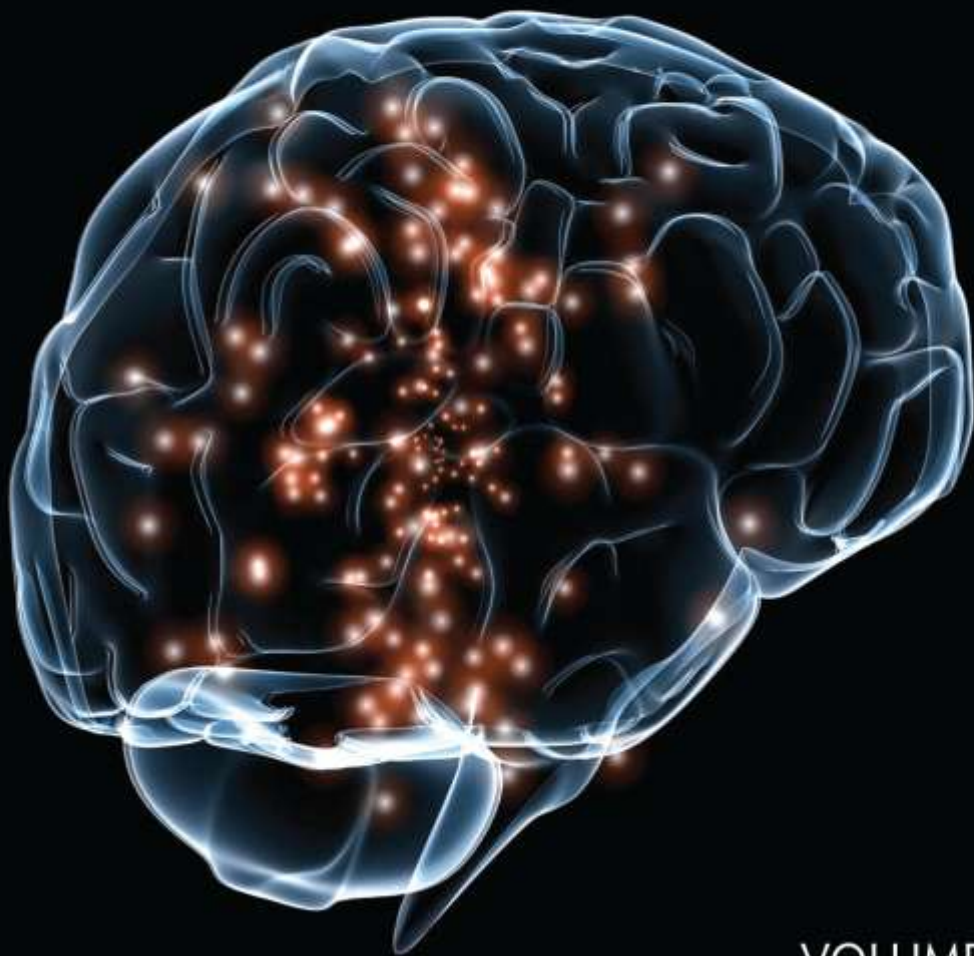


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Mapping the Neuroeducation Landscape: A Bibliometric Analysis (2020–2025)

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Abstract

Background: Neuroeducation is an interdisciplinary area of study which combines insights of neuroscience, psychology, and education to enhance learning, using the body of scientific knowledge regarding the brain. Even though scholars have already investigated different details related to neuroeducation, thorough bibliometric research in the area remains absent.

Summary: This review will provide a conceptual framework that will be used to analyse neuroeducation studies published in 2020–2025 on a medical database that would be accessed through Dimensions AI. The analyses involving VOSviewer of co-authorship, co-citation, and keywords in relation to 1,507 peer-reviewed articles were assessed. Key contributors, institutions, and theme clusters are suggested in the study. The United States, Canada and Spain became the leading contributors whereas such researchers as Antonopoulou Hera and Steve Masson made a significant contribution to the field.

Key Message: The current bibliometric analysis gives us a vivid picture of the development of neuroeducation, its trends, and collaboration which can be used by educators, researchers, and policymakers when establishing the global network of research and filling the conceptual divide between neuroscience and practice in education.

Keywords

Neuroeducation, bibliometric analysis, educational neuroscience, VOSviewer, research trends, co-authorship networks

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Introduction

Neuroeducation is an interdisciplinary approach at the interface of cognitive neuroscience, psychology, and education that seeks to improve or enhance education. Neuroeducation can provide scientific strategies and techniques that will change the way things are done in the classroom by understanding how memory is stored, how learning is generated, how we respond to stimuli, information is processed, etc. At present, as teachers increasingly look for evidence-based teaching strategies to enhance student learning, educational research is turning its attention to how the brain learns.^{1,2} Although neuroeducation is gaining interest, its implementation within schools remains sporadic. The dissemination of ‘neuromyths’, misconceptions regarding brain functioning and the misinterpretation of significant research findings, is worrisome.^{3,4} It is, therefore, important to try to get a clearer picture of where neuroeducation research is heading and what

the main contributions are. Some reviews of neuroeducation exist, but bibliometric studies characterising the field by outlining its structure, growth, and central themes are lacking. It allows scholars and policymakers to spot important contributors and publications, as well as patterns to be explored more empirically. Bibliometric methods not only help to identify key authors, institutions, and developing fields of research, but also aid researchers, educators, and policymakers in their strategic choices (Figure 1).

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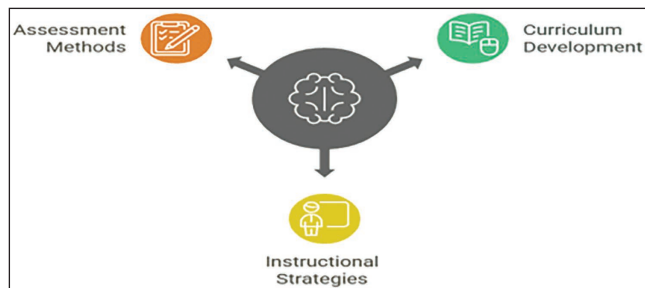


Figure 1. Impact of Neuroeducation.

Given the post-pandemic trend of digital and neuroscience-centric teaching, a bibliometric point of view is timely and needed. This study aims to address an important gap by examining neuroeducation literature through analyses of studies published between the years 2020–2025 using Dimensions AI data. Through the examination of co-authorship, co-citation and co-keyword analysis, we point out novel findings related to the field's growth worldwide as well as bring attention to potential interdisciplinary work opportunities.

The Evolution of Neuroeducation

The reasons for the development of neuroeducation as a specific area of research is beginning to be recognised as pertaining to an increased awareness of brain research and its implications for better understanding how we could teach more efficiently and effectively.⁵ Initial research in neuroeducation examined the neurobiological foundations of learning, investigating questions related to memory, attention and executive function and their influence on performance by students.⁶ These initial studies have set the stage for applying neuroscience to the classroom, and evidence-based practices like spaced repetition, retrieval practice, and multisensory learning are starting to take hold.⁷ A portion of the neuroeducation and pedagogical techniques are presented in Figure 2.

Neuroeducation receives criticism due to difficulties researchers encounter when transforming neuroscientific evidence into real-world teaching approaches. The main difficulty arises from turning intricate neuroscientific findings into something usable within actual educational environments. The analysis of recent research demonstrates how interdisciplinary collaborations, together with learning process comprehension, have resulted in the development of trainer accreditation programs beneficial for neuroscience principles implementation.⁸ Neuroeducation research in the future will improve both theoretical models and practical testing of neuroscientific principles while establishing better pedagogical foundations through neuroscience studies. Researchers assess neuroeducation through three methods of analysis, including publication patterns combined with citation networks and thematic clusters, which help reveal important contributors and essential studies alongside upcoming

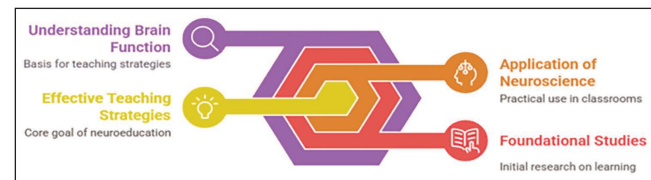


Figure 2. Neuroeducation and Teaching Strategies.

neuroeducational subject matter.⁹ These insights enable researchers to gain better knowledge about the field's development path by showing where new research opportunities lie and vacant areas need attention. The article conducts a thorough evaluation of neuroeducation research supported by bibliometric analysis to identify important research patterns together with key works and themes throughout its development. The combination of research findings from academic databases creates this article's aim to establish an enhanced understanding of how neuroscience affects educational theories and practices. These discoveries have implications for the educators, together with policy makers and researchers, who attempt to establish links between brain science and educational practice.

The Need and Significance of Bibliometric Analysis in Neuroeducation

There exists research that explores the conceptual and applied aspects of neuroeducation, but the literature lacks uses of bibliometric analysis to track how this research field has evolved. A bibliometric analysis becomes essential for promoting neuroeducation through its capability to study growth patterns and illustrate key participants, and reveal research deficits.^{10,11} Studies using bibliometric approaches in cognitive neuroscience and educational psychology fields have already proved these methods efficient for tracking research trends and directing research directions. A bibliometric analysis covering the full scope of neuroeducation research exists as the primary goal of this study. A bibliometric analysis of neuroeducation research creates several important uses that benefit the field. The analysis reveals field advancement patterns through which major research findings affect the growth rate. It reveals dominant authors together with organisations and publications, which demonstrate key contributors in research alongside their respective centres. The analysis method promotes co-citation linkages and keyword studies, allowing researchers to uncover inherent subject areas and probable future research pathways. The academic community's view on neuroeducation research can be assessed through bibliometric indicators, which include citation networks and h-index scores and journal impact factors. The worldwide expansion of neuroeducation emerges through collaborative connections that unite researchers together with institutions while focusing their work on global multidisciplinary research ventures and international research projects.

Review of Related Literature

Definition of Neuroeducation

The academic field of neuroeducation combines neuroscience with psychology and pedagogy in order to understand how the brain develops at different life stages while examining its impact on learning processes. Brain scientific research investigates both learning capabilities and emotional regulation, together with information processing and storage functions, while studying reactions to various stimuli and behavioural conditions.¹² The concept of brain plasticity, which is also known as neuroplasticity, serves as the base for understanding how the brain responds to environmental stimuli^{13,14} explains how new information processing by people depends on their personal genetic makeup and environmental exposures. According to neuroscience understanding newborn babies possess almost all neurological elements that will remain forever present. Because of great neuronal plasticity at their early age, children should get early stimulation during their first three years to reach higher brain levels and develop knowledge absorption abilities.¹⁵ Knowledge acquisition through brain plasticity allows the creation of slowly developing neuronal network patterns known as Hebbian networks. The established connections help advance neural networks because they enable network expansion while strengthening existing neural networks to support learning.¹⁶

This knowledge regarding the learning process of the brain represents important tools for teachers to innovate learning in their classrooms, making it more effective and meaningful. Therefore, an adequate implementation of neuroeducation requires teachers who not only have the appropriate training within their field but also possess basic knowledge regarding neuroscience to generate a positive impact on educational programs by improving their teaching methods.¹⁷ Currently, it is important to disseminate scientific discoveries in the field of neuroscience, especially to teachers. This is so that they can make use of them in their work, as well as to combat problems such as neuromyths, understood as misconceptions about the mind and the brain.¹⁸

Future Directions in Neuroeducation Research

As the field of neuroeducation continues to expand, future research should focus on longitudinal studies that assess the long-term impact of neuroscience-based interventions in classrooms. Advancements in artificial intelligence and brain-computer interfaces may also open new possibilities for personalised learning and cognitive enhancement. Moreover, fostering stronger partnerships between neuroscience and education will be crucial in translating research findings into practical strategies that benefit diverse learners.

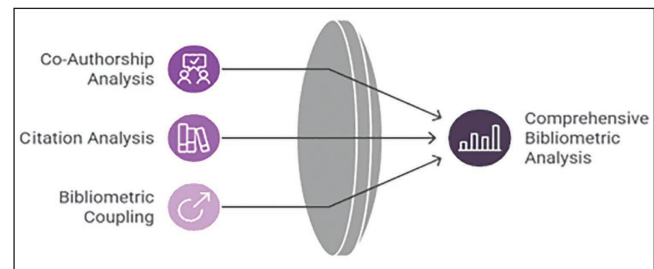


Figure 3. Types of Analysis.

This review of related literature provides a comprehensive overview of the key themes in neuroeducation, offering valuable insights into its neuroscientific foundations, applications, challenges, and future directions. Researchers and academics have conducted numerous studies on the effectiveness of neuroeducation, its various dimensions and methodology. In the last few years, there has been a significant growth in this subject. In this study, an in-depth analysis of research on the Neuroeducation dataset was conducted using Dimension AI's database. Dimension AI is an authentic and advanced research database that provides detailed information on various scientific publications, for example, network patents and research papers. This bibliometric analysis involves three (as shown in Figure 3) dimensions, Co-Authorship Analysis, Citation Analysis and Bibliometric Analysis, which are explained in the diagram below.

Objectives

A holistic bibliometric investigation of worldwide neuroeducation research from 2020 through 2025 serves as the purpose of this study to address an essential information deficit. Specifically, the study objectives are:

1. To identify distribution of publications in essential journals within the neuroeducation field over the years 2020–2025.
2. To analyse publication patterns and academic output from neuroeducation studies in research areas.
3. To examine co-authorship, citation analysis and bibliographic coupling networks for analysing partnership patterns.

Methodology

Research Design

The study data originated from Dimensions AI which maintains a detailed record of academic peer-reviewed publications. The research period spanned from 29 March to 31 March 2025 to perform the search using 'neuroeducation' throughout the title abstract and keywords fields in the Dimensions AI database. This study examined publications from 2020 to 2025 because researchers wanted to understand contemporary

developments since the pandemic while the field of neuroscience-based education experienced increased focus.

Data Source and Search Strategy

The study data originated from Dimensions AI which maintains a detailed record of academic peer-reviewed publications. The research period spanned from 29 March to 31 March 2025 to perform the search using 'neuroeducation' throughout the title abstract and keywords fields in the Dimensions AI database. This study examined publications from 2020 to 2025 because researchers wanted to understand contemporary developments since the pandemic while the field of neuroscience-based education experienced increased focus.

Sample and Data Collection

The researchers used VOSviewer to analyse 1,507 peer-reviewed English research papers that met specific criteria

regarding their availability of citation data. The step-by-step process for data collection is explained in Figure 4.

Study Selection and Data Management

The first search yielded articles which grouped various AI terms and computer science curricula, mainly involved AI research rather than AI technology implementation in higher education. After initial screening of search results, the researcher inspected publications to establish which met the criteria for inclusion in the included phase. The researcher conducted a review of 3,803 abstracts and titles to establish which ones detailed the possibilities of Neuroeducation. VOSviewer 1.6.19 received 1,507 publications from the 3,803 publications in this phase for subsequent bibliometric evaluation. The extracted CSV Excel format data contains the final information from 1,507 articles gathered through Dimension AI. The dataset contained information about keywords, together with citations and abstracts and

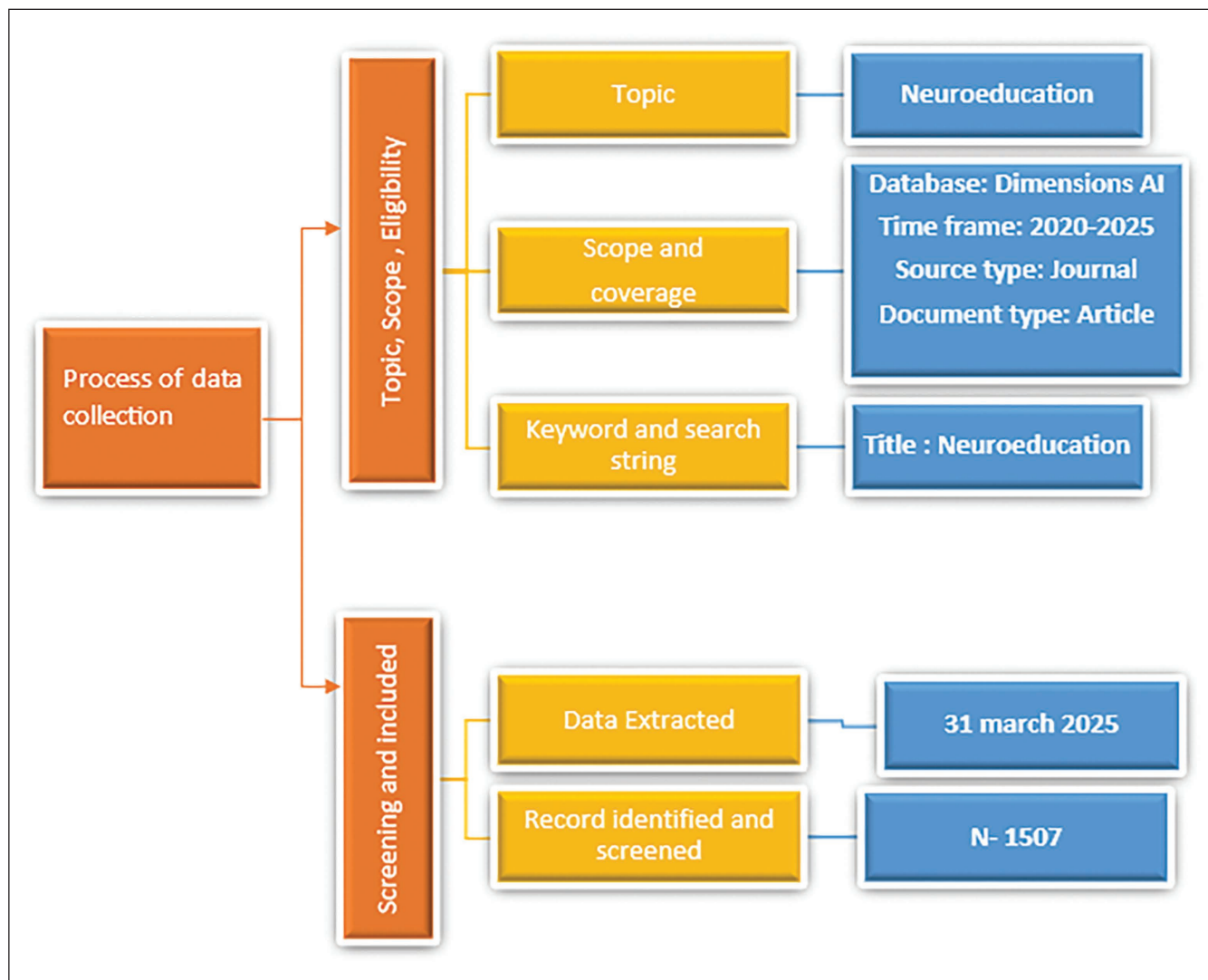


Figure 4. The Search Strategy Flow Chart Diagram Adapted from Zokaria et al. (2021).

bibliographic and funding details. The data migrated to VOSviewer 1.6.19 through a user-friendly graphical interface of the free software application.¹⁹

Data Processing and Analysis Tools

The dataset was exported in CSV format and analysed using VOSviewer (version 1.6.19), a widely used software for constructing and visualising bibliometric networks. The following types of analysis were conducted:

- Co-authorship analysis (authors, institutions, countries)
- Citation analysis (authors, organisations, countries)
- Bibliographic coupling (authors, institutions, countries)

These analyses allowed for the identification of high-impact contributors, thematic clusters, and collaboration networks.

Data Analysis

The research started with evaluating publication distributions according to yearly patterns and geographical locations, and journal metrics alongside citation counts. The analysis covered all available information in dimensions AI before exporting it to Excel for visualisation through VOSviewer. The analytical tools portrayed network representations starting from co-authorship between authors and their countries and institutions, followed by co-occurrence keywords and co-citation of authors with their references through VOSviewer software.

Limitations

The broad coverage of Dimensions AI database extends to many publications but does not contain all research materials recorded in Scopus and Web of Science. Research limitations occur when studies are restricted to English documents because it reduces the study's ability to produce results that apply to non-English territories.

Results

Objective 1. To identify the distribution of Publications in essential journals within the neuroeducation field over the Years 2020–2025.

The obtained findings have been developed from the research objectives. The study findings are organised in tables and figures to demonstrate them. Distribution of Publications over the Years. The search for 'Neuroeducation' revealed 3,803 publications according to the research results. The Dimension AI (Figure 5) database published the 2,294 targeted documents from 2020 to 2025 in its collection. The following section reveals the study results.

These are the combined number of edited books, chapters, articles, monographs, preprints, and 76 proceedings

also (as per Table 1). The outcomes of this study are presented below.

Objective 2. To analyse publication patterns and academic output from neuroeducation studies in research areas.

The research category (subject categories) interested in Neuroeducation appears in Figure 6. Education stands as the principal research field, generating 1,130 articles from 2020 to 2025 in all publications. The subject area 'Psychology' achieves position two while 'Biomedical and clinical science' ranks as number three, with their total publications being 565 and 305, respectively.

Objective 3. To examine co-authorship, citation analysis and bibliographic coupling networks for analysing partnership patterns

The bibliometric research examined 1,507 publications from the years 2020 through 2025, which were published in the field. VOSviewer served as a tool to perform network analysis and visualisation for the purpose of collecting and visualising networks between analysis types and units of analysis.

Co-authorship Network Analysis

The bibliometric techniques used for co-authorship network analysis achieve specific identification of every aspect within scientific cooperation networks. The acknowledgement of multiple authors or organisations through an official declaration comprises co-authorship. Co-authorship networks portray countries along with organisations and authors as nodes, which demonstrate their involvement in joint research (Figures 7–9).

Co-authorship Analysis – Countries

The analysis of country co-authorships in Figure 7 displays information regarding publications within Dimension AI database publications from 2020 to 2025 until the present time. The visual representation consists of circular nodes that portray countries with dominant forces displayed through expanded circle sizes. The link between country names in the network assumes collaboration between these nations. The strength of international collaboration is directly related to the thickness of the links between nodes, while their separation determines the level of collaboration. The researchers applied particular threshold criteria, including author limits at 25 per document, along with author document requirements of 2, as well as zero author citations. The analysis of co-authorship between countries took shape when VOSviewer executed these specific filters that produced the following figure.

The bar chart (Figure 10) shows two measurement types to display countries' overall document link strength, using blue bars for document number and an orange line for total link strength. The large number of documents from Spain strongly suggests a highly integrated research network because of its strong connection strength. Research papers, along with link

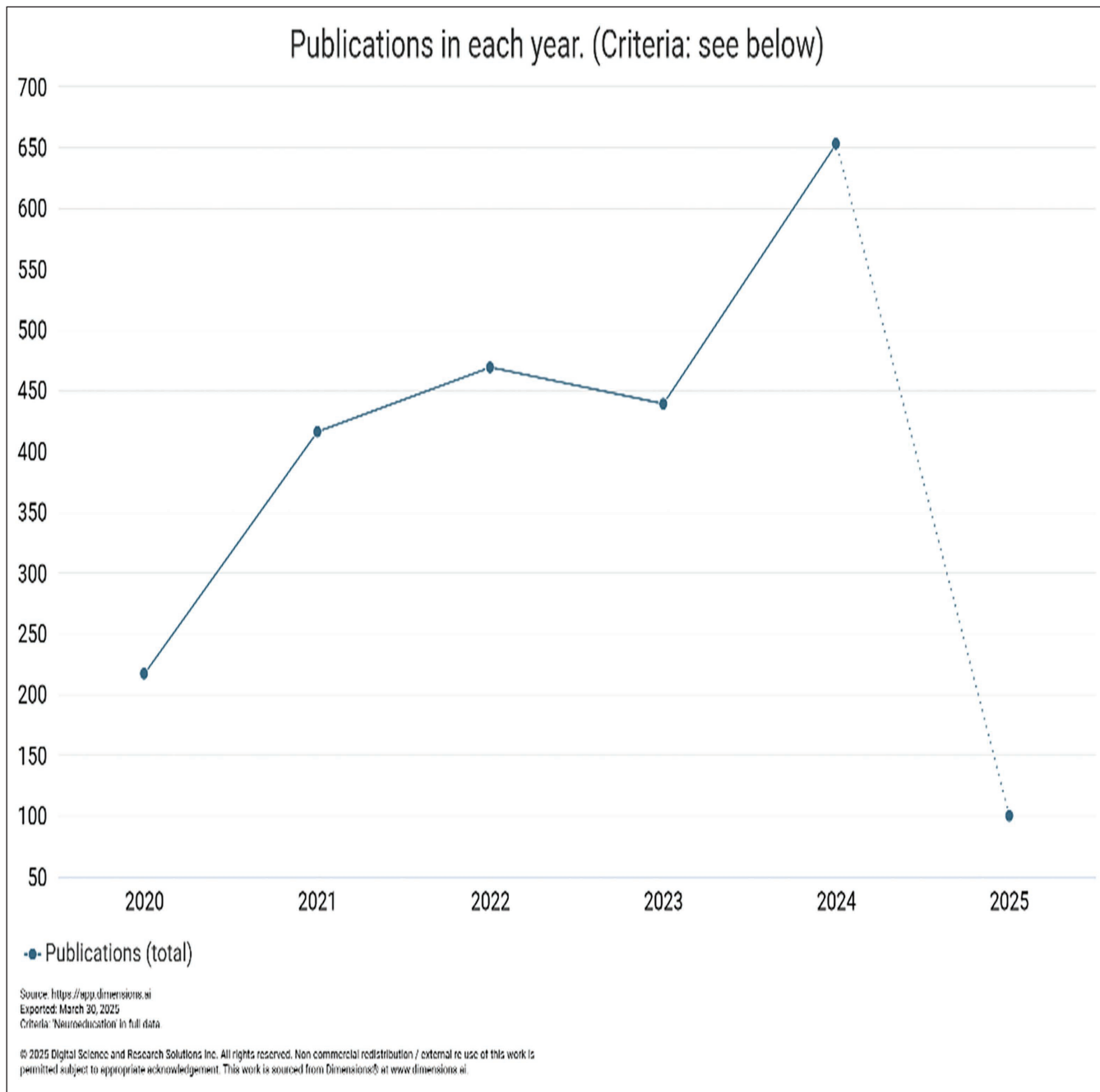


Figure 5. Here Is the Graph Show the Distribution of Publications Between 2020 And 2025 Year Only.

Table 1. Document Types with Their Publication Among the 2020–2025.

Document Type	Total Publications (TP)
Articles	1,507
Chapters	469
Edited books	158
Monographs	46
Preprint	38
Proceeding	76

strengths, support that both the USA and Canada and China demonstrate active research participation. Germany, equivalent to Italy, shows similarities with Greece alongside the UK in terms of document count and network strength capability. Conversely, nations with lower document numbers and poorer connection strengths—such as Portugal, Australia, and Hungary—indicate fewer integrated research contributions. The chart reveals how different nations vary in their research document creation levels and their mutual research connections throughout the world.

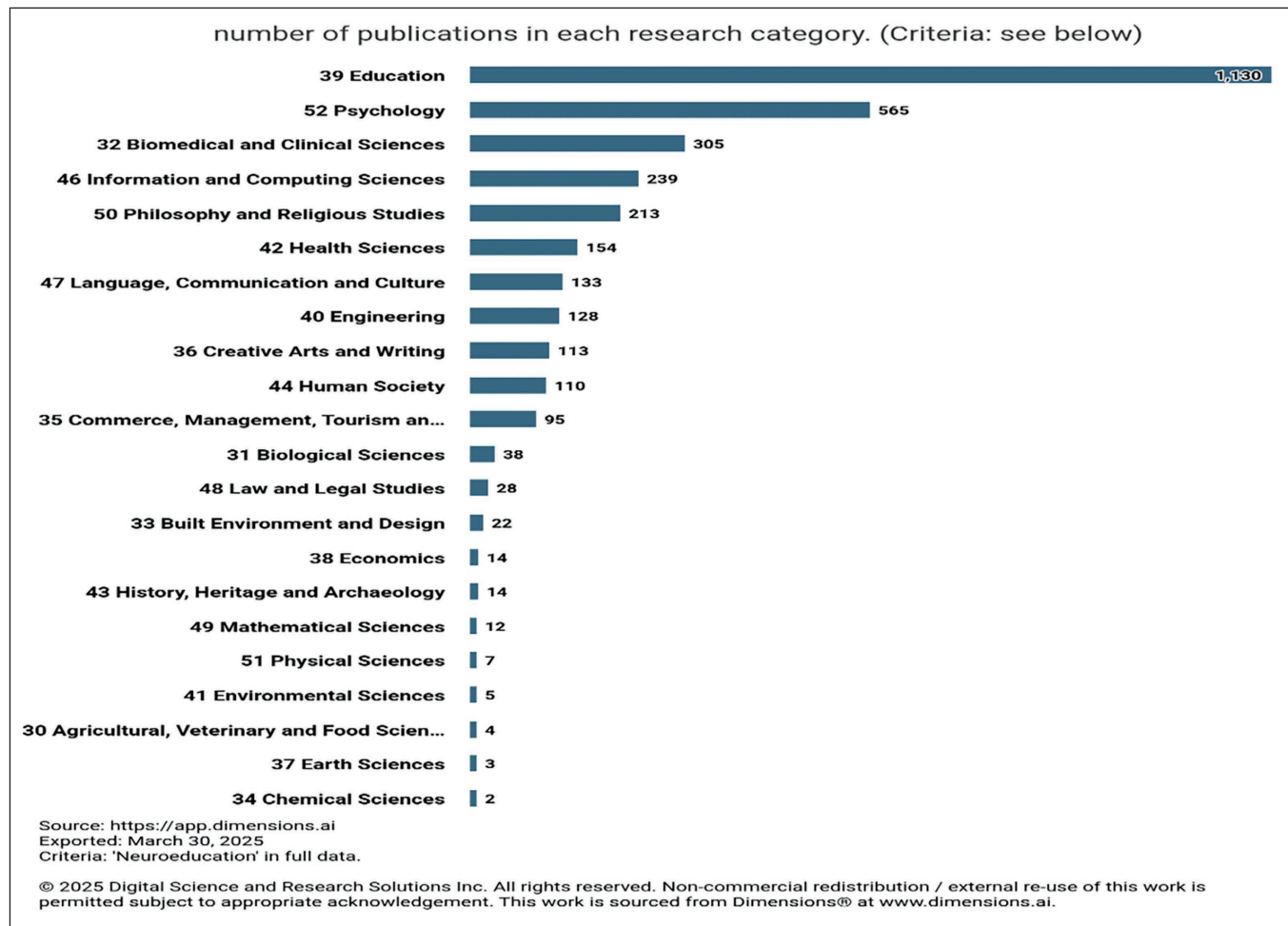


Figure 6. Publication in Neuroeducation According to Research Areas.

Co-authorship Analysis – Organisations

The co-authorship relationships between organisations present themselves through the diagram in Figure 8. The researcher defined particular limits for this assessment, where documents needed to have at most 10 authors and at least 2 documents authored by one writer, together with zero citations connecting authors to the research. The applied filters within VOSviewer allowed it to select 298 organisations from the filtered dataset that appear in the figure. The 298 organisations included in the filtered data appeared through VOSviewer filtering process in Figure 8.

Figure 8 represents a co-authorship network map generated by VOSviewer which serves as a common program for bibliometric data analysis. Nodes function as circles to represent institutions that show their research partnership connections through the visualisation. Each institution's research partnerships have a strength based on their node size because larger nodes indicate more established collaborative relationships. The visualisation presents groups of universities which collaborate closely by dividing them into different coloured

sections. A visual representation of co-authorship ties uses lines (edges) that establish between nodes which become longer when the cooperation strength intensifies. Three universities stand out through their massive nodes which indicates their importance as leading institutions in this research collaboration network. Universities operating within the same academic area or geographical region jointly conduct research projects through their university clusters. For instance, 'University College London' functions together with 'Universidade de São Paulo' as part of separate cooperation clusters from each other. The numerous tiny grey nodes indicate that the institutions have spread across a wide area while maintaining less co-authorship relations. The visual map represents educational institutions which show high involvement in campus-based research development and scholarly writing. The larger the node and the thicker the connecting lines, the stronger and more frequent the collaboration. Visualising academic collaboration between international institutions and identifying major institutions within research disciplines represent the main advantages of this type of visual analysis.

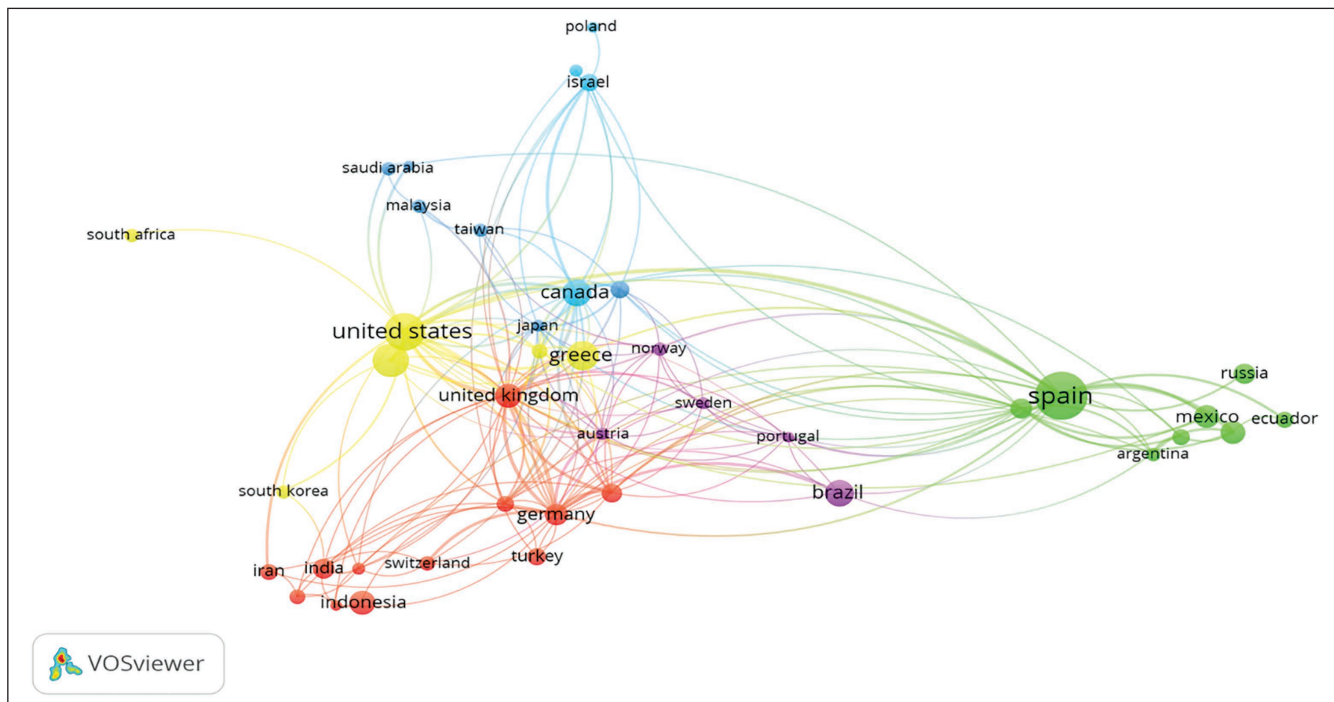


Figure 7. Network of Co-authorship Among Countries.

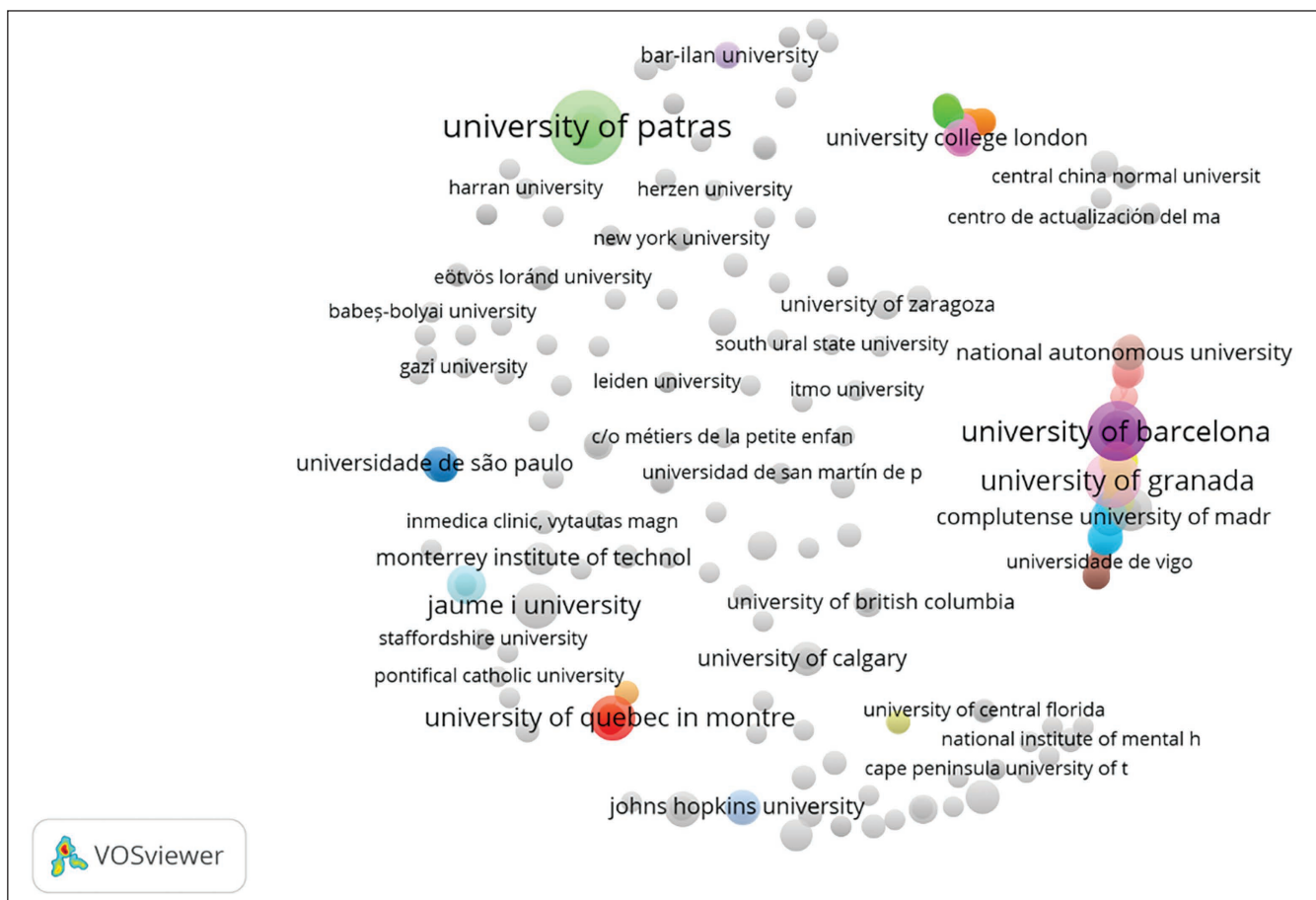


Figure 8. Network of Co-authorship Analysis Among Organisation.

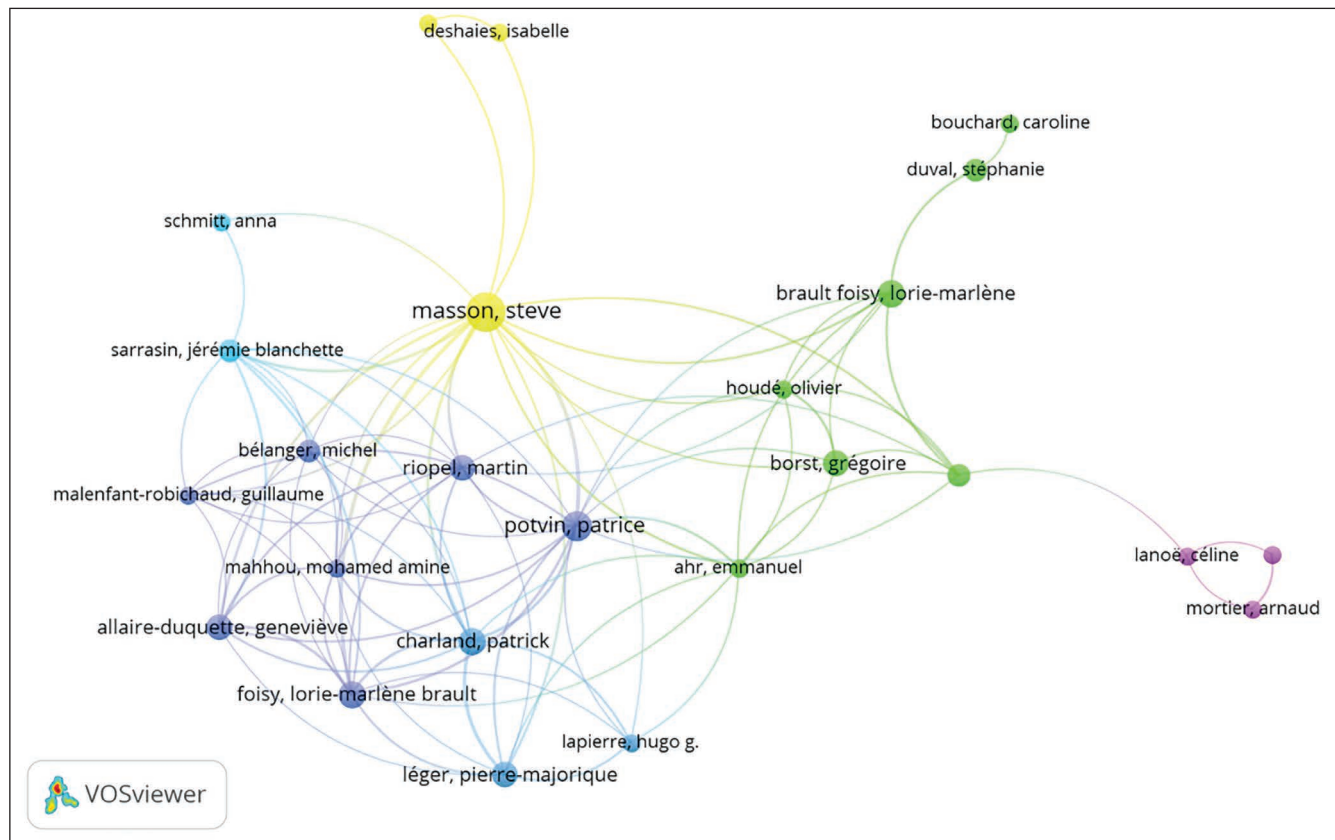


Figure 9. Network of Co-authorship Analysis Among Authors.

Co-Authorship Analysis – Authors: The co-authorship network analysis for authors displays its visual representation in Figure 9. Research teams must meet a particular threshold requirement with two documents as minimum criteria to proceed with the analysis. Administered investigation to 4,050 scholars revealed 25 interconnected authors within 330 writers who met the requirement of co-authorship. The following image displays the data that passed through the filtering process.

Figure 9 visualises academic co-authorship through VOSviewer because it displays a network based on scholarly research collaborations. The diagram contains one node representing each individual researcher who connects to others through edges that indicate co-authored publications teamwork links. Different colour segments represent researcher groups that conduct their studies in separate organisational settings. Steve Masson has a leading position in the yellow collaboration network because of multiple direct connections that demonstrate his strong teamwork drive. Strong scientific collaboration networks exist between Grégoire Borst's (green cluster) scientists and those within Patrice Potvin's (blue cluster). The blue cluster formed by Martin Riopel and Patrick Charland demonstrates the strongest research network relationships among clusters, that includes the yellow and green clusters. Arnaud Mortier and Céline Lanoë make up the purple cluster, and their segregated position suggests their

absence of professional interaction with the main research network. As a visual tool, it helps users to recognise future multidisciplinary teaming possibilities as well as recognise key influence points within the collaboration framework. Part of this system shows how some scholars perform only within their special circles, but other researchers act as bridges across groups. The research findings can support academic institutions and researchers to launch interdisciplinary ventures and build better information sharing methods and academic alliances.

Citation Network Analysis

tracks how knowledge moves through academic research domains through analysing publication references that serve to connect one document to another. A VOSviewer representation consists of nodes representing either documents or authors or journals or organisations with structured edges establishing citation relationships between documents whenever one text references another. The number of citations radiates influence toward articles and authors and organisations based on the size of the nodes. The thickness of edges between nodes represents the frequency of citation connections, thus indicating the strength of relationship. The graphic segmentation divides into coloured clusters that display linked entities frequently cited by their members among

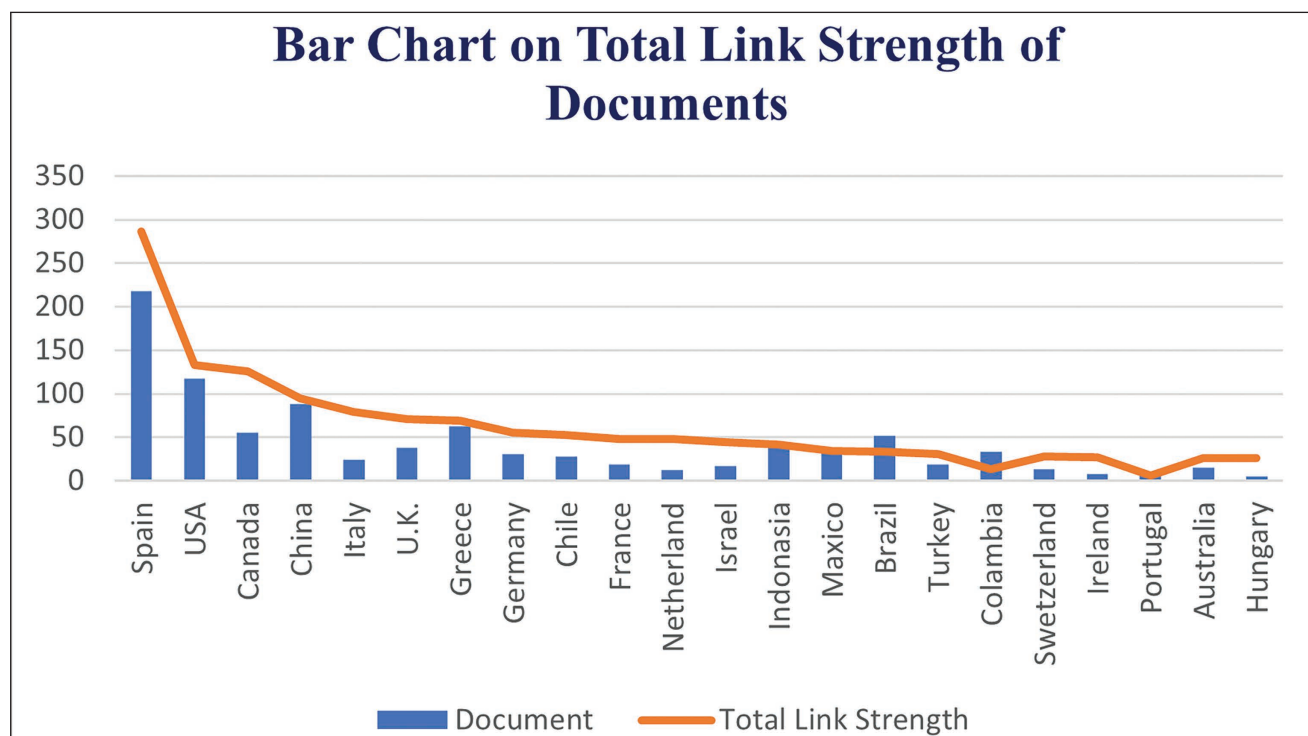


Figure 10. Total Link Strength of Documents.

authors, institutions or works. Fundamental research, together with important theorists, creates a significant influence on an area, and these influential entities demonstrate their influence through enlarged node representation. Research studies become more accessible to understand and analyse through citation network analysis, which helps users track influential studies along with concept development and research fields. This method enables researchers to access vital publications directly and evaluate their research value, along with understanding various field interrelations.

Citation Analysis – Countries

Research based on citation analysis measures the academic impact of national scholarly outputs by tracking their frequency of citations within academic fields. The visual representation of citation rates among nations appears in Figure 11. The researchers designed a threshold requirement for this study, which mandated a minimum of five research papers per nation but limited the number of included countries per document to 25. Since researchers established their threshold level, only 42 out of 88 nations met it, while four cluster networks were developed based on connected nations.

Figure 12 illustrates academic citation counts by country, with intensity of blue shading indicating higher citation counts. The darker shades indicate countries with higher numbers of citations, and lower numbers are represented by lighter shades. The darkest blue area seems to be occupied by

Russia, which would indicate a greater number of citations, along with other countries such as Argentina and some others in North America and Oceania, that have a more moderate number of citations. The rest of the world remains largely uncoloured, Africa and the Middle East in particular, indicating few or no citations recorded within this dataset. The scale of colours to the right represents a gradient from 11 to 1,534 citations. The figure reveals not only the areas where research contributions are dense, reflecting a greater impact in the academic field worldwide by those countries, but also where lower citation activity is occurring.

Citation Analysis – Organisations

Citations by organisation refer to frequencies of citations in order to measure an institution's scholarly impact. Figure 13 shows the citation network between organisations. As shown in this analysis, they set a threshold level with a maximum of 5 documents per country and a maximum of 25 documents per country. The generated clusters, corresponding to the connected organisation of the world, only show 4 clusters, of which only 45 organisations are inside the threshold level among 1,582 organisations formed.

Table 2 demonstrates the noteworthy contributions made to neuroeducation research by a number of universities. With 48 published articles, 458 citations, and the greatest overall link strength of 116, the University of Patras stands out as a significant participant, demonstrating widespread

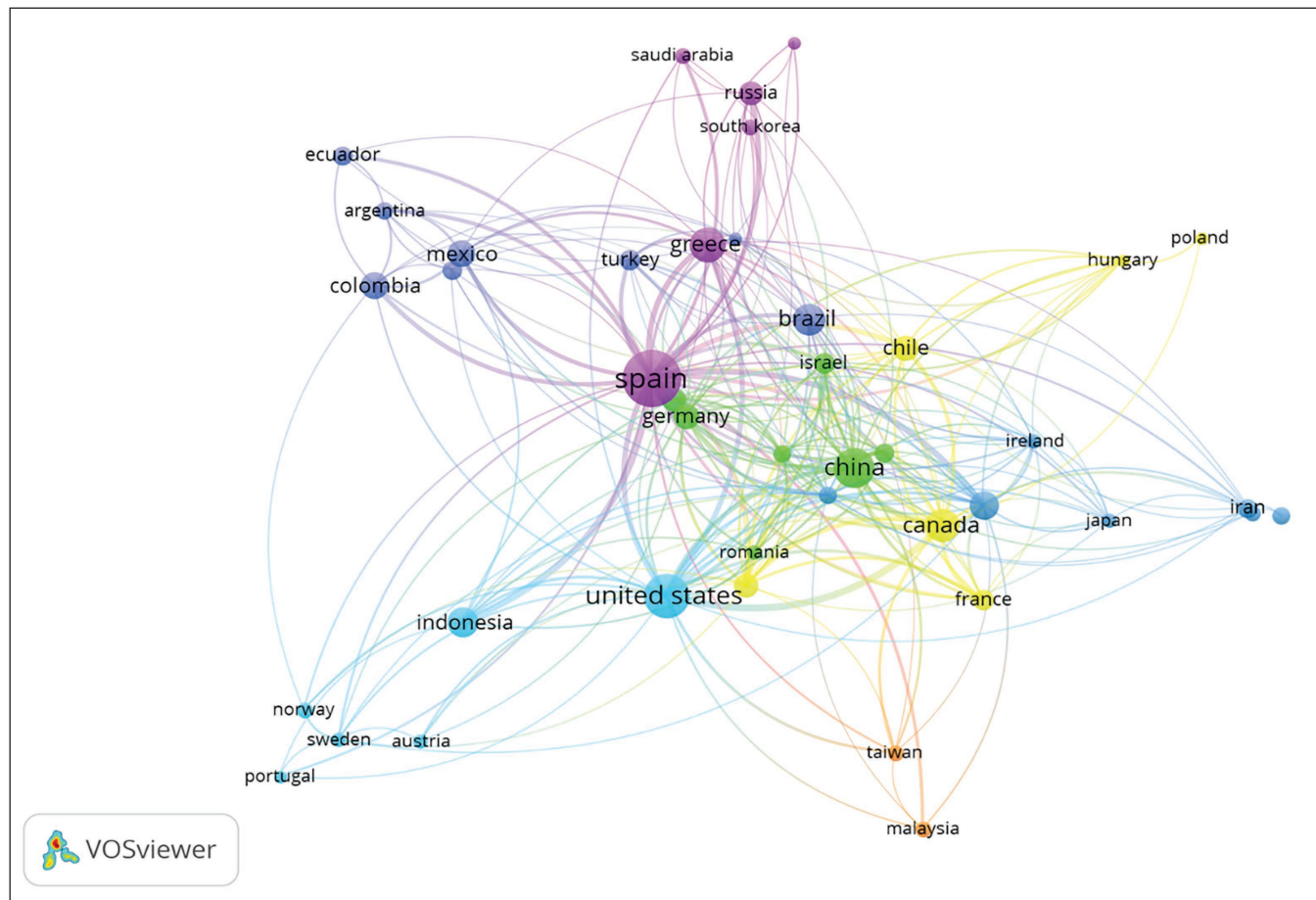


Figure 11. Network of Citation Analysis Among Countries.

collaboration and substantial scientific influence. The University of Granada comes in second with 24 publications, 191 citations, and a total link strength of 36, indicating a modest level of influence in the subject.

Remarkably, a number of primary schools have shown their engagement by contributing eight articles each, with 19 citations and a total link strength of 34. These include Agios Vasileios and Vlachopoulou, and the elementary school of Patras stand fifth with 6 publications and 14 citations and 24 total link strength.

Citation Analysis – Author

By examining how often a researcher's work is mentioned by others, citation analysis of authors assesses the influence of particular researchers. Figure 14 displays the citation network among authors. The researchers employed the default threshold, ruining a maximum of 25 authors per document and minimum no. of documents of author 5 per documents. Among 4,050 authors, only 25 authors meet the threshold. In the presented network diagram (Figure 14), different colours represent groups of different authors. This network can be divided into a total of five groups.

The higher overall strength of the links is Antonopoulou, Hera, with 228, meaning that this character has the strongest connections and influence in the network, as per Table 3. Fourteen documents and 303 citations support this. Evgenia Gkintoni and Constantinos Halkiopoulou also have the same values in total link strength, Gkintoni = 196 and Halkiopoulou = 195. Halkiopoulou has fewer documents, whereas Gkintoni has a little bit more citations. Eleni's documents, citations and overall link strengths are much lower than the other three writers, Kalogeratos, Gerasimos, and Anastasopoulou; there is less of a network influence for Eleni. From this information, we can get a picture of the relative influence and connection of these writers within their industry. Among them, those of Antonopoulou, Hera, are the most influential. Among this network, Kalogeratos and Anastasopoulou have more limited impact, though Halkiopoulou and Gkintoni also have some relevance in this network. Likely, 'total link strength' is a measure that considers both the number of citations by an author and how relevant his or her work is to the other authors' work in the field. Such analyses may be useful for understanding dynamics of particular fields, such as identifying key scholars or information flow, as well as disciplines. From VOSviewer, a possible software used to

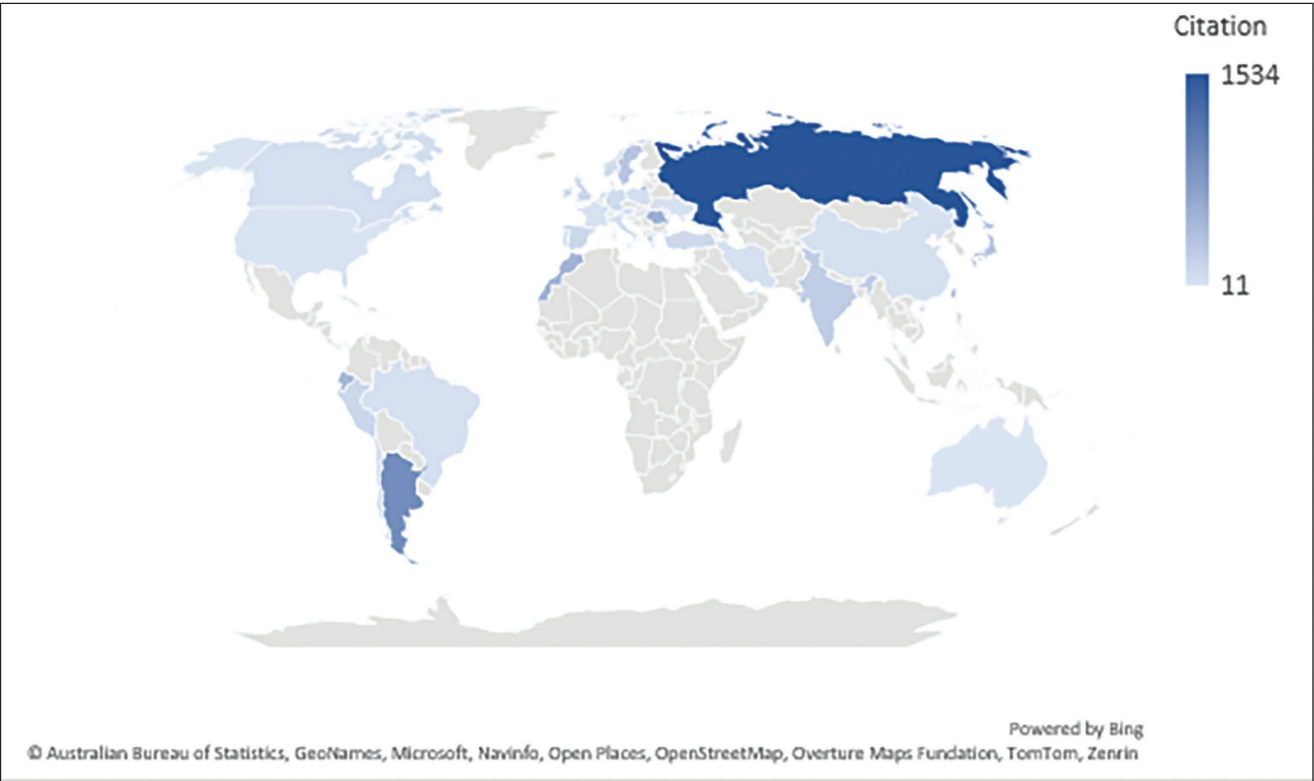


Figure 12. Citation Map of Different Countries.

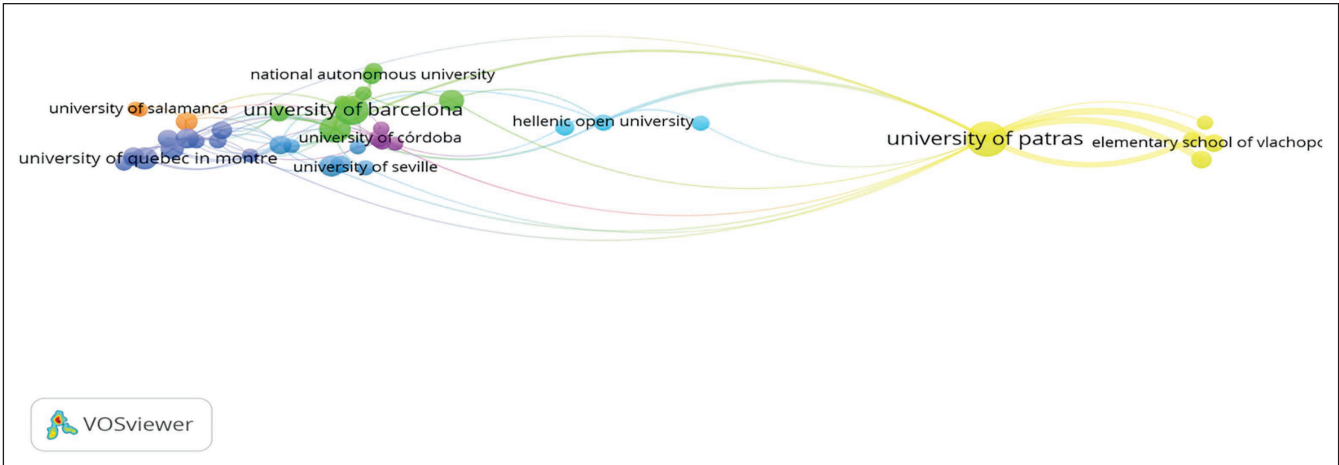


Figure 13. Network of Citation Analysis Among Organisations.

Table 2. The Top Five Organisations with the Greatest Total Link Strength in Network Analysis of Citation Analysis of Organisation.

Organisations	Documents	Citations	Total LinkStrength
University of Patras	48	458	116
University of Granada	24	191	36
Elementary school of Agios Vasileios	8	19	34
Elementary school of Vlachopoulo	8	19	34
Elementary school of Patras	6	14	24

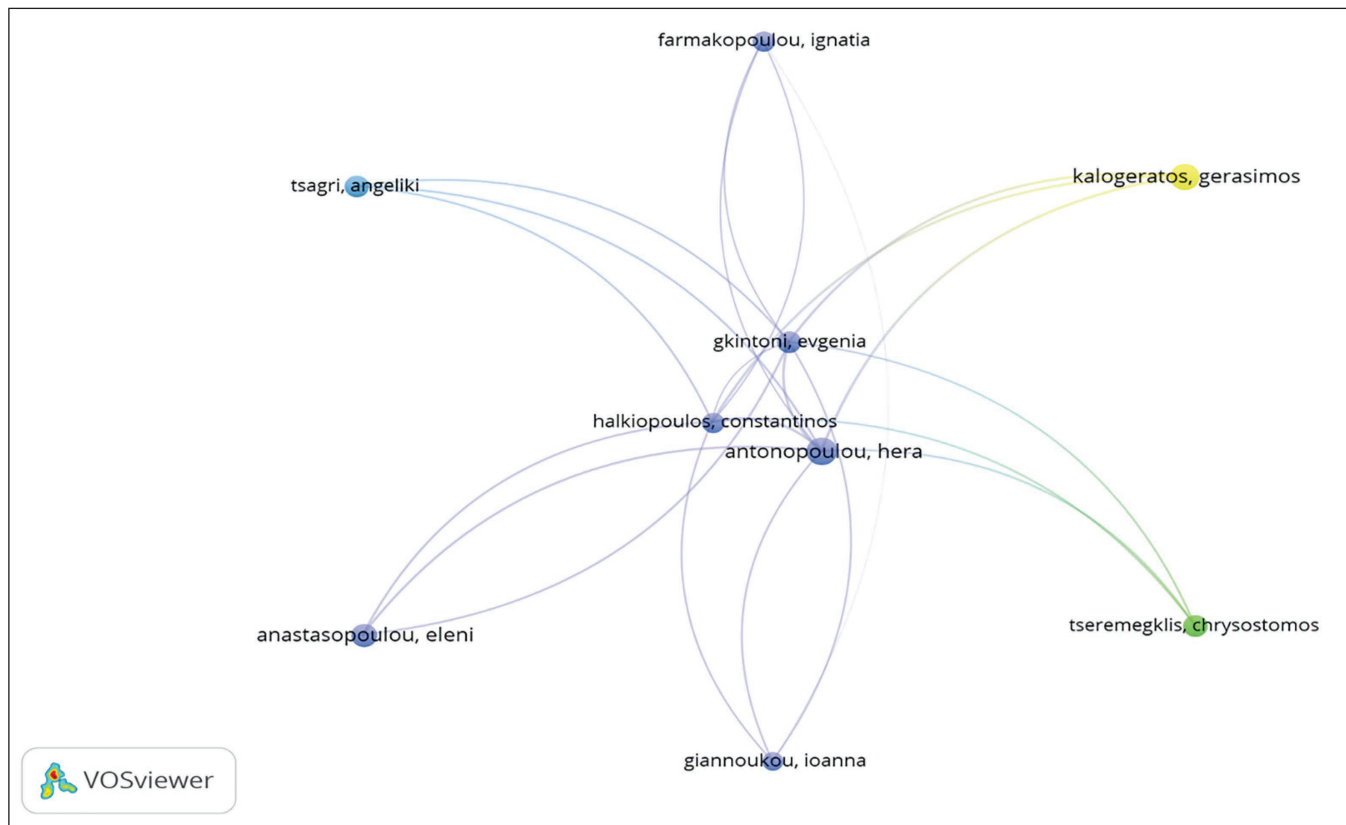


Figure 14. Network of Citation Analysis Among Authors.

Table 3. Top Five Authors with Greatest Total Link Strength in Network Analysis of Citation Analysis of Authors.

Authors	Documents	Citation	Total Link Strength
<i>Antonopoulou, hera</i>	14	303	228
<i>Halkiopoulos, constantinos</i>	6	230	196
<i>Gkintoni, evgenia</i>	7	232	195
<i>Kalogeratos, gerasimos</i>	11	25	114
<i>Anastasopoulou, eleni</i>	9	22	90

create the network map shown in Figure 14, the connections amongst the various components are more evident. From the provided information, it appears to be a bibliometric analysis, possibly dealing with co-authorship in the field of higher education inclusion. Some of the central nodes, such as ‘gkintoni evgenia’, ‘halkiopoulos constantinos antonopoulou, hera’, and ‘kalogeratos, mos gerasimos’, seem to be key researchers or concepts in this field. The connecting lines show relationships or partnerships; the colour or thickness of the line may indicate how strong the link is. ‘Farmakopoulou, ignatia’, ‘tsagri, angeliki’, ‘anastasopoulou, eleni’, ‘tseremegklisaghrysostornos’, and ‘giannoukou, ioanna’ are examples of peripheral nodes that could stand for similar writers or subjects that have less direct relevance to the main themes.

Bibliographic Coupling Network Analysis

Bibliometric coupling demonstrates the reference-based interconnection between two research papers. Through this method, it becomes straightforward to determine the degree of research connection within the keyword domain. TMPro helps researchers understand the research patterns and examines the relationship between contemporary research and its past iterations. Bibliometric Coupling enables researchers to evaluate connections between academic papers and references while showcasing essential topic developments in Neuroeducation. Researchers employed only the Author and Country nodes from the Bibliometric Coupling because these elements contained records of author and country collaboration activities.

Bibliographic Coupling Analysis – Countries

The bibliographic coupling analysis between countries appears in Figure 15 as displayed in Figure 14. The researchers set definite criteria for this analysis to include maximum 25 countries in each document and at least five documents from each country. Worldly nations can be classified into only four interconnected clusters because 42 and 88 countries satisfy the established threshold for intercountry collaboration. Figure 16 uses shared third-party source citations to display ‘Bibliographic Coupling Among Countries’, which demonstrates the importance of academic partnership. Strong academic research connections show as extensive blue sections because overall links maintain a strength between 419 and 11,614.

This VOSviewer visualisation depicts worldwide research collaboration through nation nodes and edges representing co-authored article connections between countries in Figure 15. The colour grouping indicates related research networks, while the nodes’ diameters signify research output or significance of each nation. The United States, along with Spain and Indonesia, emerge as an important international connection centre that links to many nations in different research clusters. The blue cluster shows strong research connections between Western countries since it combines the United States with the United

Kingdom and Germany, and Canada within its network. The green cluster demonstrates strong organisational ties among Scandinavian and Japanese, and French countries, while the yellow cluster shows how South American nations, as well as Mexico and Spain, work together. Russia and Indonesia form a separate research network part, which stands out as the purple cluster. Research communities globally adhere to each other through specific linkages that select countries support between different research areas.

Bibliographic Coupling Analysis – Organisations

Organisations connected through bibliographic coupling analysis Figure 17 showcase research and institutional ties because it evaluates how multiple institutions reference common scholarly publications. Figure 17 demonstrates the bibliographic coupling analysis of organisations through the same chart shown in Figure 14. The researchers established thresholds for this analysis, requiring at most 25 countries per document and a minimum of five documents per country. Four clusters have formed from 45 world organisations, while the total number of organisations used for analysis amounts to 1,582.

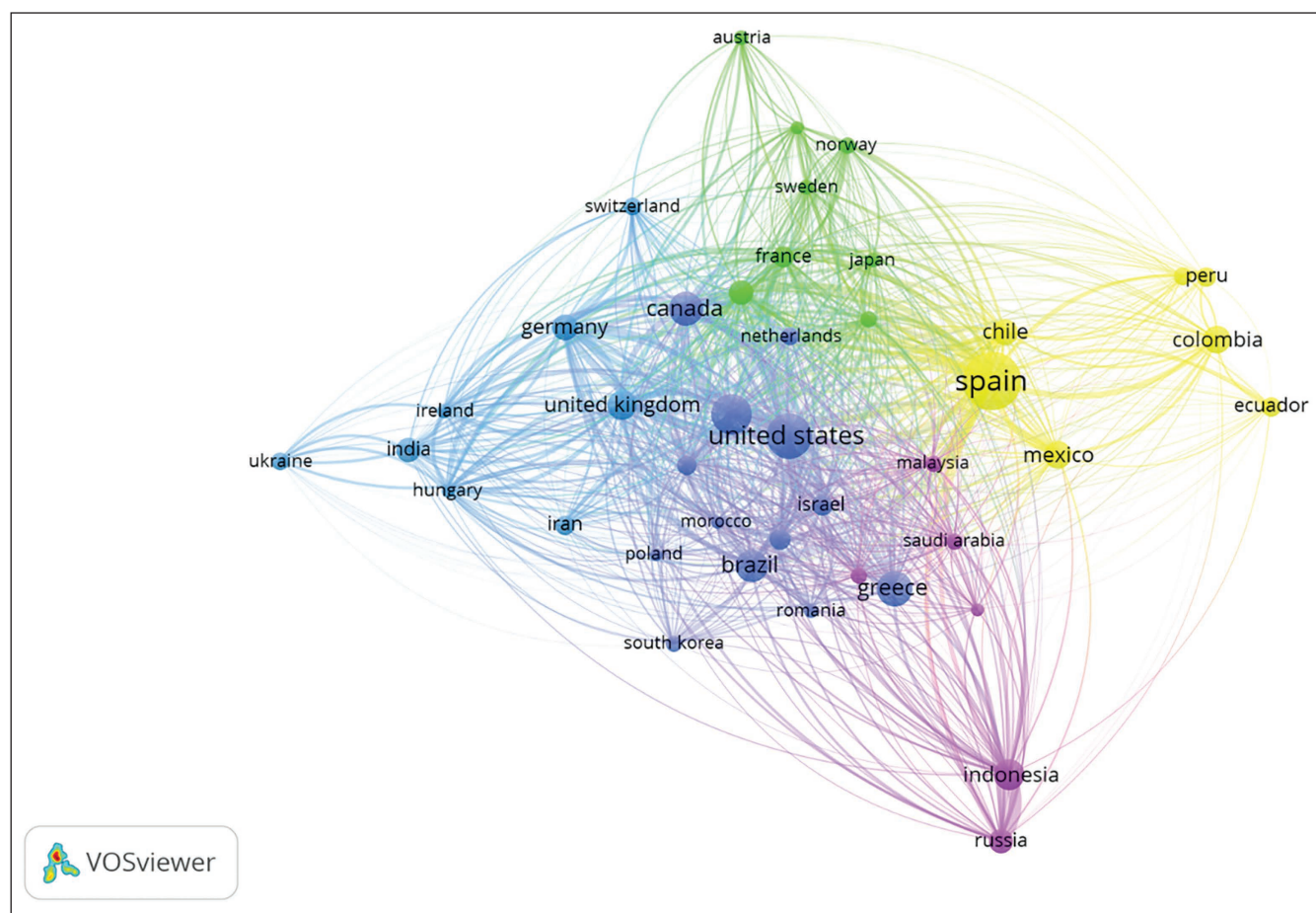


Figure 15. Network of Bibliographic Coupling Analysis Among Countries.

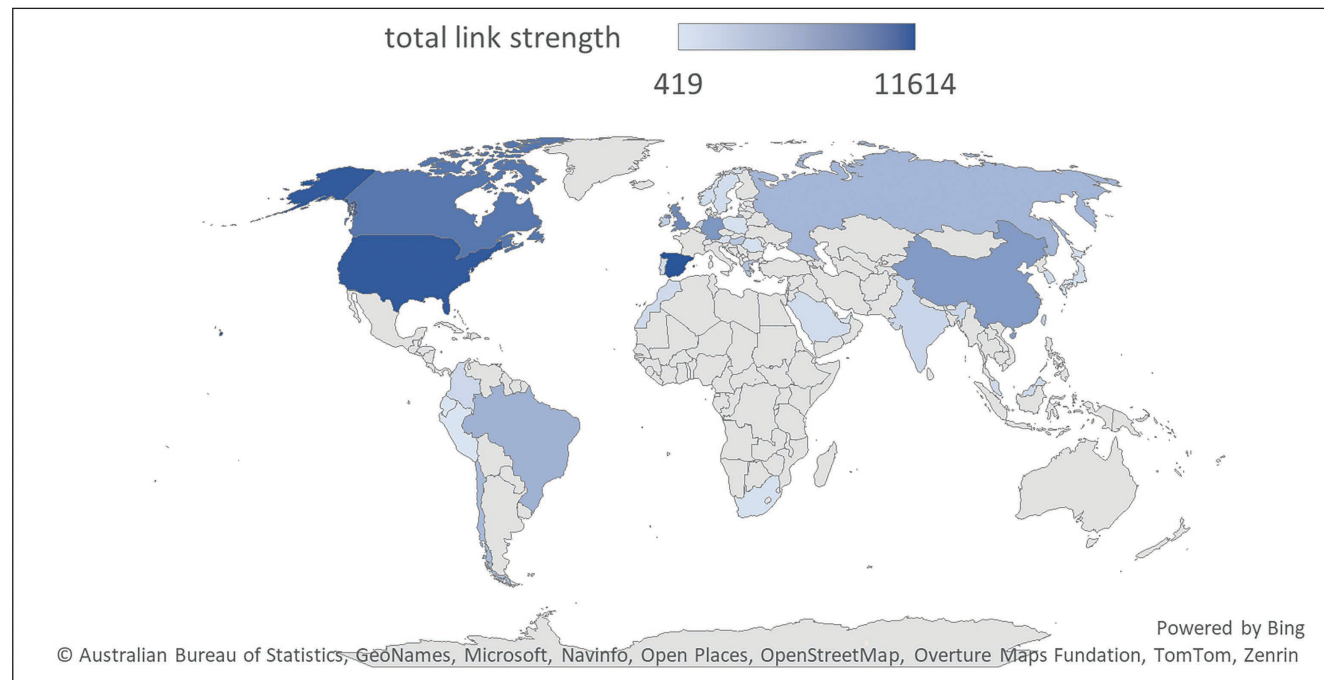


Figure 16. Bibliographic Coupling Among Countries.

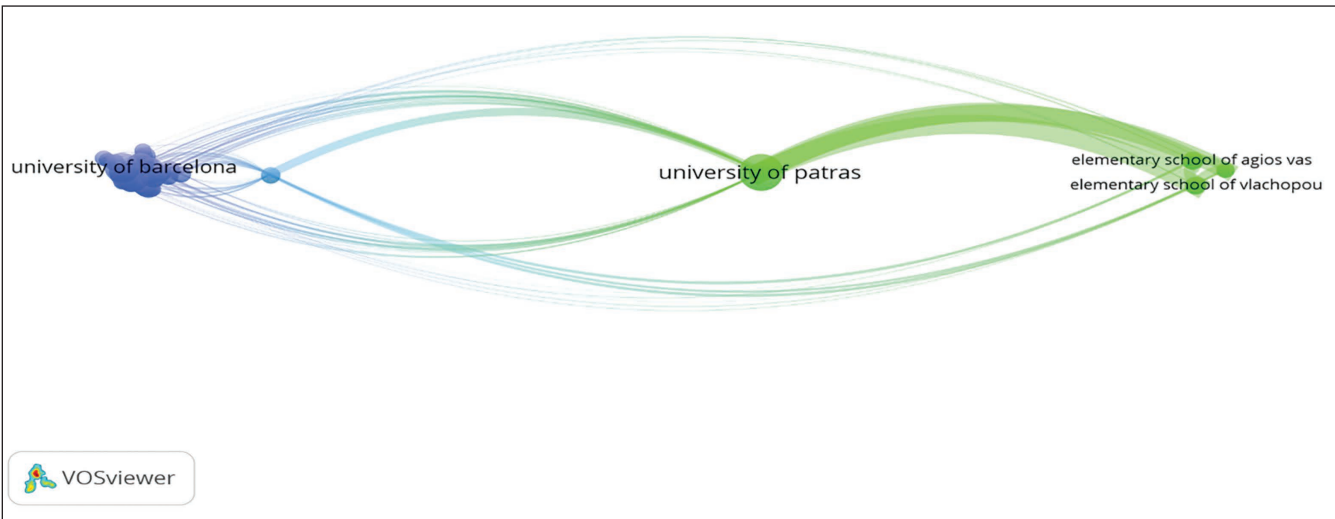


Figure 17. Network of Bibliographic Coupling Analysis Among Organisations.

The visualisation in Figure 17 shows institutional collaboration through bibliometric networks using VOSviewer whereby institutions connect through edges such as collaborative projects and co-authored publications in this network diagram. This network features the University of Barcelona as its blue cluster alongside the University of Patras operating as its green cluster. The strong number of research connections demonstrates their successful research partnership. Research activities at the school level seem to exist between the University of Patras and its two primary schools located in Agios Vas and Vlachopou based on substantial academic

connections. The edges linking the University of Patras to elementary schools appear the thickest, thus indicating their strongest connections. This depiction enables researchers to identify important institutional relationships along with research collaboration pathways between different academic and educational institutions.

Bibliographic Coupling Analysis – Author

Figure 18 represents the bibliometric coupling author network diagram that Dimension AI processed from its obtained

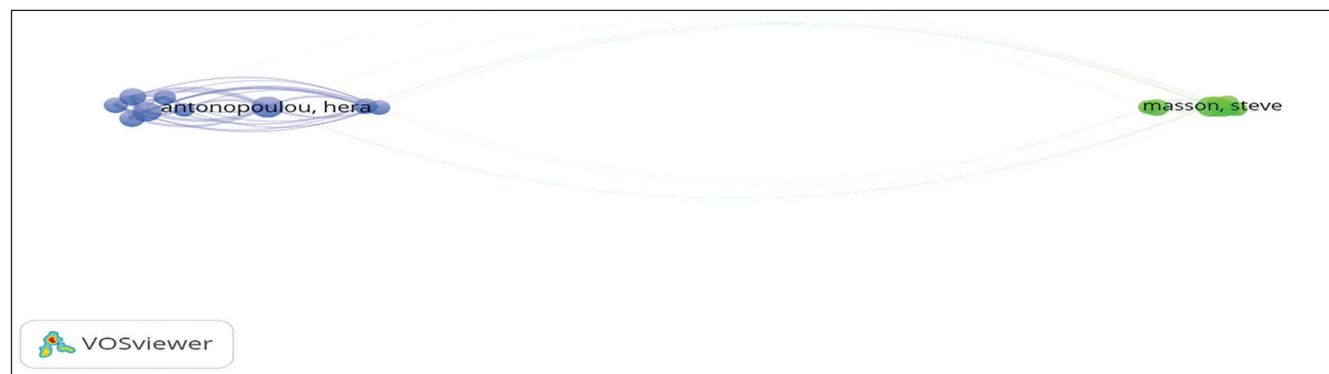


Figure 18. Network of Bibliographic Coupling Among Cited Authors.

database. The graphical network shows authors as nodes, while the references between authors become diagram links. The researchers conducted this examination by establishing an exclusive criterion that required authors to have no more than 25 documents and at least 5 articles published in respected journals. The study included 4,050 authors, but just 25 met the set threshold, while 17 items formed links.

The bibliographic coupling between referred authors appears in Figure 18 because of VOSviewer technology. Every researcher appears as a node which contains their identified name. The dimensions of each node reveal both the number of publications an author has published and their citation impact. The research group of Steve Masson occupies a smaller cluster exhibiting fewer connections, yet maintains a green cluster appearance, while Antonopoulou, Hera, appears in a dense blue cluster that indicates strong researcher connections. The nodes represent researchers through visual icons, while edges define their relationship connections, such as co-authorship and citation, through line thicknesses. The two study groups appear unconnected through the weak relationship observed between the blue and green clusters. The visual representation sheds light on author links as well as shows research partnership patterns and quantifies multidisciplinary network connections.

Discussion

Neuroeducation keeps its position as a leading research field because evidence-based teaching methods gain increasing popularity. The research will conduct a bibliometric analysis of neuroeducation research to present an organised development overview alongside major discoveries and identify potential paths for advancement.²⁰ Academics, alongside educators and policymakers, should establish interaction with this emergent field of study because neuroscience integration in education presents great opportunities to enhance learning experiences.²¹

The bibliometric study reveals that neuroeducation applies to education student teaching-learning procedures through

active student involvement. Through its implementation in education, the teaching-learning process receives scientific backing in place of traditional educational approaches. Available findings from these neuroscience studies on teaching brain development and operation offer the prospect of transitioning educational systems toward models based around motivation and emotional activation for building deep learning.²²

Neuroeducation exists as an emerging discipline which remains underutilised due to its limited entry into educational practices. The teacher training curriculum requires ongoing development to introduce neuroscience content during the initial educational phase, which will enable teachers to understand these concepts before applying them in academic settings.²³ Teachers need appropriate training to achieve competence in implementing all neuroeducation-based strategies at their educational sites.²⁴ Studying neuroeducation allows teachers to acquire knowledge which helps them assist students in mastering challenging academic subjects in various disciplines.²⁵

The research dataset for Neuroeducation was retrieved from Dimension AI on 31 March 2025 through a first search of 3,803 articles and then 1,507 research remained for analysis through screening criteria. Network visualisation with VOSviewer version 1.6.19 analysed the extracted database that contained keywords and their cited publications and research abstracts and bibliographic data. The analysis focused on co-authorship networks together with subject classification and publication yearly distribution to examine publishing patterns between 2020 and 2025. Research during 2020–2025 yielded 2,294 published works made up largely of 1,507 articles, together with 469 chapters and 158 edited volumes, 46 monographs, and 38 preprints and 76 conference proceedings. Education stood as the most widely researched topic group based on document count with 1,130 articles among the available publications. The field of psychology maintained the second position with 565 publications, followed by biomedical and clinical sciences with 305 publications. Spain led as the leading donor institution in the co-authorship study, and China, along with the United States

and Canada, exhibited tight research interaction. The University of Patras led an institutional study by establishing research collaborations along with the University of Barcelona and the University of Granada. Steve Masson, Grégoire Borst along with Patrice Potvin received recognition for their significant research influence by individual researchers through extensive collaboration efforts. The examined research provides essential findings about present-day neuroeducation studies while identifying fundamental nations together with prominent writer groups in this academic field. The research demonstrates that neuroeducation is becoming more multidisciplinary while suggesting methods to develop scholarly communication and collaboration.

Also, citation networks used in neuroeducation studies as part of the flow of knowledge analysis, where connections between publications, authors, and organisations were explored via citation linkages. VOSviewer was employed to create visual representations of this study's citation networks, with larger nodes indicating highly-cited publications, authors, or organisations and thicker edges indicating stronger citation connections between two or more nodes. The other country-level analysis points to Russia amongst the most mentioned countries, followed distantly by Argentina and a couple of other countries in North America and Oceania, while Africa and the Middle East had least citation activity in general. On the organisational level, the three Greek primary schools had smaller but important citation ties, while the University of Patras had the most overall link strength within their clusters, with 116, and the University of Granada had 36. The author-level citation analysis revealed Antonopoulou Hera as the most influential researcher with 303 total citations and highest total link strength of 228. Next, they were Halkiopoulos Constantinos and Gkintoni Evgenia, both connected to strong citation networks. They identified various leading researchers and institutions as well as trends in research globally within this multidisciplinary field, and in which prominent researchers and institutions they found in this interdisciplinary field of neuroeducation.

Bibliographic coupling network analysis examines the connections between spatial units based on common references and has been used to identify trends in research and intellectual connections among publications, authors, institutions, and countries. The bibliographic coupling analysis at the national level indicates the extent to which countries exchange scholarly materials, with US, Spain and Indonesia standing out as research hubs. Coloured clusters illustrate the emerging regional collaborations, mostly a US-UK-Germany-Canada-Western European country cluster, and a second network of South America, Mexico and Spain. Strong bibliographic ties exist between the University of Barcelona and the University of Patras at the institutional level. The latter also works closely with primary schools, indicating field-work or partnerships in educational research.

Author-level bibliographic coupling highlights key authors with similar research backgrounds. Steve Masson, for

instance, belongs to a smaller and lesser interconnected group of researchers, while Antonopoulou belongs to a very well-connected network of researchers. By illuminating the nature of international research collaborations involving institutions and prominent researchers, the analysis provides an informative overview of the progression of knowledge within the discipline. This study performed a bibliometric analysis of neuroeducation research for the years 2020 through 2025, utilising the Dimension AI database. Among these, a total of 1,507 studies were retained for further screening. The saved collection included edited books (158), chapters (469), articles (1,507), and other document types. The most covered area was education (1,130 articles), followed by biomedical science (305), psychology (565) and others. The Bibliographic Coupling Network and Citation VOSviewer were utilised for analysis to create visualisations of collaborative efforts. From citations, some key national contributors were identified, including: US, Argentina, and Russia; as well as key academic institutions like: University of Patras and the University of Barcelona. Author-level analysis revealed influential authors such as Steve Masson, Hera, and Antonopoulou. Research collaborations between nations, institutions, and writers were mapped using co-authorship analysis. Spain has the greatest network connections and the most documents. The University of Patras, the University of Barcelona, and the University of Granada were among the top universities that collaborated. Patrice Potvin, Grégoire Borst, and Steve Masson were instrumental in promoting research collaboration at the author level.

All things considered, the study offers a thorough understanding of how information is created and disseminated in the area by shedding light on international research trends, significant contributions, and scholarly partnerships in neuroeducation.

Conclusion

This research analyses neuroeducation developments which have quickly gained strength during the previous five-year period. The collected data reveals which people and institutions and countries are actively developing the transformative research field. The research revealed positive findings that neuroeducation continues shaping its own specialised discipline through educator and neuroscientist, and psychologist joint ventures. This educational movement intensely supports the development of brain science learning methods and creative teaching methods, as well as enhancing instructor training practices. Our research requires additional filling of certain gaps. Research at this point mainly derives from select few countries along with their top universities, resulting in a potential loss of significant knowledge from worldwide educational settings. Progress in our field requires active integration of new voices, which historically have been underrepresented, especially when coming from locations that remain unnoticed. The

knowledge should move beyond laboratory settings to be implemented in classroom work. The goal should be to convert advanced neuroscientific findings into convenient classroom resources which actual teaching professionals can effectively utilise. Overall, this bibliometric analysis contributes a systematic and timely evaluation of neuroeducation's trajectory, offering both scholars and educators a clearer understanding of where the field has been and where it is heading.

Authors' Contribution

All authors contributed to the study's conception/design and all authors read and approved the final manuscript.

Statement of Ethics

NA.

Declaration of Conflicting Interests

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Informed Consent

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ICMJE Statement

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NA.

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