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Neuroscience and creativity in education: trends and patterns from a bibliometric approach

Neurociencia y creatividad en la educación: tendencias y patrones desde un enfoque bibliométrico

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Abstract

The study analyzed trends and bibliometric characteristics of scientific output on neuroscience and creativity in education between 2000 and 2025. A total of 139 documents indexed in Scopus were examined, obtained using the keywords “Neuroscience” AND ‘Creativity’ AND “Education.” The results show sustained growth in output, with a notable increase between 2017 and 2024 (n = 75; 54%), a period that accounts for more than half of the publications. The United States leads the global contribution (n = 50; 29.2%), followed by other countries with lower participation. Frontiers in Psychology is the most productive journal (n = 5), and Trevarthen, C. is the most cited author (185 citations in two papers). Thematically, the research is grouped into psychology (22%) and social sciences (16%), which highlights the interdisciplinary nature of the field. In addition, emerging networks of collaboration between institutions and authors were detected, pointing to the consolidation of a research core on the relationship between neuroscience and educational creativity. In summary, since 2017, there has been an upturn and methodological diversification in studies in this area, with growing international collaboration. This panorama confirms the consolidation of an expanding field of research, oriented toward the development of educational models based on neuroscientific evidence.

Keywords: neuroscience, creativity, education, teaching, bibliometrics.

Resumen

El estudio analizó las tendencias y características bibliométricas de la producción científica sobre neurociencia y creatividad en educación entre 2000 y 2025. Se examinaron 139 documentos indexados en Scopus, obtenidos mediante las palabras clave “Neuroscience” AND “Creativity” AND “Education”. Los resultados muestran un crecimiento sostenido de la producción, con un notable aumento entre 2017 y 2024 (n = 75; 54%), periodo que concentra más de la mitad de las publicaciones. Estados Unidos lidera la contribución global (n = 50; 29,2%), seguido por otros países con menor participación. Frontiers in Psychology es la revista más productiva (n = 5), y Trevarthen, C. el autor más citado (185 citas en dos trabajos). Temáticamente, las investigaciones se agrupan en psicología (22%) y ciencias sociales (16%), lo que evidencia la interdisciplinariedad del campo. Además, se detectaron redes emergentes de colaboración entre instituciones y autores, señalando la consolidación de un núcleo de investigación sobre la relación entre neurociencia y creatividad educativa. En síntesis, desde 2017 se observa un repunte y diversificación metodológica en los estudios del área, con una creciente colaboración internacional. Este panorama confirma la consolidación de un campo de investigación en expansión, orientado al desarrollo de modelos educativos basados en evidencias neurocientíficas.

Palabras clave: neurociencia, creatividad, educación, enseñanza, bibliometría.

INTRODUCTION

In the current context, marked by rapid technological advances, unemployment, and social challenges, it is essential to rethink traditional teaching and learning methods (Sandoval et al., 2025; Murillo et al., 2024). Creativity, understood as a cross-cutting skill essential for coping with changing environments, is becoming a pillar of the new educational paradigm (Moura et al., 2021; Morrocco, 2024). In this context, neuroscience provides scientific foundations that enable us to understand and enhance the cognitive processes involved in generating original ideas (Rosell et al., 2020; Sanz, 2022).

Various studies in cognitive neuroscience have identified the brain mechanisms associated with creativity, opening up possibilities for designing teaching practices that stimulate creative thinking from an early age (Ponce & Arroyo, 2022; Rodríguez, 2023).

However, education systems still prioritize memorization and standardized testing, limiting creative development and the practical application of neuroscientific advances (Suárez et al., 2025; Medina, 2024). Added to this are poor teacher training and a lack of materials based on scientific evidence (Speratti et al., 2023).

Authors such as Ken Robinson and Howard Gardner emphasize that creativity can be cultivated through stimulating educational environments (Martín-Martínez, 2022; Vera, 2024), and neuroscientists such as Rex Jung and Andreas Fink have identified key brain regions involved in creative thinking (León-Río, 2021). These perspectives agree on the need to integrate the contributions of neuroscience into pedagogical practice to promote innovation (López et al., 2023).

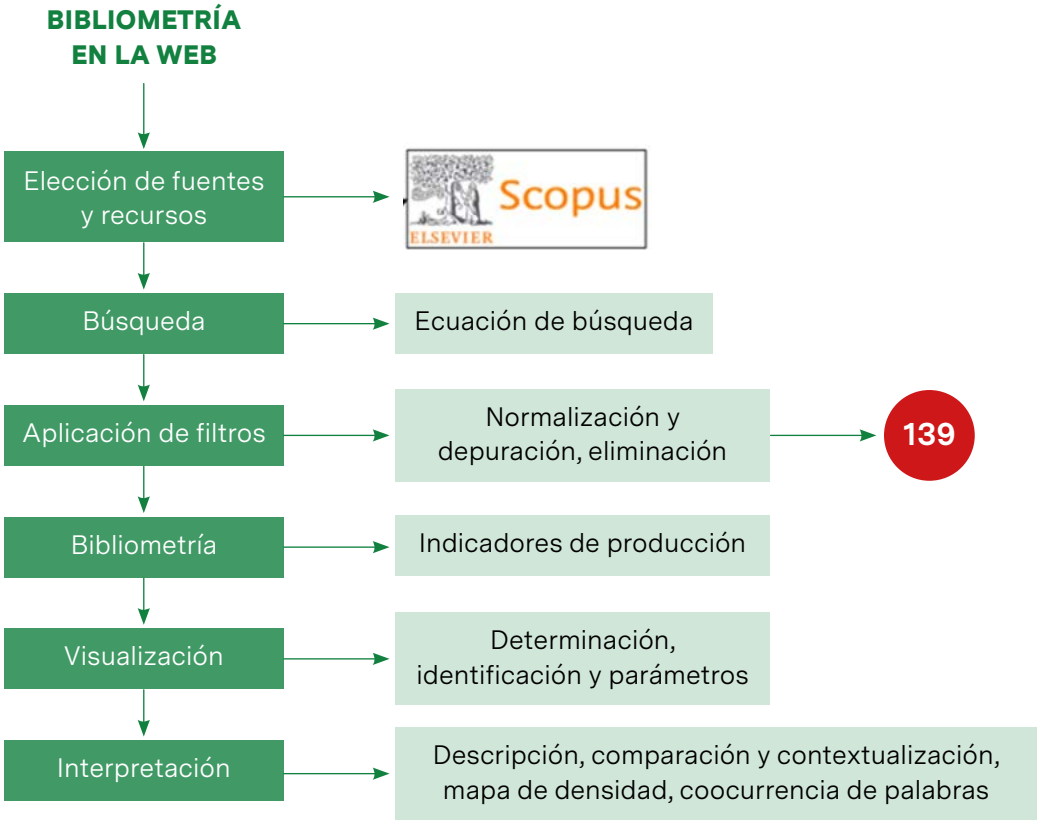
In this sense, bibliometrics is a relevant tool for analyzing the evolution of scientific knowledge on neuroscience and educational creativity, as it allows us to identify trends, collaborations, and areas of research (Caló, 2022; Bracho et al., 2023). Therefore, bibliometric markers such as year of publication, country of origin, subject area, document type, source, and authorship are used to understand the dynamics of the field. In this context, the following research question arises: What are the main bibliometric trends and patterns that characterize scientific production on neuroscience and creativity in education between 2000 and 2025?

Consequently, the overall objective is to analyze bibliometric trends and patterns in neuroscience and creativity in education from 2020 to 2025.

METHOD

This study adopted a descriptive and analytical bibliometric approach to examine the evolution, structure, and trends of scientific research on neuroscience and creativity in education. Bibliometrics, understood as a discipline that applies quantitative methods to the analysis of scientific literature, made it possible to identify patterns of production, collaboration, and citation within the field (Caló, 2022). This approach is essential for evaluating the dynamics of knowledge and guiding future lines of research, as it facilitates the identification of the authors, countries, institutions, and journals with the greatest impact (Salinas and García, 2022; Leyva et al., 2023). The information was obtained from the Scopus database, recognized for its extensive coverage of peer-reviewed scientific publications and its reliability in international bibliometric studies. The search used the English keywords “Neuroscience” AND ‘Creativity’ AND “Education,” applied to the title, abstract, and keywords of the documents. The period of analysis was set between 2000 and 2025, in order to capture both the beginnings of the field and its recent development.

Figure 1
Data search and selection method



Note: Data-based selection criteria

The following Boolean operators were applied to abstracts, titles, and keywords to collect the information: Neuroscience AND creativity AND education. As a result of this process, a database of documents was compiled, which had to undergo a process of filtering, standardization, and elimination before the final sample could be considered. A total of 139 academic papers were selected for the study. As part of this data cleansing process, the following exclusion criteria were also established: 1) research conducted outside the study period (2000-2025), 2) duplicate publications, and 3) studies unrelated to the topic.

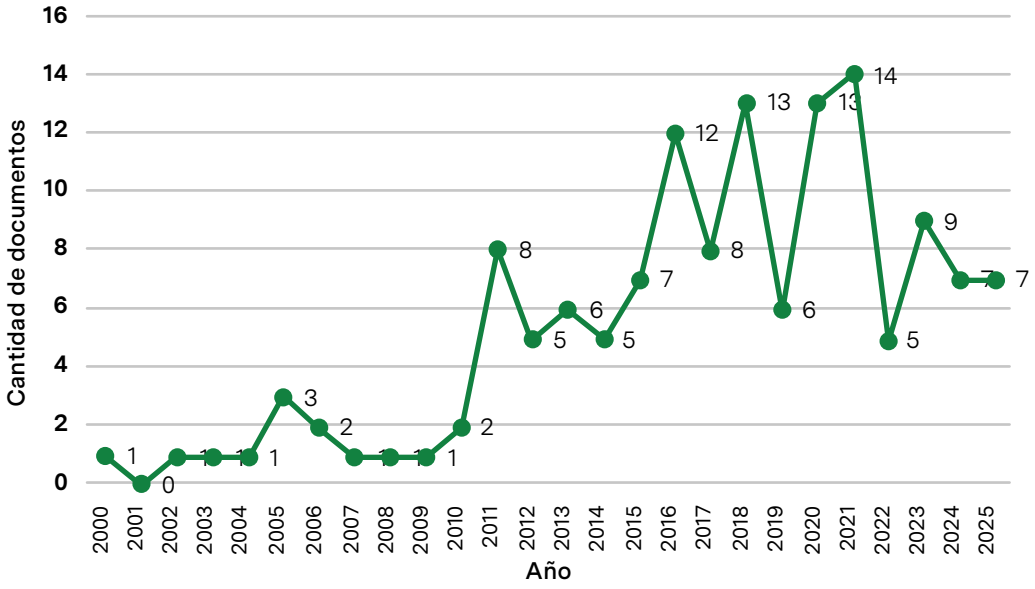
On the other hand, the impact of the selected works on the academic debate was evaluated using a set of bibliometric markers. These metrics included production broken down by year of publication, author, place of publication, type of document, topic, and institutional affiliation (Florez-Fernández & Aguilera-Eguía, 2020). A final step consisted of compiling descriptive data on the documentary volume of the sample and analyzing it in Excel. In the same way, the mapping of term co-occurrences was carried out using VOSviewer V 1.6.19.

RESULTS

The bibliometric study included 139 academic papers covering the years 2000-2025 and dealing with neuroscience and the role of creativity in education. The most recent papers on this topic indexed in Scopus are shown in Figure 2. With some fluctuations in research, the maximum number of academic papers published between 2017 and 2024 was 75, or 54% of all publications worldwide.

Figure 2

Documents published from 2000 to 2025



Note: Data from Scopus (2025)

The distribution of publications by country worldwide is shown in Figure 3. This study analyzes 38 different countries, with special emphasis on those that publish the most academic work in this field. From the point of view of scientific production, the top three countries are the United States (29.2%, n=50), the United Kingdom (11.7%; n=20), and Italy (5.3%; n=9). In addition, English is the language chosen for most of the published works (74%; n=103), followed by Spanish (18%; n=25) and Portuguese (8%; n=11).

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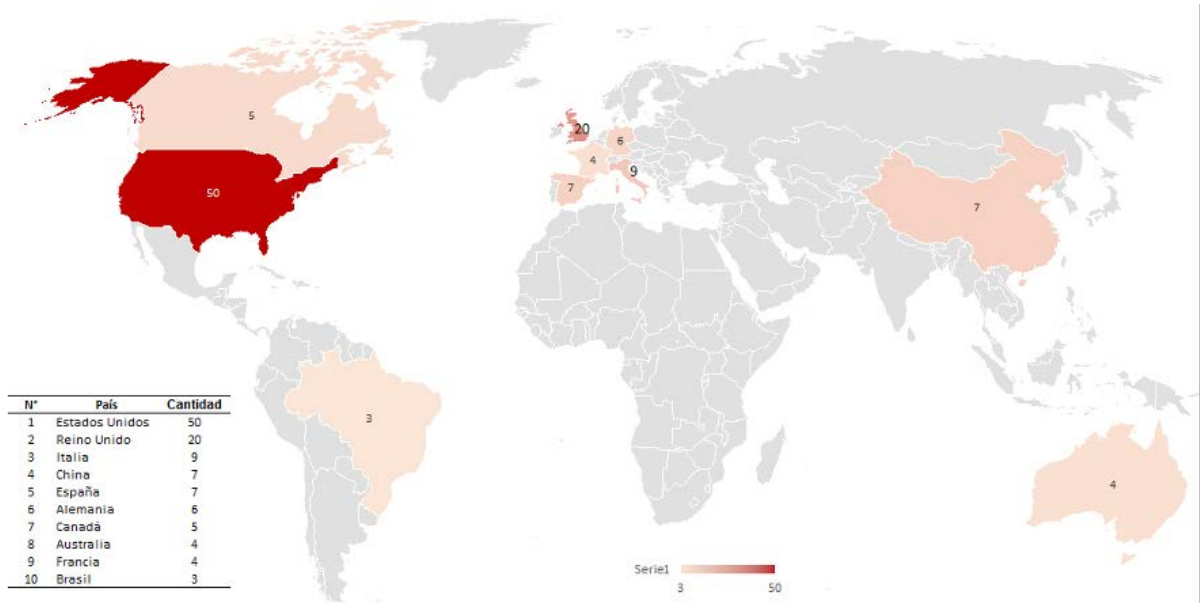
Figure 3

Publication volume in major countries



N°	País	Cantidad
1	Estados Unidos	50
2	Reino Unido	20
3	Italia	9
4	China	7
5	España	7
6	Alemania	6
7	Canadá	5
8	Australia	4
9	Francia	4
10	Brasil	3

Note: Data from Scopus (2025)

Table 1

Publication of documents by source or journal

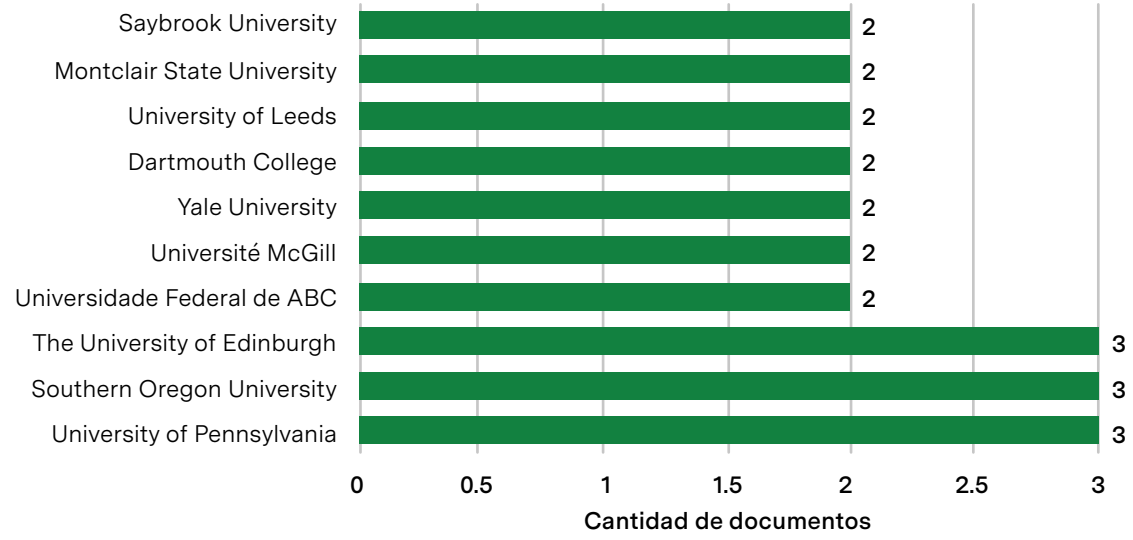
Source or Journal	Number of documents	Source or Journal	Number of documents	Source or Journal	Number of documents
Frontiers in Psychology	5	Apunts Educación Física y Deportes	1	Development and Learning in Organizations	1
Frontiers in Human Neuroscience	3	Arte Individuo y Sociedad	1	Edelweiss Applied Science and Technology	1
American Psychologist	2	Arts And Humanities in Higher Education	1	Education Sciences	1
Arbor	2	Arts in Psychotherapy	1	Encephale	1
International Journal of Psychoanalysis	2	Brain Sciences	1	Frontiers In Neuroscience	1
Journal of Consciousness Studies	2	Cerebellum and Ataxias	1	Giornale Italiano Di Psicologia	1
Neuroquan-tology	2	Clinical Pharmacology and Therapeutics	1	Industrie Textile	1
Progress in Brain Research	2	Computational Intelligence and Neuroscience	1	Industry and Higher Education	1
ANAE Approche Neuropsychologi-que Des Appren-tissages Chez L Enfant	1	Contemporary Psychoanalysis	1	Infant And Child Development	1
Advances in Group Processes	1	Creativity Research Journal	1	International Journal of Engineering and Technology Uae	1
American Journal of Clinical Hypnosis	1	Creativity Studies	1	International Journal of Environmental Research and Public Health	1
Annals of The New York Academy of Sciences	1	Current Neuropharmacology	1	Indefinido	42
Anthropology of Consciousness	1	Curriculum Journal	1	Total, journals	79

Note: Data from Scopus (2025)

The production of these 139 research papers was the result of collaboration among academics from 117 different institutions. During the study period, several universities published scientific papers on the topic of neuroscience and creativity in education. The University of Pennsylvania, Southern Oregon University, and the University of Edinburgh were the institutions that published the most, with three each (Figure 4). They were followed by several institutions, such as the Universidade Federal do ABC, Université McGill, and Yale University, each of which published two academic papers.

Figure 4

Documents published by institution



Note: Data from Scopus (2025)

A total of 124 authors from different universities contributed to the selected academic works. Table 2 shows that, of all authors with at least two publications, Trevarthen, C. has the most citations, with 185. Barbot, B. ranks second, with two articles and 161 citations. Third place goes to Agogué, M., who has one publication and 101 citations.

Table 2

Documents published by author

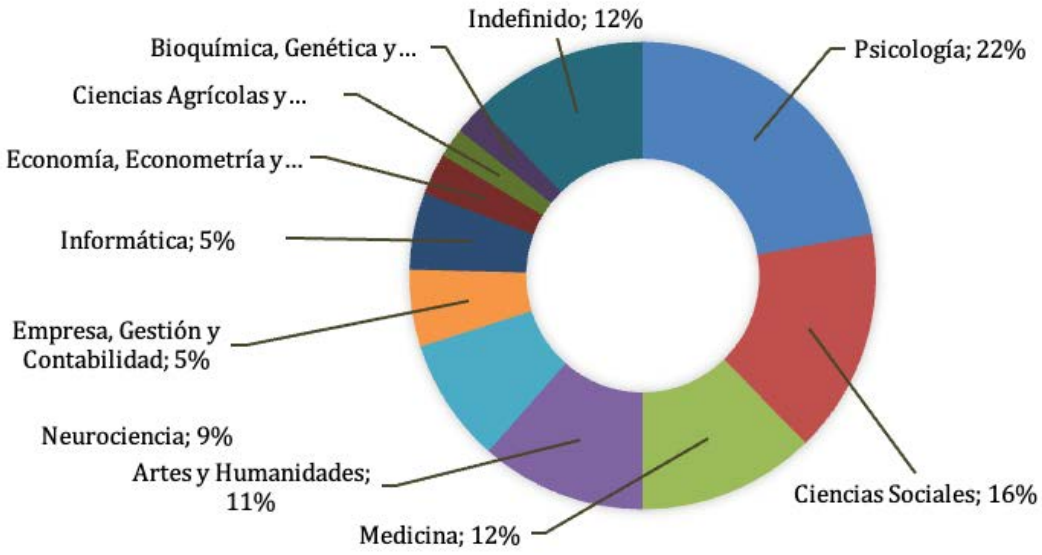
By author (principal)	Publications	Total citations
Penaluna, K.	3	31
Barbot, B.	2	161
Boesch, B.	2	3
Callahan, C.M.	2	2
Feitosa-Santana, C.	2	3
Kaag, J.	2	16
Missett, T.C.	2	2
Penaluna, A.	2	25

Runco, M.A.	2	74
Trevarthen, C.	2	185
Yeh, Y.C.	2	10
Abad-Segura, E.	1	12
Abdullah, J.M.	1	1
Abraham, A.	1	100
Agnoli, S.	1	0
Agogué, M.	1	101

Note: Data from Scopus (2025)

On the other hand, academic articles evaluating research on neuroscience and creativity in education are classified by subject area in Figure 5. Statistics compiled from 23 different academic fields show that, worldwide, 22% of all scientific production comes from the field of psychology, 16% from social sciences, and 12% from medicine. However, other areas of study—such as arts and humanities, neuroscience, computer science, biochemistry, and many more—contribute to the theoretical basis of this field of study.

Figure 5
Publication of documents by subject area

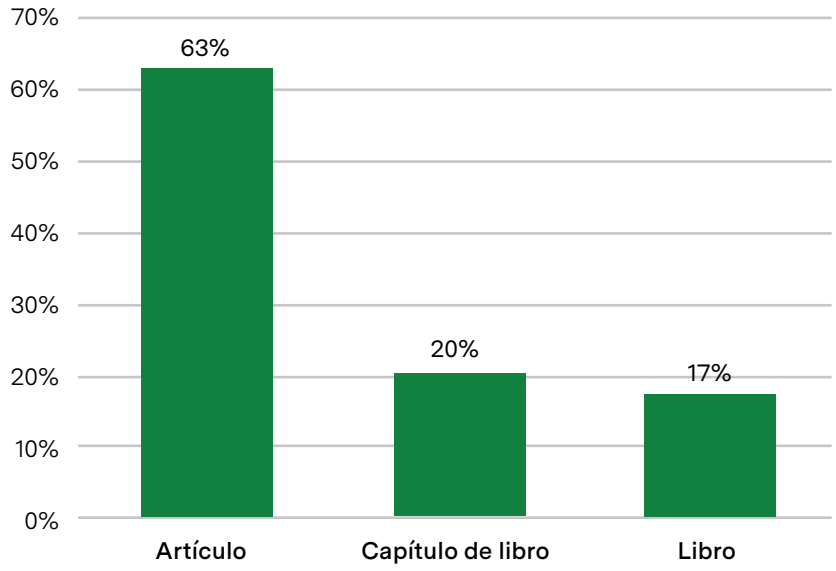


Note: Data from Scopus (2025)

According to Figure 6, the breakdown of production by type of document reveals that scientific articles constitute the majority of the total (63%), book chapters occupy second place with 20%, and books with 17%.

Figure 6

Publication of documents by type



Note: Data from Scopus (2025)

Figure 7 shows the results of a data filter that finds phrases that appear three or more times in the titles, abstracts, and keyword lists of the publications considered. To facilitate the identification of each set of phrases based on the strength of their association, VOSviewer uses a color code.

· Green cluster. "Creativity" (n=58 occurrences): this cluster constitutes the most robust core of the thematic map and articulates concepts linked to the cognitive and emotional processes that underpin creativity. The presence of terms such as emotion, divergent thinking, working memory, and creative cognition indicates a neuropsychological approach focused on the brain mechanisms involved in generating original ideas and innovative problem solving. Likewise, the mention of children as a recurring category suggests a special focus on the development of creativity in early stages and its relationship to school learning. Taken together, this cluster reflects a research axis that links emotions, cognition, and creativity as pillars of integral educational development.

· Yellow cluster. "Neuroscience" (n=46 occurrences) focuses on the application of neuroscience in artistic and therapeutic contexts. The co-occurrence of psychology, emotions, art therapy, art and stress reveal an interdisciplinary trend that combines contributions from affective neuropsychology and artistic neuroeducation. The research grouped in this block tends to explore how aesthetic and emotional experiences influence emotional self-regulation, resilience, and well-being. This approach aims to understand creativity not only as a cognitive ability, but also as an emotional and therapeutic process mediated by brain plasticity.

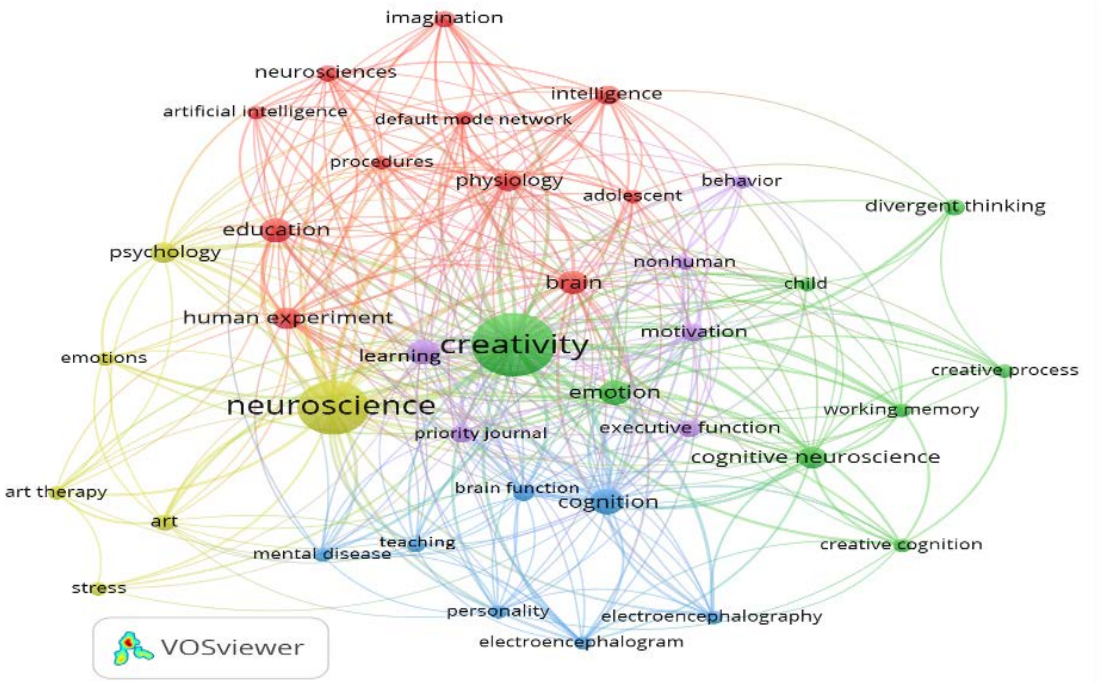
· Red cluster. "Education" (n=39 occurrences) is related to neuroeducation applied to educational contexts, highlighting a growing interest in the physiological and neurological processes involved in learning. The words brain, adolescent, intelligence, imagination, and default mode network suggest the search for neural correlates of creative thinking and intelligence. The presence of artificial intelligence indicates an emerging convergence between neuroscience and educational technology, within the framework of education 4.0. Taken together, this cluster represents the link between neuroscientific research and pedagogical practice, aimed at designing learning environments based on neurobiological evidence.

· Blue cluster. "Cognition" (n=35 occurrences) focuses on higher mental processes and their relationship to health and learning. Concepts such as brain function, teaching, mental illness, personality, and electroencephalogram indicate an interest in the neurophysiological basis of cognition and its impact on academic performance and psychological well-being.

This group reveals research that uses neurophysiological techniques (such as EEG) to explore the relationship between brain activity, cognitive styles, and educational performance, strengthening the link between experimental neuroscience and pedagogy.

· Purple cluster. "Learning" (n=29 occurrences) addresses the motivational and executive processes involved in creative learning. The words executive function, motivation, behavior, and priority diary (possibly referring to metacognitive records or reflective diaries) reflect an interest in self-regulation, planning, and adaptive behavior. The term "neo-human" can be interpreted as an emerging category related to the development of higher skills within the framework of humanistic neuroeducation. This cluster integrates contributions from cognitive neuroscience and motivational psychology to understand how the brain learns, self-motivates, and transforms through meaningful experiences. The grouping shows that the objective of the study is related to the research terms.

Figure 7
Co-occurrence of keywords



Note: Results in VOSviewer (2025)

According to the keyword analysis (Figure 7), brain functions such as cognition, executive function, working memory, and divergent thinking are strongly correlated with creative thinking in the classroom, according to a review of the relevant literature on the subject. These functions are in turn affected by the student's emotional state, personality traits, level of motivation, and behavior patterns. Likewise, research in cognitive neuroscience and psychology has shown that exposure to creative expression, whether through art therapy or other forms of creative expression, can improve the quality of learning by reducing stress, increasing empathy, and sparking the imagination. Consequently, the cognitive processes and neural circuits involved in creative cognition can be studied in great detail thanks to Artificial Intelligence. This global knowledge motivates innovative approaches to education, with an emphasis on mental health, IQ growth, and the development of creative abilities based on neuroscience.

DISCUSSION

Between 2000 and 2025, 139 studies on neuroscience and creativity in education were published, of which 14 (10.1%) correspond to 2021. Scientific production is mainly concentrated in the United States, the United Kingdom, and

Italy, which shows that participation from other countries is still limited. Several recent studies confirm that pedagogical approaches based on knowledge of the brain enhance creative processes in learning (Arias & Bastidas, 2021; Sagñay, 2024; Zarria et al., 2025). Among the most influential authors are Trevarthen, C. and Barbot, B., whose contributions on human communication, skill development, and creative ideation have helped to consolidate the field and highlight its geographical and theoretical diversity (Barbot, 2018; Trevarthen & Delafield-Butt, 2013).

The main institutions involved in research on neuroscience, creativity, and education belong to leading faculties in psychology, cognitive neuroscience, and education, including the University of Pennsylvania, Southern Oregon University, and the University of Edinburgh, recognized for their leadership and academic production in the field (Guamán et al., 2025). These affiliations reflect the importance of institutional financing in promoting multidisciplinary research (Bejarano et al., 2025). Likewise, the journals American Psychologist, Frontiers in Human Neuroscience, and Frontiers in Psychology are the most productive in this line of study, hosting methodological, theoretical, and empirical debates on how a deeper understanding of the brain can transform education and foster creativity (Soriano-Sánchez & Jiménez-Vázquez, 2023). In addition, the field has diversified with publications in Arbor, International Journal of Psychoanalysis, and Journal of Consciousness Studies, which address creativity from neuroscientific perspectives.

According to the reviewed literature, five predominant thematic areas have been identified: psychology, social sciences, medicine, arts and humanities, and neuroscience (Batista et al., 2024; Fragkaki et al., 2022; Nabar et al., 2020; Xue et al., 2025; Kenett et al., 2020). These fields attract the most research attention when addressing cognitive development, neuroplasticity, neural networks associated with creativity, and the influence of emotions and motivation on learning. They also analyze neuroscience-based pedagogical approaches and their impact on students' academic and creative performance (Vigoa et al., 2023). Taken together, the evidence allows us to understand creativity as a cognitive function supported by brain connections (Gómez-León, 2020).

Incorporating neuroscience findings into the classroom allows for the creation of environments that stimulate creative thinking (Ruiz & Kwan, 2020). Teaching students to think creatively and experimentally activates the areas of the brain related to invention and problem solving (Vega & Esteves, 2023; Arellano et al., 2021). In other words, creativity arises from the balance between the brain regions linked to cognitive thinking and spontaneous actions.

In recent years, there has been a growing dissemination of educational policies and technical documents based on neuroscientific research, demonstrating an interest in integrating brain science into educational practice (Araya-Pizarro & Espinoza, 2020). This convergence between neuroscience and education has led to a deeper understanding of the mechanisms that drive creativity and how to enhance it in the classroom (Fiallos et al., 2023). Pedagogical approaches based on brain functionality strengthen students' autonomy, motivation, adaptability, and creativity in the face of today's challenges (Soto et al., 2022).

CONCLUSIONS

According to the stated objective of the study, a bibliometric analysis of all papers indexed in Scopus from 2000 to 2025 revealed an upturn in research highlighting the importance of creativity and neuroscience in the classroom, with the largest upturn occurring between 2017 and 2024 (54%; n=75). The United States accounts for 29.2% (n=50) of the total global production among the 38 nations studied, and about 74% of the papers published on this topic were written in English. Furthermore, a deeper immersion in the data showed that of all the authors listed, Trevarthen, C. received 185, and of all the sources listed, Frontiers in Psychology had the five most relevant publications.

On the other hand, of all the phrases analyzed with VOSviewer, "creativity" appeared 58 times, making it the most frequent. But the words "neuroscience," "education," "cognition," and "learning" stand out as essential concepts because they appear often in the studies. Similarly, a review of the 139 documents in the study reveals that neuroscientific discoveries that incorporate creativity into the classroom, neurocognitive methods of dissident thinking,

and the study of the creative brain are the main areas of research.

Finally, it is concluded that there has been an uptick in scientific output since 2017 in the field of neuroscience and creativity in education, with 22% of publications addressing this topic coming from the field of psychology. The link between the topic and participating institutions, author collaborations, and the availability of bibliographic references is also demonstrated. The results show that there is a new group of researchers doing important work that will help sustain research in the future.

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Original draft writing: **DIHO-HECC**

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