# STEM Research Trends From 2013 to 2022: A Systematic Literature Review

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# STEM Research Trends From 2013 to 2022: A Systematic Literature Review

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| Article Info | Abstract |
|---|---|
| | The integration of STEM (Science, Technology, Engineering and Mathematics) approaches into learning continues to attract the attention of researchers and academics. Teachers play a key role in the success and support of learning when implementing STEM-based learning. This study aims to provide a comprehensive overview, building on previous literature, and to provide future directions for further STEM research by researchers and educators. There are 193 documents containing his STEM in the Taylor & Francis database, which were synthesized. Research questions include annual publication frequency. Distribution includes STEM titles, method and topic distributions, most cited counts, most contributing countries, and frequently publishing journals in the STEM field. Of the 193 articles, only 21 contained the word MINT in the title, and 64 documents saw a significant increase in publication frequency in 2022. Most of the research published in the STEM field focuses on teaching and learning and mastering concepts. Aligned by country, the United States, United Kingdom and Sweden make the largest contributions in this area compared to other countries, followed by the Netherlands, Germany, Finland and Norway. The most cited authors are Joseph Krajcik, Susan Codere, Chanyah Dahsah, Renee Bayer, and Kongju Mun, who have been cited 110 times. Based on the number of articles, the International Journal of Science Education is the journal that contributed the most to STEM between 2013 and 2022. |

## Introduction

STEM is a combination of (Science, Technology, Engineering and Mathematics) which is widely implemented in various countries in an effort to develop students' cognitive (Billiark et al., 2014; Daugherty, 2013). The purpose of STEM is to develop knowledge, conceptual understanding, and critical thinking skills and prepare teachers to play an active role in student development (Asigigan & Samur, 2021; Bursztyn et al., 2015; He et al., 2021). STEM helps teachers implement student-centered learning by explicitly or implicitly integrating science, technology, engineering, and math skills into learning (Abdurrahman Boran, Erkan Hasan Atalmış, 2014). It is believed that STEM can give the impression of rigorous learning and personal experience and can bring meaning to lifelong learning (Colomer et al., 2013).

STEM plays a key role in preparing a work-ready generation to inspire interest in the knowledge, values, and abilities students need to succeed in the globalized world of the 21st century (Biberman-Shalev, 2021). STEM-based learning offers learning orientation through high-tech manufacturing that incorporates interactive learning tools and media (Walan, 2021). STEM helps teachers discover interdisciplinary concepts and identify integrated problem-solving frameworks (Fernandez et al., 2022; Priemer et al., 2020; Ring-Whalen et al., 2018). However, learning with a STEM approach also requires support from professional educators. (Griful-Freixenet et al., 2021). Learning success depends on teacher motivation (DeLuca et al., 2021; Matewos et al., 2019; Zhang et al., 2022).

Mustafa Sirakaya and Didem Alsancak Sirakaya (2022) conducted a STEM literature review on the use of AR in STEM learning. It contains a systematic review of 28 articles. Another systematic review was conducted by Mi Song Kim (2019) on learning design for teachers using STEM approaches. A systematic analysis by Elena Prieto-Rodriguez et al. (2022) focuses on interventions for girls in STEM learning. Of all these systematic reviews, none analyzed and studied trends in her STEM studies from 2012 to her 2019 (Kim, 2021; Prieto-Rodriguez et al., 2020; Sırakaya & Alsancak Sırakaya, 2020).

The purpose of a systematic literature search or literature survey is to provide researchers with information for choosing future research methods (Krull & Duart, 2017; W. H. Wu et al., 2012). This overview provides trends in STEM research for the study period 2013-2022, including annual STEM publication circulation, methods commonly used in STEM research, most cited authors, and prolific authors. It provides appropriate references for the countries where the publications are located and the journals that are the most popular publications on STEM. It is hoped that this systematic review will provide updates to guide future research related to her STEM fields.

Information about STEM (Science, Technology, Engineering and Mathematics) helps researchers and educators understand the development of STEM research and shape the future of integrated STEM learning. The current study aims to analyze the latest trends and is in the form of a comprehensive overview. As you know, Taylor & Francis is a large database that publishes millions of scientific documents in various fields, including education. To date, no one has studied, reviewed, or studied STEM using systematic reviews in the last decade.

The current study therefore provides a comprehensive and accurate overview of the field, helping researchers and educators around the world to carry out his STEM-related research and the future publication of their research. . For this reason, there are several formulations of the problem that researchers can pose:

1. How often will you find STEM-related research trends from 2013 to 2022?
2. What is the distribution of articles containing STEM for titles published between 2013 and 2022?
3. How is MINT's field research topic-based?
4. What is the distribution of research methods in STEM from 2013 to 2022?
5. Which country contributed the most to STEM from 2013 to 2022? 6. What are the research trends in the most cited or cited papers in scientific journals from 2013 to 2022?
7. In which academic journal did he publish the most STEM-related articles between 2013 and 2022?

## Method

### Research Design

This systematic review uses the protocol developed by Wu (2013) to achieve the proposed goal. For this study, the researcher used his Taylor & Francis database (https: http://www.tandfonline.com) 2013 to his 2022 period. A document search was performed on him on November 4, 2022.

### Inclusion and Exclusion Criteria

Researchers will specify certain criteria or inclusions when searching for documents in this study. B. Papers must be written in English and published between 2013 and 2022. Only Open Access documents are used. Search topics include education, 'curriculum studies', 'science education', 'mathematics', and 'technology in education'. , "Educational Research", "Secondary Education", "Teachers and Teacher Education", "Higher Education". All the documents used for the search contain his word MINT in the title, keywords and abstract. Researchers then select multiple or overlapping articles, book chapters, books, proceedings, and conference proceedings to set exclusion criteria.

### Data Analysis

The term used in item search is "STEM" for retrieving related items. A search of the Taylor & Francis database returned 27567 items. Researchers then analyze articles to identify keywords, titles, and abstracts to obtain objectives related to their research goals. Researchers screened several papers that came exclusively from the education field. It was then reduced to 'Curriculum Studies' and 'Science Education', yielding 431 articles. The researchers then read and reviewed the documents extensively to ensure that the included articles met our criteria and were free of duplication. Researchers determine exclusivity criteria by selecting articles whose last publication was published in the period 2013-2022. Articles are open access and articles with content "Curriculum Research" and "Pedagogical Research" receive 193.

During the selection process, researchers read the titles and abstracts, then proceed to the full text of all articles with the assistance of researchers to produce an accurate and comprehensive systematic review. Discuss the relevance of the manuscript to the main topic by reviewing the research questions to see if they meet the selection criteria. Researchers then conducted an independent review of 193 articles that met the inclusion and exclusion criteria. This is done to make decisions related to trends in STEM research, research methodologies, article distribution, major contributing countries, number of articles cited, and frequently published journals on STEM. Note that one type of paper used in the review is associated with only one type of study.

## Results

### Annual Distribution of Document Issuance

Taylor & Francis is a popular database of quality documents from various countries and around the world. Taylor

and Frances database (http://www.tandfonline.com) found 193 publication articles highlighting his STEM according to selection criteria set by the researcher. These 193 articles were searched using titles, keywords, and summaries containing his STEM words for the period from 2013 to his 2022. Below is the distribution of his STEM publications in the Taylor and Francis database based on the period 2013-2022 (see Figure 1).
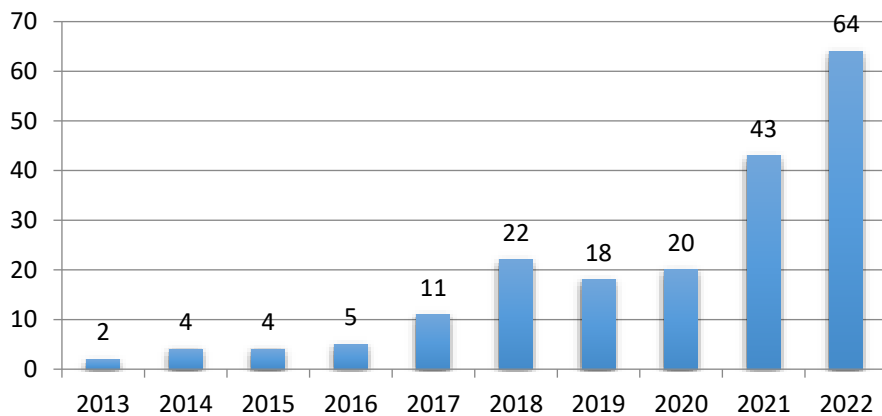


Figure 1. Annual Publication Frequency

Given the annual volume of STEM research, the analysis results indicate that work in this area fluctuated from 2017 to November 2022, with the number of works published in 2022 (n=64), and the number of documents. It shows a rapid increase in lying. surpassed the previous year. The proportion of annual publications in the STEM field fluctuates from 2017 to 2020, but is as important as his STEM-related publications from 2021 to the present (2022) is the number of papers (n = 43) not. significantly increased.

**Distribution of Articles containing STEM in the Title**

From early 2017 to late 2022, the distribution of papers with and without STEM titles fluctuated. The number of articles with STEM titles was 21 and the number of papers without STEM titles was 172. The distribution of STEM research papers, with or without a STEM title, shows a more positive trend as articles are reviewed, with a gradual increase from 2017 to 2022 and the possibility of a sharp increase in 2023 there is (see Figure 2).
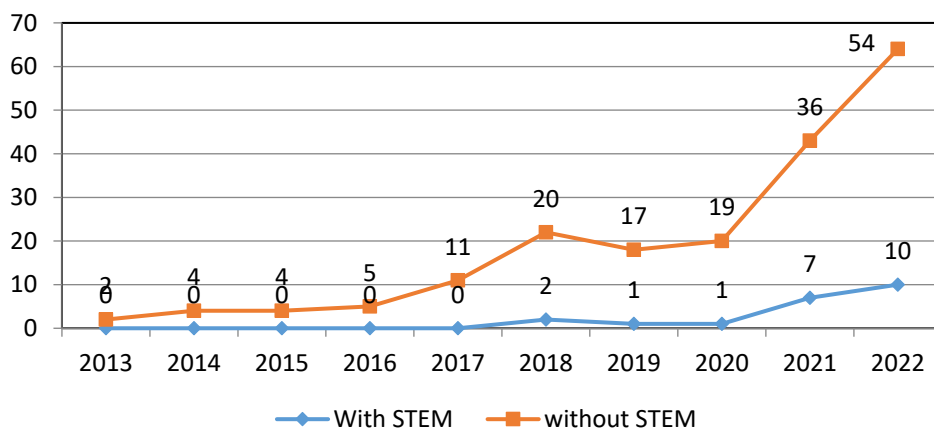


Figure 2. Distribution of the Word "STEM" in Titles

## Distribution of Research Methods

An analysis of the commonly used methods in STEM research trends reveals that qualitative research dominates. A trend towards qualitative methods seems to be taking hold among researchers. In terms of the number of publications, the popularity of qualitative research peaked in 2022, but from 2013 to 2017, Taylor and Francis' database did not have too many publications involving STEM fields. Qualitative research design will become commonplace among STEM researchers in 2022. The survey method frequency distribution will start from 2018 to 2022 (see Figure 3).
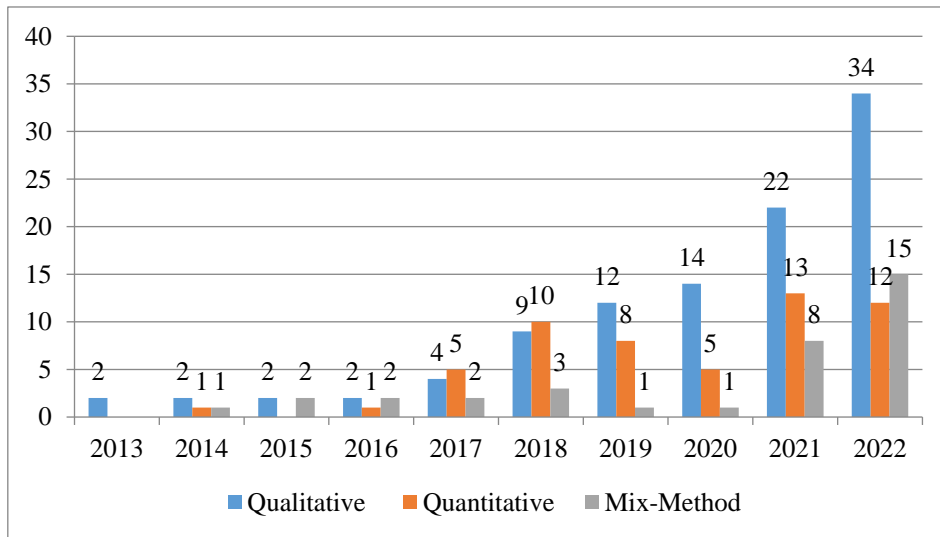
Figure 3. Distribution of Research Methods in the STEM Field

## Research Distribution Based on Themes

The top research topics commonly used by researchers between 2013 and 2022 were teaching and learning at 24%, followed by conceptual STEM subjects at 14%, and pedagogy and social studies (see Figure 4).
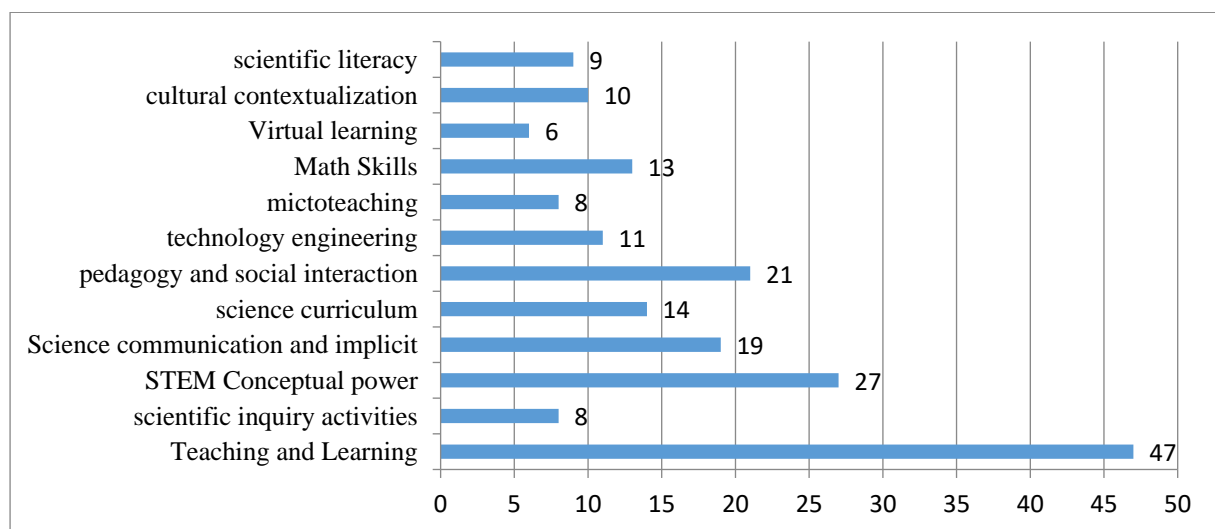
Figure 4. Distribution of Themes in STEM Research

11% for explicit interaction, 10% for science communication and implicit, and 10% for science curriculum and match. Skills 7%, Cultural Contextualization and Scientific Literacy 5%, Scientific Research Activities and Microteaching 4%, Virtual Learning 3%. Some of the most dominant themes used in STEM research seem to be directed toward teaching and learning, and reinforcing her STEM learning concept for both students and teachers is the use of STEM learning. is also relatively dominant in The direction of research distribution will continue to develop according to the era and challenges of learning, which is growing rapidly with the needs of the times.

**The Most Productive Countries in STEM Research**

Aiming to identify the most prolific countries for STEM-related research according to the third question, researchers identified 23 documents by printing all articles meeting the inclusion criteria. Table 3.1 below shows the countries with the highest number of published papers on Taylor & Francis in his STEM field in the world from 2013 to 2022 (see Table 1).

Table 1. Top 7 Most Productive Countries in STEM Research

| Rank | Country | *N of Papers* | Percentage (%) |
|------|---------|---------------|----------------|
| 1 | USA | 37 | 19.17 |
| 1 | UK | 37 | 19.17 |
| 1 | Sweden | 37 | 19.17 |
| 2 | Netherlands | 16 | 8.29 |
| 3 | Germany | 12 | 6.22 |
| 4 | Finland | 9 | 4.66 |
| 5 | Norway | 7 | 3.63 |
| 6 | Canada | 5 | 2.59 |
| 7 | Israel | 3 | 1.55 |
| 7 | Spain | 3 | 1.55 |
| 7 | Ireland | 3 | 1.55 |
| 7 | Austria | 3 | 1.55 |
| 7 | Switzerland | 3 | 1.55 |
| | Other | 18 | 9.33 |
| **Total** | | **193** | 100.00 |

Research on STEM is generally done by developed countries. The analysis reveals that the countries with the highest levels of documentation productivity in the STEM field are dominated by the US, UK and Sweden, with N = 37 (19.17%) works, followed by the Netherlands. . 1 percent (8.29%), Germany (6.22%), Finland (4.66%), Norway (3.63%), Canada (2.59%), Israel, Spain, Ireland, Austria, Switzerland (9.33%). Essentially, the Taylor & Francis database found the seven countries in which he made the greatest contribution to the publication of STEM-related articles in the period 2013-2022. This indicates that the average contribution of developed countries is around 90%.

**Documents with the Most Citations**

To answer the fourth research question, researchers visualized documents from the Taylor & Francis database to identify the highest number of citations for the period 2013-2022. To answer the research question, the documents were analyzed and sorted by the highest number of citations in the STEM field (see Table 2).

Table 2. Top 10 Valuable Documents with the Most Citations in STEM Fields

| No. | Citation | Year | Author | Title |
|---|---|---|---|---|
| 1 | 110 | 2014 | Joseph Krajcik, Susan Codere, Chanyah Dahsah, Renee Bayer & Kongju Mun | Planning Instruction to Meet the Intent of the Next Generation Science Standards |
| 2 | 102 | 2015 | Jennifer DeWitt & Louise Archer | Who Aspires to a Science Career? A comparison of survey responses from primary and secondary school students |
| 3 | 98 | 2018 | Nicole M. Ardoin, Alison W. Bowers, NoelleWyman Roth, Nicole Holthuis | Environmental education and K-12 student outcomes: A review and analysis of research |
| 4 | 92 | 2016 | Silke Rönnebeck, Sascha Bernholt, Mathias Ropohl | Searching for a common ground – A literature review of empirical research on scientific inquiry activities |
| 5 | 65 | 2018 | Anniek van den Hurk, Martina Meelissen, Annemarie van Langen | Interventions in education to prevent STEM pipeline leakage |
| 6 | 64 | 2016 | Robert Fletcher | Connection with nature is an oxymoron: A political ecology of "nature-deficit disorder" |
| 7 | 62 | 2014 | Emily Dawson | Equity in informal science education: developing an access and equity framework for science museums and science centres |
| 8 | 44 | 2017 | Jesper Sjöström, Nadja Frerichs, Vânia G. & Ingo Eilks | Use of the concept of Building in the international science education literature, its potential, and implications for teaching and learning |
| 9 | 39 | 2017 | Helen Kopnina | Teaching Sustainable Development Goals in The Netherlands: a critical approach |
| 10 | 36 | 2018 | Jingoo Kang, Jonathan Hense, Annette Scheersoi & Tuula Keinonen | Gender study on the relationships between science interest and future career perspectives |

| No. | Citation | Year | Author | Title |
|-----|----------|------|--------|-------|
| **10** | 36 | 2016 | Abdelkrim Hasni, Fatima Bousadra, Vincent Belletête, Ahmed Benabdallah, Marie-Claude Nicole & Nancy Dumais | Trends in research on project-based science and technology teaching and learning at K–12 levels: a systematic review |

Among the 10 most cited articles most frequently published and cited in the International Journal of Science Education Journal were Joseph Krajcik, Susan Codere, Chanyah Dahsah, Renee Bayer and Kongju Mun, with 110 It was quoted twice. A document published in the International Journal of Science Education has been cited by a total of 6954 readers in November 2022, 123 times on Scopus, 0 times on Web of Science, and 110 times on Crosreff. He was followed by Jennifer DeWitt and Louise Archer with his 102nd citation. Their published documents were cited 112 times on Scopus, 99 times on Web of Science, and 102 times on Crosreff, with a total of 8,407 readers.

**Number of Journal Publications in the STEM Field**

This section answers current research questions about the most published journals in STEM fields from 2013 to 2022 (see Table 3).

Table 3. Top Seven Most Published Journals in STEM Field

| Rank | Journal | N *of Papers* |
|------|---------|---------------|
| **1** | International Journal of Science Education | 58 |
| **2** | Environmental Education Research | 25 |
| **2** | Research In Science & Technological Education | 25 |
| **3** | International Journal of Mathematical Education in Science and Technology | 17 |
| **4** | Journal of Geoscience Education | 13 |
| **5** | International Journal of Science Education, Part B | 11 |
| **5** | Journal of Science Teacher Education | 11 |
| **6** | Journal of Biological Education | 8 |
| **6** | The Journal of Environmental Education | 8 |
| **7** | Studies in Science Education | 7 |

Our analysis reveals that there are 7 best frequently published journals in the STEM field. The International Journal of Science Education placed him first with a total of 58 identified papers. The magazine publishes 12 articles per year. We publish an article every month. The journal is also on record as the first issue from 1979 to the present (2022) with 8-10 journal articles published monthly. In second place are research in environmental education and research in science and technology education. Environmental Education publishes 12 articles per year, with 4-5 articles per issue. The journal publishes documents from 1995 to the present (2022). Research In

Science & Technological Education publishes approximately 5-8 articles in 3 issues per year. This journal also started publishing from 1983 to the present (2022) with a scientific perspective and technical education purposes. Third place goes to International Journal of Science Education, Part B, Journal of Geoscience Education. The number of identified articles is up to 25 documents.

Third place is taken by the International Journal of Mathematical Education in Science and Technology, with a number of identified works of up to 17 documents. This journal has a document ratio of 10-15 articles, and in a year he publishes 9 articles. The journal publishes from 1970 to the present with a focus on research in mathematics, science and technology. Fourth place goes to the Journal of Geoscience Education. The journal publishes international research on pedagogy and philosophy of education in earth-related fields, including earth and climate and environmental sciences. The magazine has produced articles with a quarterly circulation since 1951. Each published article contains about 10 articles. Of the top seven journals that publish articles in the STEM field, these are also open access journals, meaning researchers can access these journals regularly to publish their articles.

## Discussion

This study provided a comprehensive overview and systematic literature review to gain relevant insights for publications in the STEM field. The study found that the circulation of published articles increased from 2013 to 2022. This is also consistent with his Literature Review study on STEM conducted by Mustafa Sirakaya and Didem Alsancak Sirakaya (2022) on the use of AR in his STEM learning, which includes a systematic review of 28 articles.

Another systematic review was conducted by Mi Song Kim (2019) on learning design for teachers using STEM approaches. A systematic analysis by Elena Prieto-Rodriguez et al. (2022) focuses on interventions for girls in STEM learning. None of these systematic reviews analyzed and explored trends in her STEM studies from 2013 to her 2022 (Kim, 2021; Prieto-Rodriguez et al., 2020; Sırakaya & Alsancak Sırakaya, 2020). This shows that researchers and academics around the world are paying attention to STEM. As such, there can be a rapid and significant increase in releases throughout the year.

Global interventions in the STEM sector will need to be reassessed as STEM trends will continue to increase significantly (Prieto-Rodriguez et al., 2020). This study is a systematic validation study conducted extensively to provide initial information to researchers and scholars. The first step is systematic feedback, providing comprehensive information on prospects for future professional development in STEM fields (Bas & Kivilcim, 2021; Kuehnert et al., 2019).

A second researcher asked about the distribution of papers with and without STEM titles, and it varied from early 2017 to late 2022. The highest number of papers with a STEM title was 21, with 172 papers without a STEM title. STEM research papers trended higher. Regardless of whether the title includes STEM, the articles reviewed are positive because from 2017 he is likely to grow gradually through 2022, and more rapidly in 2023. target. Taylor

& Francis database. However, as the number of articles reviewed will gradually increase from 2018 to 2022, and may increase rapidly in 2023, the number of publications, whether or not they contain STEM in their titles, will be higher. It shows a positive trend. STEM can be integrated with learning media that support STEM disciplines, such as: B. Curriculum development that can be integrated into virtual labs, augmented reality (AR), media development, learning tools, and STEM field studies (Birney & McNamara, 2022; Boeve-De Pauw et al., 2022; Farihah et al., 2021; Mater et al., 2022; Ong et al., 2020; Sırakaya & Alsancak Sırakaya, 2020).

Research on STEM is usually produced via way of means of advanced nations. Based at the effects of the evaluation, it turned into observed that nations with report productiveness tiers withinside the STEM area have been occupied via way of means of the USA, UK, and Sweden with N = 37 papers (19.17%). USA is the best u . s . with the maximum book scores and the best variety of citations all through the 2013-2022 period. Frequent guides withinside the International Journal of Science Education with the maximum citations Joseph Krajcik, Susan Codere, Chanyah Dahsah, Renee Bayer & Kongju Mun with a hundred and ten citations. Documents posted withinside the magazine International Journal of Science Education are mentioned as many as 123 Scopus citations, zero citations at the Web of Science, and a hundred and ten on Crosreff with a complete of 6954 Viewers as of November 2022. Followed via way of means of Jennifer DeWitt & Louise Archer with 102 citations Their posted files had been mentioned as many as 112 Scopus citations, ninety nine citations on Web of Science, and 102 on Crosreff with a complete of 8,407 Viewers.

Based at the effects of the evaluation of the techniques which are frequently used withinside the studies fashion on STEM, it seems that qualitative studies is dominated. The fashion of the Qualitative Method appears to be finished always amongst researchers. In phrases of the variety of guides, the height reputation of qualitative studies extended unexpectedly in 2022, while from 2013 to 2017 there have been now no longer too many guides protecting the STEM area withinside the Taylor and Francis database. Qualitative studies designs have become famous amongst STEM researchers in 2022. The frequency distribution of studies techniques begins off evolved from 2018 to 2022. Qualitative training replicates different findings due to the fact the float of statistics relies upon at the subject's social position and courting with the researcher (Cheung & Tai, 2021). The results of the analysis of the major research themes that are often used by researchers from 2013 to 2022 are teaching and learning with a percentage of 24%. The theme of teaching and learning is indeed a world concern in an effort to improve the quality of learning and teaching outcomes (Bonfield et al., 2020). The Developing innovations that can lead research groups (Martin & Grudziecki, 2006). Mobile learning-based learning is also smooth, easy, efficient, relevant and convenient to support learning  (Q. Wu, 2015; Yang et al., 2021)

The International Journal of Science Education made the most contributions in this area, with a total of 58 articles identified. The magazine publishes 12 articles per year. We publish an article every month. The journal is also on record as the first issue from 1979 to the present (2022) with 8-10 journal articles published monthly. In fact, the journal focuses on early childhood science teaching and learning in a university setting. The journal also bridges research and practice by providing information, ideas, and opinions. This journal is an excellent reference for scholars, practitioners and educational researchers to publish their best papers.

## Conclusion

The distribution of annual publications has changed from 2013 to 2022 and will continue to evolve. It was then synthesized from 193 documents containing STEM in the Taylor & Francis database. Of the 193 articles, only 21 of them contain the word STEM in their titles, with 64 documents seeing a spike in publication frequency in 2022.

Most of the published work in the STEM field has themes of teaching, learning and empowering concepts. When broken down by country, the United States, United Kingdom and Sweden make the greatest contributions compared to other countries in this sector, followed by the Netherlands, Germany, Finland and Norway. The most cited authors are Joseph Krajcik, Susan Codere, Chanyah Dahsah, Renee Bayer, and Kongju Mun, who have been cited 110 times. Based on the number of articles, the International Journal of Science Education is his most contributing journal to STEM between 2013 and 2022.

The recommendation in this study is that a detailed survey of STEM publications is needed by including inclusion and exclusion criteria in the literature review. Then you can add the databases you want to use considering balanced or reputable databases.

## Acknowledgements

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