve reliable results (Fahimnia et al., 2015). With this in mind, the study focused on high-impact publications, as they provide meaningful insights into the theoretical frameworks that shape the research field. To ensure data accuracy, SCOPUS served as the primary source for data collection (Al-Khoury et al., 2022; di Stefano et al., 2010; Khiste & Paithankar, 2017). Additionally, to maintain quality, the study only considered articles published in peer-reviewed academic journals, deliberately excluding books and lecture notes (Gu et al., 2019). Using Elsevier's Scopus, known for its broad coverage, publications were collected from 2015 through October 2025 for further analysis.

Data Search Strategy

The search strategy for this study was systematically conducted using the Scopus database, chosen for its extensive coverage of peer-reviewed publications and strong indexing standards.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

To ensure precision, the Scopus advanced search function was applied with the following string: TITLE (("Design Thinking" OR "Creative Metacognition" OR "Neuroscience") AND Education) AND PUBYEAR > 2014 AND PUBYEAR < 2026. This search string was executed in October 2025 to capture the most updated body of literature available within the defined parameters. In line with the inclusion and exclusion criteria outlined in Table 2, the study restricted the timeline to the years 2020 and 2025, thereby focusing exclusively on the most recent decade of scholarship. Publications dated prior to 2015 were excluded, as they were considered less relevant to the contemporary theoretical and practical advancements in education.

Additionally, the dataset was refined to include only articles published in peer-reviewed academic journals, deliberately excluding books, lecture notes, and conference proceedings to maintain academic quality and ensure the reliability of results. Following the application of these criteria, the final dataset comprised 875 publications, which represents a significant body of literature addressing the intersection of design thinking, creative metacognition, neuroscience, and education. This substantial number of publications not only highlights the scholarly relevance and growing interest in these domains but also provides a comprehensive foundation for bibliometric analysis. The dataset will further enable mapping of research patterns, identification of intellectual structures, and examination of emerging themes that define the evolution of innovative educational practices.

A systematic search was conducted in the Scopus database to identify studies on design thinking, creative metacognition, and neuroscience published between 2020 and 2025. The search string and selection criteria are presented in Tables 1 and 2 below.

Table 1: The Search String

Scopus	TITLE-ABS-KEY (("Artificial intelligent") AND (assist* OR adapt*)) AND PUBYEAR > 2009 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE "ar") OR LIMIT-TO (DOCTYPE, "cp")) AND (LIMIT-TO (LANGUAGE, "English")) Accessed Date: October 2025

Table 2: The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2020 – 2025	< 2020
Literature Type	Journal (Article), Conference	Book, Review

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

Data Analysis

VOS viewer is a widely recognised bibliometric software developed by Nees Jan van Eck and Ludo Waltman at Leiden University, Netherlands (Van Eck & Waltman, 2010, 2017). Celebrated for its intuitive and user-friendly interface, VOS viewer has become an indispensable tool for visualising and analysing large volumes of scientific literature. Its strength lies in its ability to construct sophisticated network visualisations, cluster related items, and generate density maps that reveal intellectual and thematic structures across research domains. The software's versatility extends to the exploration of co-authorship, co-citation, and keyword co-occurrence networks, enabling scholars to develop a comprehensive and nuanced understanding of research landscapes. Continuous updates and improvements further enhance its dynamic capabilities, ensuring researchers can efficiently navigate, interpret, and customise complex bibliometric data (Van Eck & Waltman, 2010).

One of the defining features of VOS viewer is its capacity to transform intricate datasets into visually interpretable maps and charts, positioning it as a robust alternative to traditional bibliometric methods. With its emphasis on network visualisation, the software excels in clustering, mapping co-occurrence patterns, and generating density distributions. Its accessibility makes it equally valuable for novice and expert researchers, while its flexibility ensures adaptability across diverse bibliometric datasets, including co-authorship and citation networks. This positions the VOS viewer as a versatile and indispensable tool for advancing scholarly insights (Van Eck & Waltman, 2010).

For the present study, datasets in Plaintext format containing publication year, title, author name, journal, citation counts, and keywords were retrieved from the Scopus database, covering the period from 2015 to December 2025. These datasets were analysed using VOS viewer version 1.6.19, which applies clustering and mapping techniques to generate knowledge maps. Unlike traditional Multidimensional Scaling (MDS), which relies on similarity measures such as cosine and Jaccard indices, VOS viewer situates items in low-dimensional space by employing a more robust normalisation method association with strength (ASij) and calculated as (Van Eck & Waltman, 2007)::

$$AS_{ij} = \frac{C_{ij}}{w_i w_j}$$

where $AS\ ij$ represents the ratio of observed co-occurrences of items i and j relative to the expected number under statistical independence (Van Eck & Waltman, 2007). This approach not only refines the accuracy of bibliometric mapping but also strengthens the interpretive validity, reinforcing VOS viewer's position as a cutting-edge tool for scientific metric and bibliometric research (Appio et al., 2014; Van Eck & Waltman, 2007).

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

Findings and Discussion

RQ1: What Are the Global Publication Trends of Design Thinking, Creative Metacognitive and Neuroscience in Education?

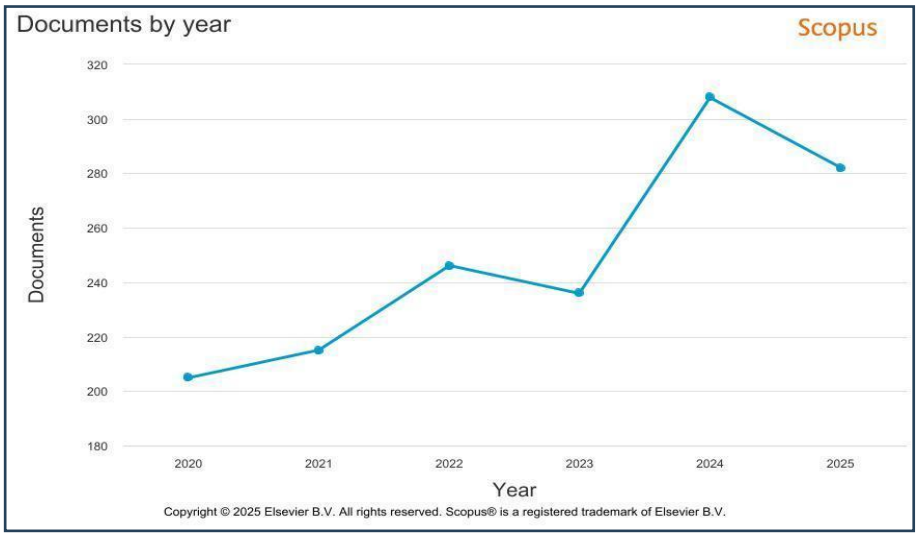

Figure 2: The Research Trends of Design Thinking, Creative Metacognition, And Neuroscience in Education

The publication trend from 2020 to 2025, based on Scopus data, reveals a significant upward trajectory in research related to Design Thinking, Creative Metacognition, and Neuroscience in education, with a total of 1,496 journal articles indexed. The number of documents rose steadily from 205 in 2020 to a peak of 309 in 2024, reflecting an increasing academic interest in innovative, brain-based, and creativity-oriented educational approaches. This growth corresponds with the global movement toward the Fifth Industrial Revolution (Education 5.0), which emphasizes human-centered innovation, cognitive flexibility, and interdisciplinary integration between technology, creativity, and neuroscience. The rise in publications during this period indicates that scholars and educators are increasingly recognizing the importance of transforming learning environments to support creativity, problem-solving, and emotional intelligence skills, which are crucial for future-ready learners. The slight decline in 2025, with 285 publications, may be attributed to the natural publication cycle, where some articles remain under review or delayed in indexing. Nevertheless, the overall trend suggests that research in this area remains robust and expanding. The sharp rise in 2024 may also be attributed to post-pandemic educational reforms that hastened the adoption of digital learning innovations and teaching approaches grounded in neuroscience, reflecting a renewed focus on human-centred and compassionate learning experiences. This shift reflects a growing consensus that effective future education requires the fusion of brain science, design-based learning, and metacognitive awareness, aligning with global priorities for personalized, empathetic, and sustainable education systems.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

Table 3: Number of Publications by Year

Year	Total Publication
2024	308
2025	282
2022	246
2023	236
2021	215
2020	205

The publication trend from 2020 to 2025, as shown in Table 1, demonstrates a consistent upward movement in research focusing on the intersection of design thinking, creative metacognition, neuroscience, and education. Beginning with 205 publications in 2020 and gradually rising to a peak of 308 in 2024, the data reveal an increasing academic commitment to exploring innovative, brain-based, and creativity-driven approaches to learning. This upward pattern suggests that global education systems are embracing multidisciplinary research that connects cognitive science, technology, and pedagogy. The acceleration from 2021 to 2024 may be attributed to the growing influence of digital transformation and post-pandemic educational shifts that prompted educators and researchers to rethink teaching strategies through the lens of neuroscience and design-led learning innovation.

Although a slight decline is observed in 2025 with 282 publications, the overall trend indicates sustained scholarly engagement and consolidation in this emerging field. The temporary drop may be due to publication delays or thematic saturation as researchers refine existing frameworks. This pattern also aligns with global educational priorities outlined in **Sustainable Development Goal (SDG) 4 – Quality Education**, which emphasises inclusive, equitable, and transformative learning. The upward trend reflects a collective movement towards human-centred education that values creativity, empathy, and cognitive development as a key pillar of the Fifth Industrial Revolution. The results demonstrate how the fusion of neuroscience, metacognition, and design thinking continues to shape the future of teaching and learning worldwide.

RO2: What Are the Most Cited Authors and Articles?

The top ten most influential articles by authors integration design thinking, creative metacognitive and neuroscience in future education are shown in Table 4.

Table 4: Most Cited Articles by Authors

No.	Authors	Source title	Cited by
1	Zhang et al. ,(2020)	Information Fusion	370
2	(Meyer & Norman (2020)	She Ji	267
3	(Górriz et al., 2020)	Neurocomputing	231

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

4	Pande & Bharathi (2020)	Thinking Skills and Creativity	207
5	Fromm et al., (2021)	Internet and Higher Education	162
6	Tang et al. (2020)	Thinking Skills and Creativity	162
7	O'Connor et al. (2020)	British Journal of Psychology	161
8	Khetarpal et al. (2022)	Journal of Artificial Intelligence Research	155
9	Lynch et al. , (2021)	Technological Forecasting and Social Change	138
10	Mansoori & Lackéus (2020)	Small Business Economics	133

The citation analysis of the top ten most cited publications from 2020 to 2022 highlights a strong concentration of influential works in the fields of design thinking, creative metacognition, and neuroscience, each contributing significantly to educational innovation and interdisciplinary research. The most cited study by (Zhang et al., 2020), published in *Information Fusion* with 370 citations, demonstrates the critical role of multimodal data fusion in neuroimaging, bridging the gap between neuroscience and artificial intelligence. This paper's prominence reflects the growing reliance on data-driven methodologies and neurotechnological advances in understanding human cognition and learning processes. Similarly, (Meyer & Norman, 2020) and (Pande & Bharathi, 2020), published in *She Ji* and *Thinking Skills and Creativity* respectively, show substantial influence within educational research, emphasising the pedagogical integration of design thinking and constructivist approaches. These publications underscore the academic community's shift toward experiential, reflective, and brain-based frameworks that align with emerging educational paradigms.

The dominance of journals such as *Information Fusion*, *Thinking Skills and Creativity*, and *Technological Forecasting and Social Change* indicates a convergence of technology, psychology, and education as interrelated domains driving research innovation. The high citation counts reflect the increasing importance of **neuroscience-informed learning** and **creative cognition** in shaping education for the future. Moreover, the prominence of 2020 publications can be attributed to the surge in post-pandemic research focusing on human-centred learning and digital adaptation. The recurring themes, such as artificial intelligence, virtual reality, and design-based learning, highlight the academic community's response to the evolving needs of the Fifth Industrial Revolution, which places strong emphasis on empathy, creativity, and neuro-cognitive development. These highly cited works thus provide a foundational knowledge base that continues to guide transformative educational practices and policy developments worldwide. The high citation rates can be attributed to the growing relevance of these studies in shaping modern educational frameworks, driving technological innovation, and informing mental health research fields that witnessed a notable rise in funding, publications, and cross-disciplinary collaboration during this period. Overall, the results reflect a shift toward integrative, technology-driven, and human-centered research paradigms that resonate strongly with the current global research agenda.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

RO3: Where Is the Top Ten Countries Based on Number of Publications?

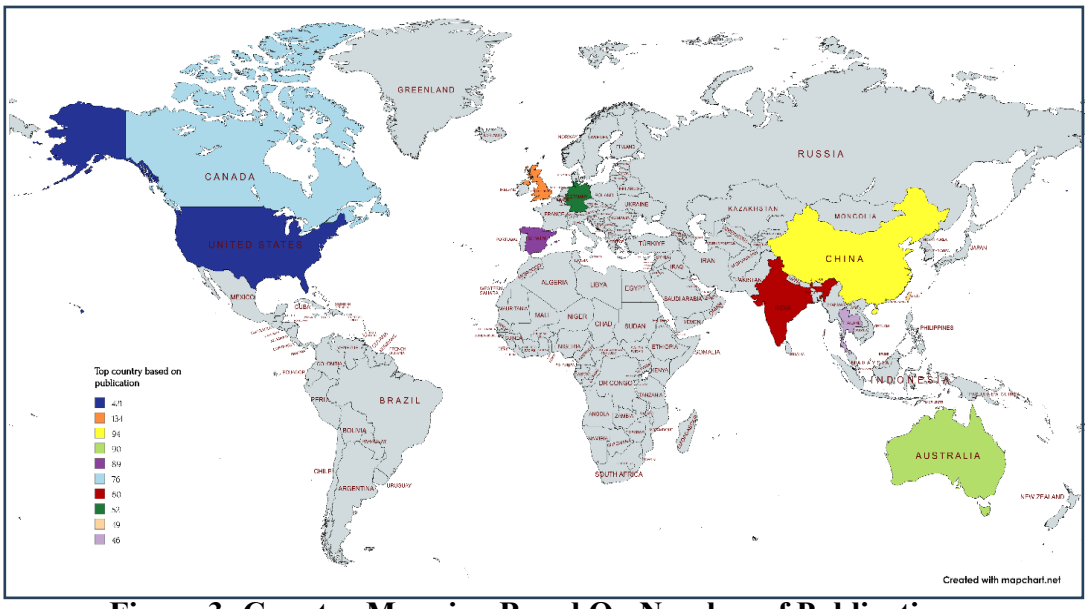

Figure 3: Country Mapping Based On Number of Publication

The country mapping reveals that the United States leads significantly with 421 publications, followed by the United Kingdom (134), China (94), and Australia (90). This dominance reflects the strong research infrastructure, extensive funding, and established collaborations across universities and research institutions in these countries. The United States and United Kingdom, in particular, have long-standing traditions in educational innovation and interdisciplinary research, which align closely with emerging themes such as design thinking, creative metacognition, and neuroscience in education. Their commitment to integrating technology, pedagogy, and brain-based learning explains the higher output and visibility of research from these nations, supported by robust academic-industry partnerships and access to global academic networks.

Countries like China, Australia, Spain, and Canada also show notable engagement, suggesting increasing global interest in rethinking education through cognitive and creative frameworks. Emerging contributors such as India, Germany, Taiwan, and Thailand indicate growing academic awareness and policy support for future-oriented learning models, particularly under the influence of the Fifth Industrial Revolution. These findings collectively underscore a shift towards a globalised, human-centred educational research agenda, where both developed and developing nations contribute to advancing Sustainable Development Goal 4 (SDG 4) and ensuring inclusive and quality education that fosters creativity, innovation, and lifelong learning opportunities for all.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

RO4: What Are the Popular Keywords and Theme Related to The Study?

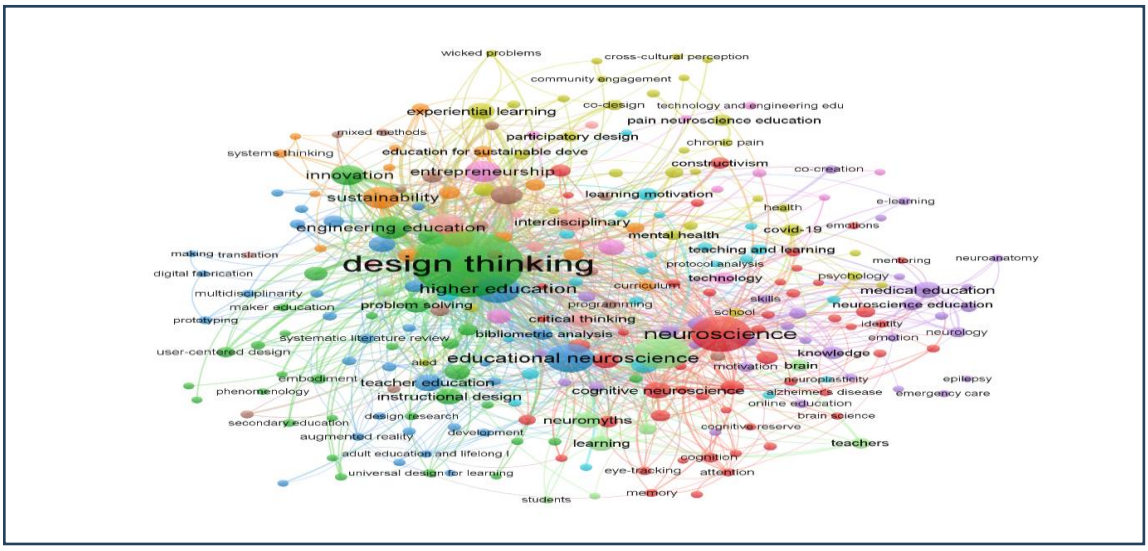

Figure 4: Network Visualization for Keywords' Co-Occurrence

The keyword co-occurrence network visualization reveals four major interconnected research clusters, with *design thinking*, *neuroscience*, *educational neuroscience*, and *higher education* appearing as central themes. The prominence of *design thinking* at the core of the network indicates its strong interdisciplinary influence, linking areas such as *innovation*, *entrepreneurship*, *engineering education*, *sustainability*, and *problem solving*. This suggests that design thinking serves as a unifying framework that integrates creativity, cognitive processes, and experiential learning across multiple disciplines. The close proximity of terms like *experiential learning*, *instructional design*, and *educational neuroscience* reflects a growing academic interest in bridging human-centred design approaches with brain-based learning theories to enhance teaching, creativity, and learning outcomes.

The emergence of *neuroscience*, *medical education*, and *neuroeducation* as tightly linked clusters highlights the convergence between cognitive science and pedagogy. Keywords such as *cognition*, *motivation*, *learning*, and *mental health* suggest that current research is shifting toward understanding how the brain supports learning and innovation. The inclusion of pandemic-related terms like *COVID-19* and *online education* demonstrates how global educational practices have adapted to technological and neurological insights in recent years. Overall, the network illustrates a shift from traditional teaching methods towards integrative, evidence-based, and neuro-cognitive approaches that equip learners for complex, interdisciplinary, and digitally enhanced learning environments.

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

RO5: What Is Co-Authorship by Countries' Collaboration?

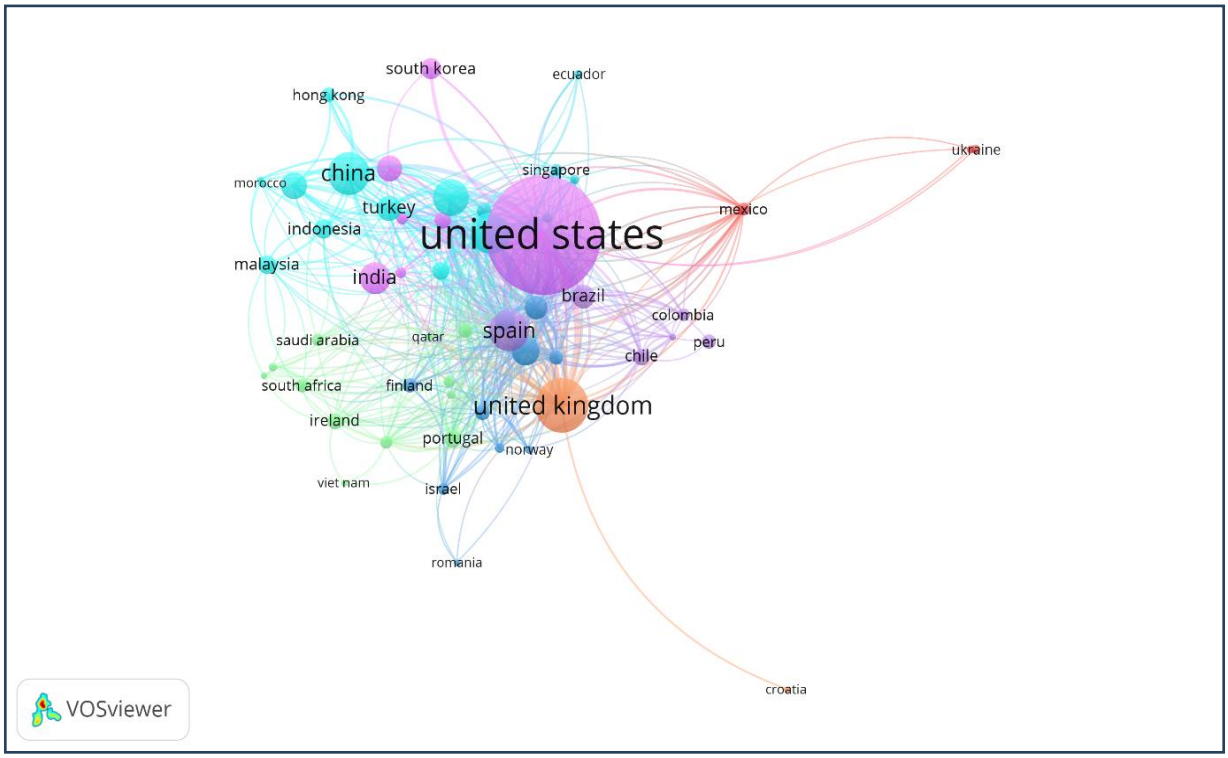

Figure 5: Network Visualization for Co-Authorship by Countries

The co-authorship analysis by countries in VOSviewer visualises the strength of collaboration among nations based on shared academic publications. Each node represents a country, and the connecting lines (links) indicate the frequency and intensity of co-authored research. The larger the node, the greater the publication volume, while thicker links signify stronger international collaboration networks. This visualization provides insight into global academic connectivity, revealing how countries contribute to the exchange of ideas, knowledge transfer, and interdisciplinary innovation through collaborative research. It also highlights the role of leading nations as research hubs that drive international cooperation and influence the development of emerging research fields.

This map was generated using the full counting method with a minimum threshold of five publications. Out of 103 countries, 57 met the threshold, and with a minimum cluster size of five, eight clusters were formed. The United States appears as the largest and most interconnected node, collaborating extensively with countries such as the United Kingdom, China, Spain, and Brazil. This dominance reflects the U.S.'s research capacity, global partnerships, and access to funding. Countries like Malaysia, Indonesia, and India form part of regional clusters linked to major research economies, showing growing engagement in international collaborations. These findings contribute to the body of knowledge by illustrating how global academic networks are structured, identifying power dynamics in knowledge production, and revealing emerging research linkages that enhance scientific development and innovation across regions. Overall, the figure supports the idea that international co-authorship fosters a more integrated and collaborative global research ecosystem, where both developed and developing nations contribute to advancing scientific innovation and knowledge exchange.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

Conclusion

This bibliometric analysis was to map and synthesise the global research landscape on design thinking, creative metacognition, and neuroscience approaches within the context of future education. The study sought to identify publication trends, influential works, key authors, international collaborations, and thematic patterns that define this emerging interdisciplinary field. Through the analysis of 1,492 Scopus-indexed publications, the research offered a comprehensive overview of how these three domains converge to inform innovation-driven and brain-based pedagogical practices aligned with the evolving educational demands of the Fifth Industrial Revolution.

The analysis revealed a consistent upward trend in scholarly output between 2020 and 2025, with the United States, the United Kingdom, and China identified as the most prolific contributors. Four dominant research clusters were identified: design-driven learning innovation, neuro-cognitive creativity, interdisciplinary education, and technology-enhanced pedagogy. These clusters reflect an increasing emphasis on human-centred, creative, and evidence-based approaches to learning. High citation patterns in journals such as *Thinking Skills and Creativity* and *Information Fusion* indicate growing scholarly interest in integrating cognitive science and design methodologies to strengthen creativity, empathy, and problem-solving in education.

This study contributes to the academic discourse by providing an integrated bibliometric overview that bridges fragmented research across neuroscience, design thinking, and metacognitive creativity. It extends existing literature by revealing the emergence of a new educational paradigm grounded in neuro-cognitive insight and design-led innovation. These findings align with the principles of Sustainable Development Goal 4 (Quality Education), which emphasises inclusive, equitable, and transformative learning that equips individuals with creative and cognitive skills for lifelong learning. In practice, the insights from this study highlight the potential for educators, policymakers, and curriculum developers to adopt neuroscience-informed and design-based learning models to foster adaptive and empathetic learning ecosystems.

Despite its comprehensive scope, the study faced limitations related to database coverage and language restriction to English-only publications, which may have excluded valuable regional perspectives. Future research could expand the scope by incorporating other bibliographic databases, employing longitudinal analyses, and exploring cross-cultural variations in integrating neuro-cognitive and creative pedagogies. Overall, this bibliometric mapping reinforces the significance of interdisciplinary research in shaping future-ready education and underscores the vital role of design thinking, creative metacognition, and neuroscience in cultivating innovation-oriented and human-centric learning for the next generation.

Acknowledgements

The author would like to express sincere appreciation and gratitude to all individuals who directly or indirectly contributed to the completion of this paper. Special thanks are extended to the participants and organisers of the *Bibliometric Article Writing Workshop* by Iman Excellence and Global Academic Excellence (M) Sdn. Bhd. for their invaluable support, guidance, and insightful feedback.

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051

References

Al-Khoury, A., Hussein, S. A., Abdulwhab, M., Aljuboori, Z. M., Haddad, H., Ali, M. A., Abed, I. A., & Flayyih, H. H. (2022). Intellectual Capital History and Trends: A Bibliometric Analysis Using Scopus Database. Sustainability (Switzerland), 14(18). https://doi.org/10.3390/su141811615

Alves, J. L., Borges, I. B., & De Nadae, J. (2021). Sustainability in complex projects of civil construction: Bibliometric and bibliographic review. Gestao e Producao, 28(4). https://doi.org/10.1590/1806-9649-2020v28e5389

Amran, M. S., Rahman, S., Surat, S., & Bakar, A. Y. A. (2019). Connecting neuroscience and education: Insight from neuroscience findings for better instructional learning. Journal for the Education of Gifted Young Scientists, 7(2), 341–352. https://doi.org/10.17478/JEGYS.559933

Appio, F. P., Cesaroni, F., & Di Minin, A. (2014). Visualizing the structure and bridges of the intellectual property management and strategy literature: a document co-citation analysis. Scientometrics, 101(1), 623–661. https://doi.org/10.1007/s11192-014-1329-0

Arias Salegio, I. S., & Batista Mainegra, A. (2021). Focuses on neuroscience: Current challengeseducation. Universidad y Sociedad, 13(2), 42–49. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85103898944&partnerID=40&md5=9c45ad5f798e84df400687ce3a803760

Assyakur, D. S., & Rosa, E. M. (2022). Spiritual Leadership in Healthcare: A Bibliometric Analysis. Jurnal Aisyah : Jurnal Ilmu Kesehatan, 7(2). https://doi.org/10.30604/jika.v7i2.914

Bourgeois-Bougrine, S., Latorre, S., & Mourey, F. (2018). Promoting creative imagination of non-expressed needs: Exploring a combined approach to enhance design thinking. Creativity Studies, 11(2), 377–394. https://doi.org/10.3846/cs.2018.7184

Brady, J., & Katre, A. (2021). Innovating at the nexus of world languages and cultures and design thinking. Pedagogies, 16(4), 378–396. https://doi.org/10.1080/1554480X.2021.1897011

Christodoulou, J. A., Saxler, P. K., & del Tufo, S. N. (2013). New frontiers in education neuroscience (pp. 202–212). Taylor and Francis. https://doi.org/10.4324/9780203809402-32

di Stefano, G., Peteraf, M., & Veronay, G. (2010). Dynamic capabilities deconstructed: A bibliographic investigation into the origins, development, and future directions of the research domain. Industrial and Corporate Change, 19(4), 1187–1204. https://doi.org/10.1093/icc/dtq027

Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. In International Journal of Production Economics (Vol. 162, pp. 101–114). https://doi.org/10.1016/j.ijpe.2015.01.003

Fromm, J., Radianti, J., Wehking, C., Stieglitz, S., Majchrzak, T. A., & vom Brocke, J. (2021). More than experience? - On the unique opportunities of virtual reality to afford a holistic experiential learning cycle. Internet and Higher Education, 50. https://doi.org/10.1016/j.iheduc.2021.100804

Górriz, J. M., Ramírez, J., Ortíz, A., Martínez-Murcia, F. J., Segovia, F., Suckling, J., Leming, M., Zhang, Y. D., Álvarez-Sánchez, J. R., Bologna, G., Bonomini, P., Casado, F. E., Charte, D., Charte, F., Contreras, R., Cuesta-Infante, A., Duro, R. J., Fernández-Caballero, A., Fernández-Jover, E., … Ferrández, J. M. (2020). Artificial intelligence within the interplay between natural and artificial computation: Advances in data science, trends and applications. Neurocomputing, 410, 237–270. https://doi.org/10.1016/j.neucom.2020.05.078

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051
Gu, D., Li, T., Wang, X., Yang, X., & Yu, Z. (2019). Visualizing the intellectual structure and evolution of electronic health and telemedicine research. International Journal of Medical Informatics, 130. https://doi.org/10.1016/j.ijmedinf.2019.08.007

Kelleher, I., & Whitman, G. (2018). A Bridge No Longer Too Far: A Case Study of One School's Exploration of the Promise and Possibilities of Mind, Brain, and Education Science for the Future of Education. Mind, Brain, and Education, 12(4), 224–230. https://doi.org/10.1111/mbe.12163

Khetarpal, K., Riemer, M., Rish, I., & Precup, D. (2022). Towards Continual Reinforcement Learning: A Review and Perspectives. Journal of Artificial Intelligence Research, 75, 1401–1476. https://doi.org/10.1613/JAIR.1.13673

Khiste, G. P., & Paithankar, R. R. (2017). Analysis of Bibliometric term in Scopus. International Research Journal, 01(32), 78–83.

Latorre-Cosculluela, C., Vázquez-Toledo, S., Rodríguez-Martínez, A., & Liesa-Orús, M. (2020). Design Thinking: Creativity and Critical Thinking in College. Revista Electronica de Investigacion Educativa, 22, 1–13. https://doi.org/10.24320/REDIE.2020.22.E28.2917

Lynch, M., Kamovich, U., Longva, K. K., & Steinert, M. (2021). Combining technology and entrepreneurial education through design thinking: Students' reflections on the learning process. Technological Forecasting and Social Change, 164. https://doi.org/10.1016/j.techfore.2019.06.015

Maldonado-Arbogast, P. (2024). The convergence between neuroscience and education: a pending challenge. MedUNAB, 27(3). https://doi.org/10.29375/01237047.5345

Mansoori, Y., & Lackéus, M. (2020). Comparing effectuation to discovery-driven planning, prescriptive entrepreneurship, business planning, lean startup, and design thinking. Small Business Economics, 54(3), 791–818. https://doi.org/10.1007/s11187-019-00153-w

Massonnié, J., & Thomas, M. S. C. (2022). Perspectives on learning from neuroscience. In International Encyclopedia of Education: Fourth Edition (pp. 57–66). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.14008-4

Meyer, M. W., & Norman, D. (2020). Changing Design Education for the 21st Century. She Ji, 6(1), 13–49. https://doi.org/10.1016/j.sheji.2019.12.002

O'Connor, D. B., Aggleton, J. P., Chakrabarti, B., Cooper, C. L., Creswell, C., Dunsmuir, S., Fiske, S. T., Gathercole, S., Gough, B., Ireland, J. L., Jones, M. V., Jowett, A., Kagan, C., Karanika-Murray, M., Kaye, L. K., Kumari, V., Lewandowsky, S., Lightman, S., Malpass, D., … Armitage, C. J. (2020). Research priorities for the COVID-19 pandemic and beyond: A call to action for psychological science. British Journal of Psychology, 111(4), 603–629. https://doi.org/10.1111/bjop.12468

Pande, M., & Bharathi, S. V. (2020). Theoretical foundations of design thinking – A constructivism learning approach to design thinking. Thinking Skills and Creativity, 36, 100637. https://doi.org/10.1016/j.tsc.2020.100637

Pastén, L. E. (2021). Metacognitive, Critical and Creative Thinking in Educative Contexts: Conceptualization and Didactic Suggestions. Psicologia Escolar e Educacional, 25, 1–8. https://doi.org/10.1590/2175-35392021220278

Samuels, B. M. (2009). Can the differences between education and neuroscience be overcome by Mind, Brain, and Education? Mind, Brain, and Education, 3(1), 45–55. https://doi.org/10.1111/j.1751-228X.2008.01052.x

Stringer, S., & Tommerdahl, J. (2015). Building bridges between neuroscience, cognition and education with predictive modeling. Mind, Brain, and Education, 9(2), 121–126. https://doi.org/10.1111/mbe.12076

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 28 (December 2025) PP. 736-751
DOI: 10.35631/IJMOE.728051
Tang, T., Vezzani, V., & Eriksson, V. (2020). Developing critical thinking, collective creativity skills and problem solving through playful design jams. Thinking Skills and Creativity, 37. https://doi.org/10.1016/j.tsc.2020.100696

van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. Scientometrics, 111(2), 1053–1070. https://doi.org/10.1007/s11192-017-2300-7

Van Eck, N. J., & Waltman, L. (2007). Bibliometric mapping of the computational intelligence field. International Journal of Uncertainty, Fuzziness and Knowldege-Based Systems, 15(5), 625–645. https://doi.org/10.1142/S0218488507004911

Verbeek, A., Debackere, K., Luwel, M., & Zimmermann, E. (2002). Measuring progress and evolution in science and technology - I: The multiple uses of bibliometric indicators. International Journal of Management Reviews, 4(2), 179–211. https://doi.org/10.1111/1468-2370.00083

von Thienen, J. P. A., Weinstein, T. J., & Meinel, C. (2023). Creative metacognition in design thinking: exploring theories, educational practices, and their implications for measurement. Frontiers in Psychology, 14. https://doi.org/10.3389/fpsyg.2023.1157001

Wu, Y. C. J., & Wu, T. (2017). A decade of entrepreneurship education in the Asia Pacific for future directions in theory and practice. In Management Decision (Vol. 55, Issue 7, pp. 1333–1350). https://doi.org/10.1108/MD-05-2017-0518

Yusuf, A., Mouas, S., Al-khresheh, M. H., & Boudouaia, A. (2026). Individual vs peer support in the AI era: Investigating students' cognitive dispositions in design education. Thinking Skills and Creativity, 59. https://doi.org/10.1016/j.tsc.2025.101986

Zhang, Y. D., Dong, Z., Wang, S. H., Yu, X., Yao, X., Zhou, Q., Hu, H., Li, M., Jiménez-Mesa, C., Ramirez, J., Martinez, F. J., & Gorriz, J. M. (2020). Advances in multimodal data fusion in neuroimaging: Overview, challenges, and novel orientation. Information Fusion, 64, 149–187. https://doi.org/10.1016/j.inffus.2020.07.006