



## Research on Mixed Methods in Education: A Bibliometric Analysis of Development Dynamics (2003 – 2023)

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### Abstract

In recent years, education consistently has ranked among the fields with the highest use of mixed methods research. However, few researchers systematically have reviewed and have visually mapped the development dynamics of mixed methods research in education. Hence, to address this gap, this article focused on the Web of Science (WoS) category “Education Educational Research,” filtering and downloading 793 English-language articles published from 2003 to 2023 that included “mixed method(s)” or “mixed methodology” in the title. These articles were sourced from two sub-databases within the Web of Science Core Collection: SSCI (Social Sciences Citation Index) and A&HCI (Arts & Humanities Citation Index). Using bibliometric analysis with the R programming language, this quantitative research study primarily examines the scientific production, collaborative networks, research topics, and future trends in mixed methods research in education over the past 20 years. Findings indicate a steady increase in research productivity within the field during this period. Journals and universities emerged as the dominant contributors with respect to sources and affiliations, while the USA, UK, China, and Australia were leading countries in MMR contributions within education. Additionally, the most frequently used keywords, trending topics, conceptual structures, and future directions also are discussed.

**Keywords:** *mixed methods; educational research; bibliometric analysis; development dynamics*

### Research on Mixed Methods in Education: A Bibliometric Analysis of Development Dynamics (2003 – 2023)

As a key factor in both social progress and economic development, the field of education holds a significant position in all countries. It not only is expansive with numerous related disciplines and knowledge, but also encompasses a wide range of participants, such as educators, students, researchers, and policymakers, all dedicated continually to enhancing the quality of education and addressing challenges within the educational sphere. Although some disagreements surround its exact definition, educational research typically is described as a systematic, rigorous and critical investigation of various aspects of education, which enhances knowledge and contributes to society by allowing individuals to lead more enriched lives (McMillan, 2012).

Educational research can take various forms, including quantitative, qualitative, and mixed methods research approaches, and it encompasses a wide range of topics and issues related to

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education. The choice of research methods to investigate and to analyze educational phenomena depends on the specific research questions and objectives. Researchers choose quantitative methods, such as surveys and experiments, for collecting numerical data and establishing statistical relationships; qualitative methods, including interviews and observations, for seeking in-depth insights and understanding of complex educational processes; or mixed methods research approaches with both quantitative and qualitative techniques for a comprehensive view of educational issues (McLaughlin et al., 2013).

### **Mixed Methods Research**

Following quantitative research and qualitative research in chronological sequence, mixed methods research is regarded as the third research paradigm, and a research design with philosophical assumptions and a research method (Askun & Cizel, 2020; Johnson et al., 2007). Following the paradigm wars between 1980 and 1989, the mixed methods research movement progressed through the subsequent three significant methodological stages: “the institutionalization of mixed methods as a distinct methodological orientation (1990 to 2009),” “the emergence of mixed methods research into young adulthood (2010 to 2014),” and “the emergence of integration,” referred to as Mixed Methods Research 2.0 (2015 to the present day) (Onwuegbuzie et al., 2022). The related terms of mixed methods include integrating, synthesis, quantitative and qualitative research methods, multimethod, mixed research, and mixed methodology (Bryman, 2006; Creswell, 2015; Onwuegbuzie & Hitchcock, 2022; Tashakkori & Teddlie, 2010). Through integration across various dimensions, including philosophy, theory, sampling, data collection and data analysis (J. W. Creswell & J. D. Creswell, 2018; Fetters & Molina-Azorin, 2017; Onwuegbuzie & Collins, 2007), it has the potential to leverage the strengths of both quantitative and qualitative research approaches while mitigating their respective limitations.

Given no perfect method, increasingly, researchers attempt to choose mixed methods to design their research, including using both quantitative and qualitative methods to balance their strengths and weaknesses or methods to tackle one or all research questions from various angles (Tashakkori & Creswell, 2007). According to J. W. Creswell and J. D. Creswell (2018), there are three core mixed methods designs (the convergent design, the explanatory sequential design, and the exploratory sequential design) and more complex designs, including the mixed methods experimental design, the mixed methods case study design, the mixed methods participatory–social justice design, and the mixed methods evaluation design and so on.

### **Mixed Methods Research in the Education Field**

What can be considered as the cornerstone of countries, education is a classic research domain, and the state of research in this field will have a profound impact on a country’s competitiveness, and even its survival. The prevalence rate research up to 2010 indicates, apart from the field of nursing, the field of education consistently exhibited the highest levels of engagement in mixed methods research (Onwuegbuzie et al., 2022). However, the three research traditions, quantitative research, qualitative research, and mixed methods research, are unevenly utilized in the overall field of education and its numerous specialized disciplines. Influenced by Western philosophy, quantitative research methods historically have taken the lead in educational research, followed by qualitative research methods. In fact, mixed methods research only has reached the expected threshold, approximately 33% on average, in the discipline of mathematics education (Onwuegbuzie & Corrigan, 2014; Onwuegbuzie et al., 2022). Furthermore, whereas mixed methods research historical has roots dating back to

Aristotle (384-322 BCE), as identified by Collins et al. (2007), as identified by Onwuegbuzie et al. (2022), it was only in 1972 that the first formally declared mixed methods research work published by Parkhurst et al. (1972) emerged in the field of education.

In recent years, the rapid development of mixed methods research also has been boosting the development of educational research, helping researchers investigate survey data and answer research questions more comprehensively and helping teachers identify teaching deficiencies and promptly adjust their instructional methods. However, the latest systematic review of mixed method research in the field of education, which employed a mixed methods bibliometric study, ended in 2021 (Onwuegbuzie et al., 2022) and there has been no more systematic review. Considering this point, the present article involved use of the Bibliometrix sub-tool biblioshiny to analyze quantitatively published related articles of mixed methods research (MMR) in the field of education from the Web of Science (WoS) core collection, providing a broad overview of the main features of these publications over the past 20 years, and giving some recommendations to facilitate the advancement of future studies and educational practices.

The following sections are structured as such: The methodology section outlines the research questions, data sources, data collection, and analysis methods. The results section presents the bibliometric analysis of mixed methods research (MMR) in education using visual displays, tables, and written descriptions. In the discussion section, the authors interpret the research results by comparing and contrasting them with relevant studies from existing literature. Finally, the conclusion section summarizes the research content, highlights the potential impact and applications of the research results in the field, provides recommendations for future research, and acknowledges limitations of this research.

## Research Questions

This research represents a quantitative research study endeavor that involves a systematic analysis of the 20-year historical evolution of mixed methods research (MMR) articles in the field of education through bibliometric analysis, utilizing the R programming language. Moreover, biblioshiny allows us to highlight the most relevant sources, countries, authors, affiliations, and documents, as well as visualize the different research collaboration networks established and identities emerging trends in a specific area of knowledge.

Therefore, the purpose of this review is to address the following research questions of the development of mixed methods research in the field of education from 2003 to 2023: The following four research questions were addressed: (a) RQ1: What is the main information (including annual scientific production and citation) regarding the identified mixed methods research works? (b) RQ2: What are the productivity of sources, authors, affiliations, and countries? (c) RQ3: What are the collaborative patterns evidenced in these publications? and (d) RQ4: What are the research topics and possible trends of the development of mixed methods research in education?

## Method

### Data Sources and Collection

The data collection process for this research can be broken down into three distinct stages: data retrieval, manual data cleaning, and data download. During the first stage, the researchers used the WoS Core Collection (including the citation Index Social Sciences Citations Index (SSCI) and Arts and Humanities Citation Index [A&HCI]) as their source of bibliographic

information. As a referee-controlled literature database widely used for bibliometric analyses, Web of Science stands out due to its highly selective journal coverage, open access, and authoritative data for tracking and analyzing scientific publications (Singh et al., 2021; Yang et al., 2013). During the second stage, a manual reading and exclusion process was conducted. This step aimed to ensure that there was no duplication of data, resulting in a final count of 793 unique articles that were contained in the WoS Core Collection database over the past 20 years. In the third stage, these data were downloaded on September 8, 2023, with the research title including the keyword “mixed method(s),” or its derivative “mixed methodology” in the title, WoS category as “Education Educational Research,” language in English, and publication timespan from 2003 to 2023.

These data then were imported into Biblioshiny, allowing for the extraction of relevant visual figures and tables by capturing screenshots. The literature data obtained from Web of Science (WoS) were downloaded in BibTex format, containing comprehensive records of each article, such as the title, source, publication year, author(s), DOI number, abstract, keywords, citation frequency, and so forth. Additionally, the dataset included references cited in the articles to fulfill the operational requirements of Biblioshiny. Due to limitations within the software, which restricts the export of data records to 500 at a time, the researchers conducted two separate exports. These two sets of data subsequently were combined into a single data set, which then was imported into Biblioshiny to facilitate quantitative data analysis.

### **Bibliometric Analysis and Bibliometrix Tool**

Bibliometrics is a subset of scientometrics that utilizes statistical, mathematical and algorithmic methods to investigate and to analyze all scientific literature to assess the impact, trends, and development of scientific topics as its primary objective (Dabbagh et al., 2019; Duquenne et al., 2020; Firdaus et al., 2019; Guo & Donev, 2020; Jiang et al., 2021; Miao & Yang, 2018; Sánchez-Núñez et al., 2020). Bibliometric techniques have drawn the attention of top journals and scholars, and scholars from various disciplines have secured the publication of highly influential articles using them, studying different fields’ evolutionary nuances and capturing emerging trends (Mukherjee et al., 2022). Bibliometrix is a specific R programming package designed for conducting bibliometric analysis, was developed by Massimo Aria and Cuccurullo (2017). It can be used to analyze data from SCOPUS, Clarivate Analytics’ Web of Science, PubMed, Digital Science Dimensions, and Cochrane databases. Bibliometrix provides a transparent, dynamic, systematic and reproducible review process, gaining tremendous popularity in various research fields (Diodato & Gellatly, 2013; Pritchard, 1969). With Biblioshiny, a shiny web app, the above R-tool has become very easy to use, even for those without coding skills (Aria & Cuccurullo, 2017). Moreover, the research results present a specific, scientific and holistic overview of the literature in certain areas with the subjectivity of analyzing data drastically reduced, and intuitive network visualization highlighted.

### **Results**

In the following sections, visual tables and figures obtained from biblioshiny, along with textual descriptions, will provide a detailed interpretation of the essential data, highlighting the current research output, relevant rankings, and thematic trends to address the aforementioned research questions.



## Main Information Analysis

### *Preliminary Information About Sata*

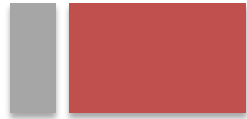
Table 1 shows the main results of the 793 retrieved documents, involving document types, documents contents, authors, and degree of author collaboration. These documents have been experiencing an annual growth rate of 26.44% and have an average age of 4.13 years. They pertain to mixed methods research in education conducted between 2003 and September 8, 2023, with an average of 11.97 citations per document and a total of 35,008 references, which exhibit strong citation and significance within these fields. Based on the publication status and content of the documents, they are categorized into three types of articles: (a) formally published academic articles ( $n = 726$ ), (b) articles that are about to be published but have not been formally published yet ( $n = 65$ ), and (c) research papers presented at academic conferences ( $n = 2$ ).

The 2,430 different keywords used by the 2,725 authors, indicating a broad diversity of topics and themes covered by the individual contributions. Furthermore, 1,543 keywords collectively are associated with all the works in the sample, suggesting that the sample encompasses a wide variety of research content, organized or categorized through these keywords. In addition, we found that only 89 authors of the total 2,725 authors were single authors. There were 3.66 authors per article, with 21.06% of the works representing international co-authorships. These findings indicate that the past 20 years of published MMR works within the field of education predominantly have been characterized by the collaboration of authors.

**Table 1**

### *Preliminary Data Summary*

<b>Description</b>	<b>Results</b>
<b>Main Information About Data</b>	
Timespan	2003:2023
Sources (e.g., Journals, Books)	179
Documents	793
Annual Growth Rate %	26.44
Document Average Age	4.13
Average citations per doc	11.97
References	35,008
<b>Document Types</b>	
article	726
article; early access	65
article; proceedings paper	2
<b>Document Contents</b>	
Keywords Plus (ID)	1,543
Author's Keywords (DE)	2,430
<b>Authors</b>	
Authors	2,725
Authors of single-authored docs	89




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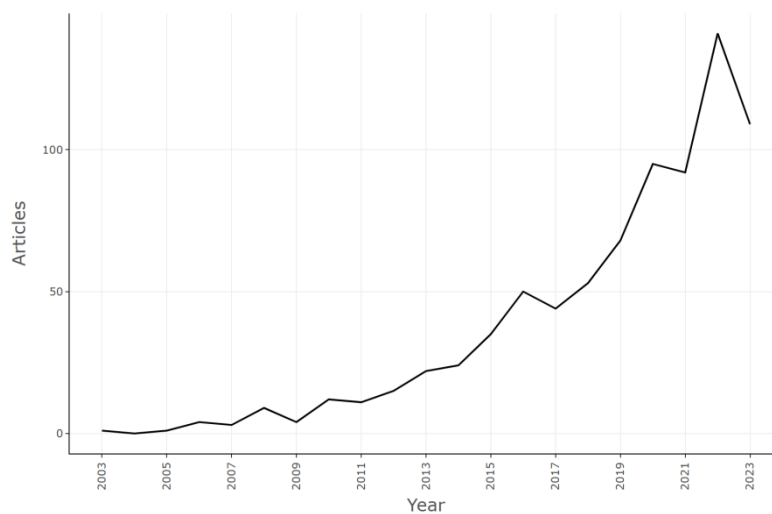
<b>Authors Collaboration</b>	
Single-authored docs	93
Co-Authors per Doc	3.66
International co-authorships %	21.06

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**Annual Scientific Production and Citation**

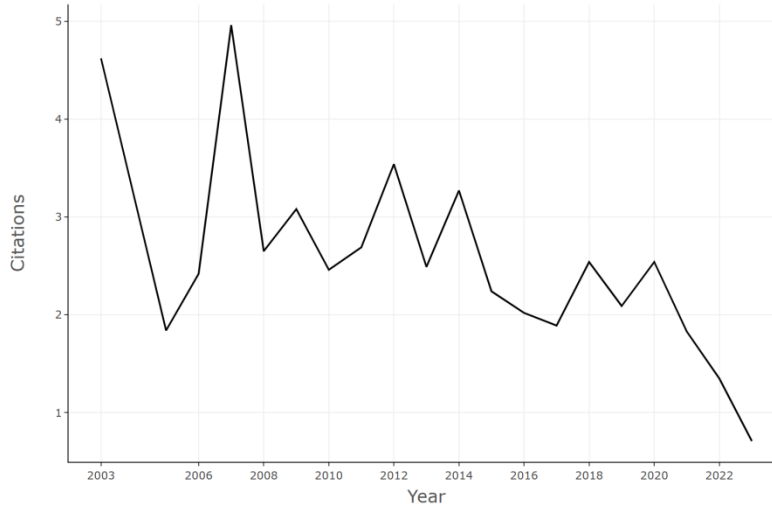
Figure 1 shows the annual scientific production (2003–2023) of MMR in education. Although there has been minor fluctuations, it has experienced a rapid growth of 26.44% per year. The production has grown from single digits or even zero in the early years to more than 100 in recent 2 years. Because the data obtained for 2023 only cover part of the year, 2022 stands out as the most productive full year, with a total of 141 works. Therefore, Figure 1 provides compelling evidence that MMR in education has gained momentum. Additionally, Figure 2 shows that, although the average citations per year for these MMR works fluctuate over time, they remain relatively low, peaking at 5 citations in 2007. This figure suggests that the average annual citations for these MMR studies generally have been modest, with noticeable fluctuations but no sustained increase over the period from 2003 to 2023.

**Figure 1.** Annual scientific production (2003-2023)





**Figure 2.** Average citation per year (2003-2023)



**Productivity Attribution Analysis**

***Most Relevant Sources***

Table 2 shows the top 10 most relevant academic-scientific sources on MMR development in education, all representing journal articles. Compared to the remaining nine journals listed in Table 2, each of which has only 11 to 25 related articles, BMC Medical Education holds the top spot with 160 publications, placing it far ahead in publication volume. This journal relates to the training of healthcare professionals and has a special focus on curriculum development, evaluations of performance, assessment of training needs and evidence-based medicine. Based on the research fields represented by these journals, we can infer that mixed methods research in education closely is related to addressing complex health problems and applying digital technology.

**Table 2**

*Top 10 Most relevant sources (2003–2023)*

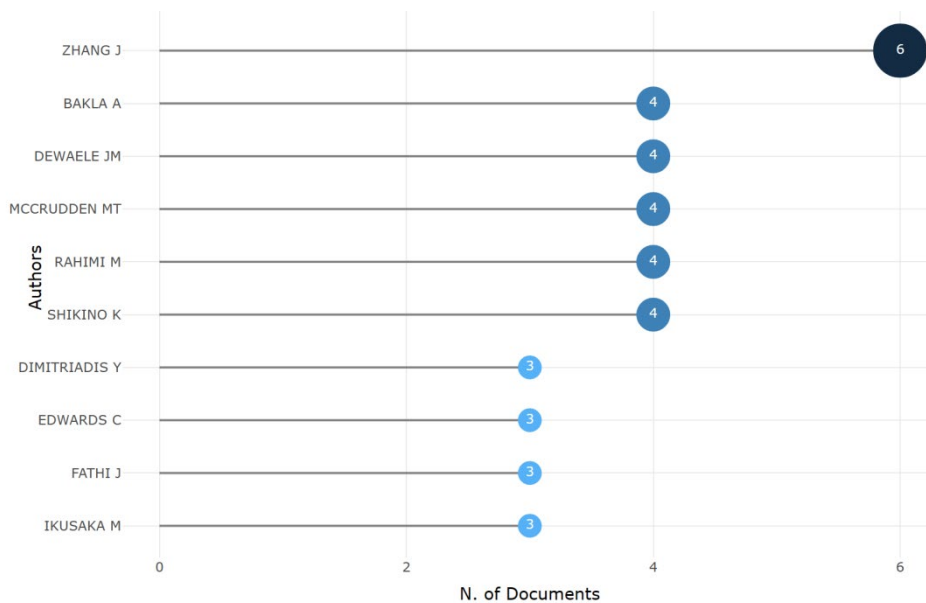
Sources	Articles
Bmc Medical Education	160
Teaching And Teacher Education	25
Education And Information Technologies	21
Computers \& Education	18
Journal Of American College Health	15
Health Education Research	13
Journal Of School Health	13
Early Childhood Education Journal	12
Medical Education Online	12
Early Education And Development	11



**Most Relevant Authors**

Figure 3 presents the top 10 most relevant authors and the number of articles that they have published, highlighting those who have made significant contributions to the field of MMR in education. The ranking is organized in descending order based on the number of articles that each author has published, with ties in publication count sorted alphabetically by last name. Zhang has been the most prolific author, with six publications on MMR in education, followed by the five authors, Bakla, Dewaele, McCrudden, Rahimi, and Shikino, each with four publications.

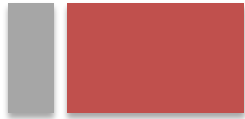
**Figure 3.** Top 10 most relevant authors (2003–2023).



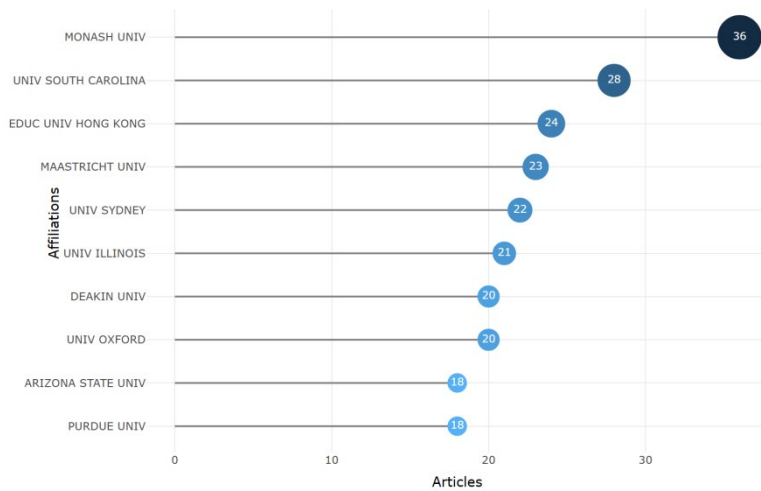
**Most Relevant Affiliations**

Figure 4 presents the top 10 affiliations contributing to mixed methods research (MMR) in education, listed in order of publication volume: Monash University (Australia), University of South Carolina (USA), Education University of Hong Kong (China), the Maastricht University (Netherlands), University of Sydney (Australia), University of Illinois (USA), Deakin University (Australia), University of Oxford (UK), Arizona State University (USA), and Purdue University (USA), each with at least 18 articles. The results indicate that the most productive and influential affiliations are based primarily in the United States and Australia, whose collaborative efforts are driving forward the development of MMR in the field of education.





**Figure 4.** Top 10 most relevant authors’ affiliations (2003–2023).



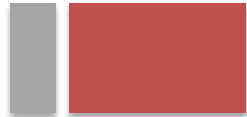
### Corresponding Authors’ Countries

Table 3 introduces the top 10 most relevant countries by corresponding authors, along with evaluations of single-country publication (SCP), multiple-country publications (MCP), and MCP Ratio (MCPR). The corresponding author typically is the one who submits the article to the journal editor, communicates with them and other researchers, and whose e-mail address usually is listed on the first page of the article (Mattsson et al., 2011). USA, UK, and China, these three corresponding authors’ countries all occupy the first three place in publications and single country publication (SCP). The USA, UK, and China hold the top three positions in both total publications and SCP. Among these, the USA, China, Australia, and UK exhibit the highest rates of international collaboration. Notably, although Turkey ranks sixth in the number of corresponding authors, it shows no international collaborations.

**Table 3**

*Corresponding Author’s Country: Intra-Country (SCP) and Inter-Country (MCP) Collaboration (2003-2022)*

Country	Articles	SCP	MCP	Freq	MCP_Ratio
Usa	290	255	35	0.366	0.121
United Kingdom	64	49	15	0.081	0.234
China	63	46	17	0.079	0.27
Australia	54	38	16	0.068	0.296
Canada	34	26	8	0.043	0.235
Turkey	31	31	0	0.039	0
Germany	26	24	2	0.033	0.077
Iran	19	14	5	0.024	0.263
Belgium	17	14	3	0.021	0.176
Netherlands	15	12	3	0.019	0.2



## Collaborative Relationship Analysis

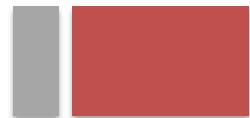
### *Most Global Cited Documents*

Table 4 presents the top 10 globally cited papers came from nine different journals, along with their DOIs, total citations per year, and normalized total citations. Citation counts are influenced heavily by the time since publication, with older works having a greater chance of accumulating citations from newer works. However, this does not detract from the importance of recent works. For example, the article entitled, “From Gatekeeping to Engagement: A Multicontextual, Mixed-Method Study of Student Academic Engagement in Introductory STEM Courses,” authored by Gasiewski et al. (2012), has received the highest number of citations, with a global total of 235 as of September 2023. This study involved use of a sequential explanatory mixed methods research design to provide deeper insights into the correlation between student engagement and introductory science instruction. The “Normalized Total Citations” addresses the time-based bias in citation counts, allowing for a fairer comparison of articles across different publication periods and fields. For instance, a 2013 article listed with the highest normalized citation count of 7.22 demonstrates impact within a shorter timeframe, underscoring its significant influence.

**Table 4**

*Most Global Cited Documents (2003-2023).*

Paper	DOI	Total Citations	TC per Year	Normalized TC
Gasiewski Ja, 2012, Res High Educ	10.1007/s11162-011-9247-y	235	19.58	5.53
Bressler Dm, 2013, J Comput Assist Learn	10.1111/jcal.12008	198	18.00	7.22
Woltering V, 2009, Adv Health Sci Educ	10.1007/s10459-009-9154-6	139	9.27	3.01
Davies Bs, 2012, BMC Med Educ	10.1186/1472-6920-12-1	127	10.58	2.99
Ivankova Nv, 2007, Res High Educ	10.1007/s11162-006-9025-4	123	7.24	1.46
Sammons P, 2007, Br Educ Res J	10.1080/01411920701582264	120	7.06	1.42
Zumbrunn S, 2014, Instr Sci	10.1007/s11251-014-9310-0	118	11.80	3.61
Atman Cj, 2008, J Eng Educ	10.1002/j.2168-9830.2008.tb00981.x	114	7.13	2.69
Hoffman B, 2010, Etr&D-Educ Tech Res Dev	10.1007/s11423-009-9134-9	109	7.79	3.16
Creswell Jw, 2008, S Afr J Educ	10.15700/saje.v28n3a176	107	6.69	2.52

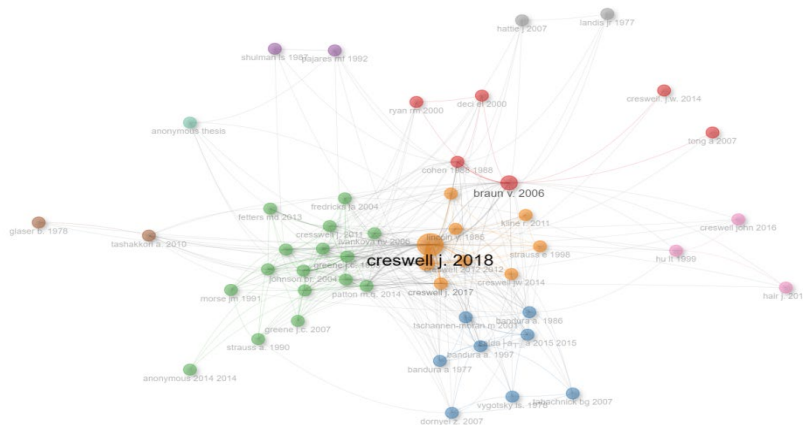


### **Co-Citation Network - Papers**

“Co-citation analysis” is a bibliometric technique aimed at identifying patterns in which documents are cited together, allowing researchers to uncover thematic connections and relevance among publications. Figure 5 displays nine color-coded clusters, wherein circles within the same cluster represent publications addressing similar issues. The size of each circle reflects the number of co-citations: larger circles indicate papers with higher co-citation counts. Notably, J. W. Creswell and J. D. Creswell’s (2018) article, represented by the largest circle in the orange cluster, demonstrates the highest betweenness centrality, highlighting its central role and strong connections with other publications in the network.

**Figure 5**

*Co-Citation Network - Papers (2003-2023)*



### **Social Structure: Collaboration Network (Countries)**

Figure 6 shows the social structure represented by a country collaboration network that produces research related to MMR in education and the generated collaborative networks. Only two clusters of the total eight clusters with more than two countries, blue cluster is centered around USA and red one is centered around UK. And there are no clear collaborative relationship with other countries shown of Cyprus, Greece, Italy, Indonesia, and Malaysia.

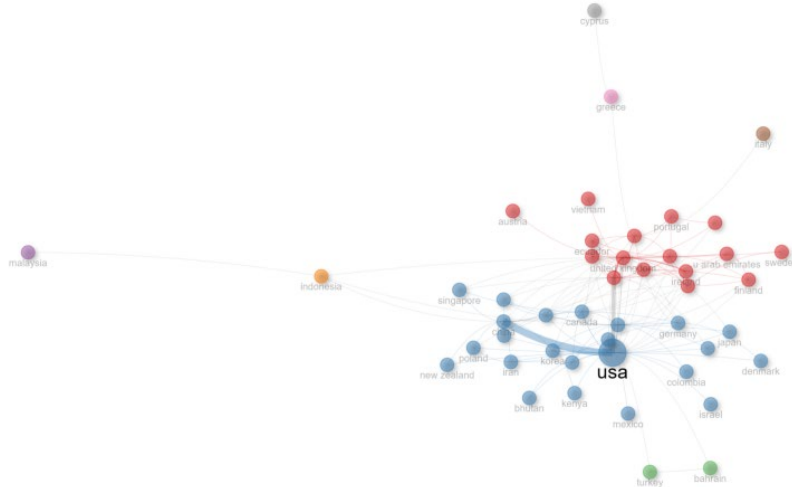
### **Research Trends Analysis**

#### **Author’s Keywords Treemap**

In Figures 7 and 8, the size of each rectangular box represents the frequency of a keyword: the larger the box, the more frequently the term appears either in the author’s keywords or within the articles as a whole. Author keywords typically highlight the article’s main subject, methodology, and core content, providing readers with a quick understanding of the article’s focus and positioning within academic literature. In Figure 7, the top two keywords—“mixed methods” and “education”—clearly validate our selection criteria focused on research methodology and field. This figure also reveals that “medical education” and “higher education” are prominent topics, occurring 34 and 24 times, respectively.

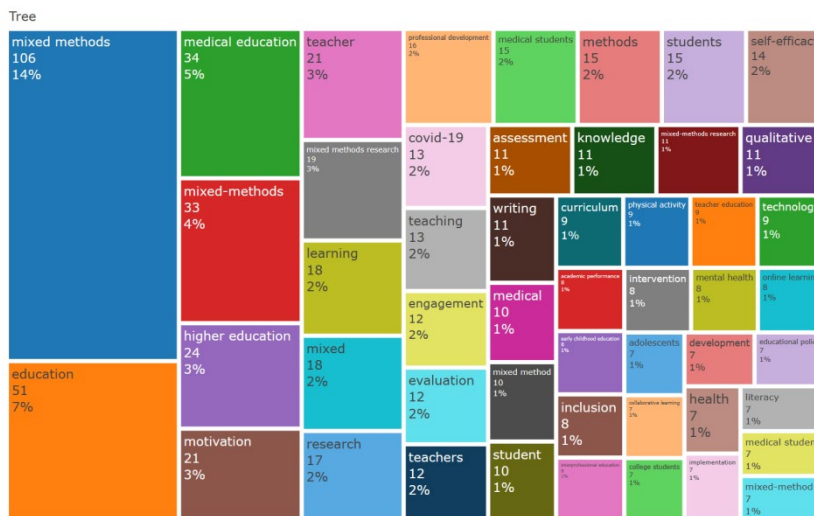
**Figure 6**

*Social Structure: Collaboration Network (Countries) (2003-2023)*



**Figure 7**

*The Top 50 Authors' Keywords Treemap (2003-2023)*

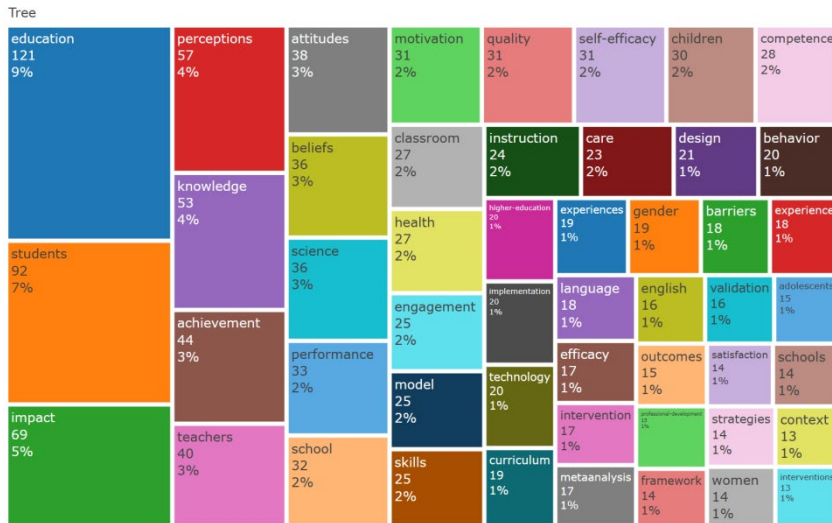


**Keywords Plus Treemap**

The bibliometric analysis technique, which examines “keywords plus,” is used to identify field trends across articles published over time (Wang et al., 2015). “Keywords plus” provides additional insight into the field’s ability to push the boundaries of knowledge. Figure 8 visualizes 50 of the 1,543 keywords plus from the downloaded data, with terms like “Students” and “teachers” frequently appearing, with “students” being the most prominent. Other terms such as “impact,” “perceptions,” “knowledge,” and “achievement” suggest their potential as emerging research areas due to their larger proportions. Meanwhile, Figure 9 highlights four trending topics in 2023—“intervention,” “framework,” “challenges,” and “policy”—indicating current research interests in the field.

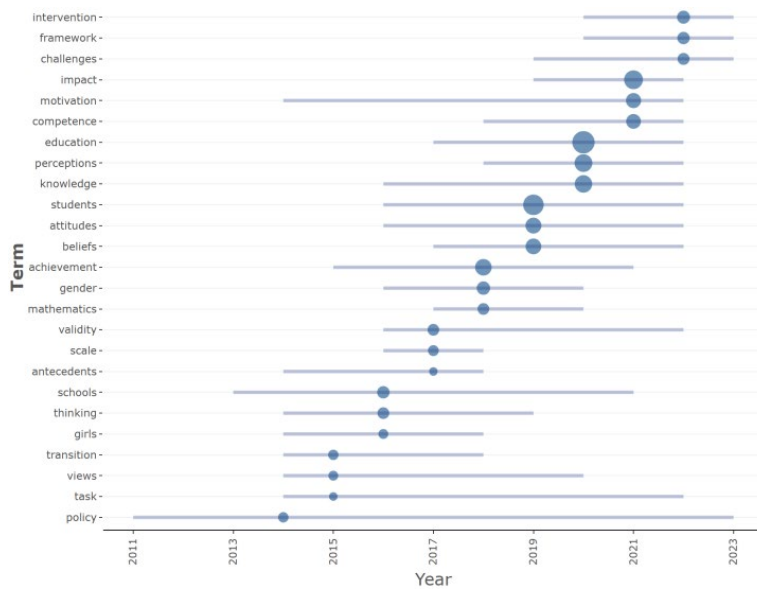
**Figure 8**

*The Top 50 Keywords Plus Treemap (2003-2023)*



**Figure 9**

*Trend Topics (2003-2023)*



**Discussion and Conclusion**

This article explored and evaluated trends in English-language publications on MMR in education, based on the WoS core collection (SSCI and A&HCI) from 2003 to Sep 8, 2023. In contrast to earlier bibliometric studies, particularly “Twenty Years of Research on Mixed Methods” (Askun & Cizel, 2020) and “A 41-Year History of Mixed Methods Research in Education: A Mixed Methods Bibliometric Study of Published Works from 1980 to 2021” (Onwuegbuzie et al., 2022), this article specifically focused on the field of education within

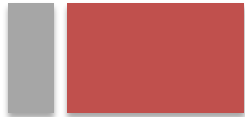
MMR, utilized a different database (avoiding ProQuest and ERIC), and employed Biblioshiny instead of Python coding. Additionally, it incorporated the latest research from 2022 and 2023 in order to offer updated insights and new focal points.

The review highlighted several significant findings: the dataset comprised 793 publications by 2,725 authors, across 179 sources (e.g., journals, books), from 63 countries of corresponding authors, and 1,038 affiliations. MMR in education has shown sustained growth, with an annual growth rate of 26.44% and average of 11.97 citations per document. Regarding productivity, *BMC Medical Education* (160 articles), J Zhang (6 articles), Monash University (36 articles), and the USA (290 articles) emerged as the most relevant source, author, affiliation, and country, respectively, due to their strong numerical presence. Additionally, journals and universities were the primary contributors in terms of sources and affiliations. However, there were 2,575 (94.5%) authors, 63 sources (36.4%), 420 affiliations (40.5%), and 20 countries (31.7%) with only one publication each, showing that a large proportion of contributors provided a smaller volume of publications but added meaningful diversity to the field.

Citation and collaboration network analyses revealed that only 3% of publications were cited 50 times or more, while 146 articles had not yet been cited. The article “From Gatekeeping to Engagement: A Multicontextual, Mixed-Method Study of Student Academic Engagement in Introductory STEM Courses” (Gasiewski et al., 2012) was the most globally cited, with 235 citations. Meanwhile, “The movement of mixed methods research and the role of educators” (Creswell & Garrett, 2018) held the highest betweenness centrality within the co-citation network, indicating a central position and strong linkage with other works. The USA, UK, China, and Australia emerged as leading countries in MMR in education, with collaboration networks observed across multiple countries. Beyond these four, Germany and Spain also demonstrated high citation counts and significant betweenness centrality, respectively. The top 10 most productive affiliations were primarily located in the USA and Australia. To identify future trends, we analyzed keyword treemaps and trend topics, revealing that “medical education,” “higher education,” “intervention,” “framework,” “challenges,” and “policy” are likely to remain focal points in MMR research in education.

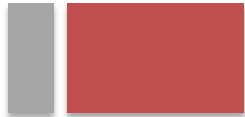
### **Recommendations**

As a quantitative research study, Biblioshiny was employed to analyze the research dynamic of our resources. This article enables researchers to leverage these resources to gain insights into contemporary educational research using MMR, providing a more comprehensive understanding that addresses the field’s existing limitations. However, the study is restricted by the use of a single database and specific document types. Therefore, future research should incorporate additional or multiple databases, such as Scopus and Google Scholar, and consider evaluating a broader range of documents beyond just articles. Additionally, the timespan and the analysis tool used here are not unique; thus, timely updates in operational knowledge and perspectives are needed to enrich further our understanding of MMR in education.



## References

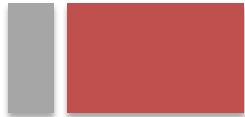
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