Bibliometric Analysis and Content Evaluation: Relationship between STEM Education and Islam and Other Religions

Ali Veysel Akcan[1].

Abstract

The study examines STEM education through a bibliometric analysis of 6008 publications. Using the Web of Science database, it identifies trends and key players in the field. The findings reveal a steady increase in STEM education publications since 2011, with the United States leading in both publications and citations. Purdue University stood out as the institution with the most publications, while the University of Washington was the most cited institution. Charles Henderson stood out as the most prolific author, while Scott Freeman was the most cited author. Cbe-Life Sciences Education was the leading journal in terms of publication volume, while Proceedings of the National Academy of Sciences of the United States of America was the most cited journal. The 10 most cited studies focus on productivity, achievement and gender ratios in STEM education, while the most recent studies focus on productivity, curriculum and improvement. In addition, studies on Islam and STEM education examine the relationship between them, while religiously-neutral studies examine the connection between STEM education and various religions.

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[1] Lecturer Dr., Department of Islamic Law, Necmettin Erbakan University, Konya, Turkiye, aliveysel.akcan@erbakan.edu.tr, ORCID: https://orcid.org/0000-0001-7994-8256

Introduction

STEM education has emerged in recent years as a prominent and contemporary educational approach, particularly within the educational policies of various countries, most notably the United States. This approach is designed to enhance students' cognitive abilities in science, technology, engineering, and mathematics from the early stages of learning through to the end of higher education. The primary aim is to foster critical thinking in students' everyday lives and scientific inquiries. It is feasible to describe STEM as an educational approach that can be evaluated through the lens of the positive sciences.

On the other hand, it is evident that all major world religions place great importance on education, both to effectively convey their religious teachings and to provide their adherents with a broad perspective in scientific and cultural contexts. In this regard, the perspectives offered by Islam and other religions in educational processes related to STEM subjects present an intriguing element in the foundation of modern educational approaches. This research, therefore, aims to establish an academic framework for examining the relationship between STEM and Islam, as well as other religions.

In today's ever-evolving world, the education of science, technology, engineering and mathematics, which are directly related to these, has become very important. This study aims to guide researchers about STEM Education by analyzing the studies conducted within the scope of STEM Education in the Web of Science database. In addition, the study also discusses some studies on the relationship between STEM Education and religion.

This study is important to get an idea about the studies conducted in the field of STEM Education and to identify the most important studies. Afterwards, it is also important to examine these studies related to Islam and religions in general with the content analysis method in order to show the relationship between the studies in the field of STEM Education and Islam and religions in general. therefore, this study aims to contribute to researchers working in the field of STEM Education. In addition, it is also useful for researchers who conduct research on the Islamic religion in terms of partially examining the relationship between the field of STEM Education and the Islamic religion. The same is true for researchers working on religions in general.

This analysis study on STEM Education seeks answers to questions such as which fields the studies on STEM Education are related to, the most important people and the most important studies in this field, which countries, institutions and journals attach the most importance to STEM Education, what are the contents of the most cited and most up-to-date studies, and finally how STEM Education is related to religions in general and Islam in particular. Within the scope of these questions, the Web of Science database was scanned by the bibliometric analysis method and some selected studies were scanned by the content analysis method.

This study aims to find the following questions in the field of STEM Education:
1) Which country has the highest number of publications and citations in the field of STEM Education?
2) Which institution has the highest number of publications and citations?
3) Who are the most published and cited authors in the field of STEM Education?
4) Which is the most published journal and the most cited journal in the field of STEM Education?
5) What were the main focuses of the ten most cited studies in the field of STEM Education?
6) What were the main focuses of the ten most recent studies in STEM Education?
7) What are the aims of STEM Education studies related to the religion of Islam?
8) What are the aims of STEM Education studies related to religion in general?

Literature Review

Islamic Religion as Educational Tools and Educational Approaches of Other Religions

In recent years, various studies have been conducted using the religious perspective

in relation to the issues of STEM education. In a research that deals with the innovative approaches of science and religion in the education system, a religious evaluation is made about the technology-related aspect of STEM (Qambarov, 2022). In an article written on a similar topic, the impact of the use of technology on students in universities in Pakistan, a country where Muslims live in large numbers, is evaluated (Rehman et al., 2018). In a study conducted in Malaysia, an attempt to create a new curriculum by evaluating the progress of science together with the basic values of the Islamic religion and the method it has put forward regarding education (Ibrahim et al., 2015). A research that offers an evaluation and solution proposal that scientific education in the Islamic world is generally insufficient can also be evaluated in this context (Zou'bi, 2015). In addition to these studies that offer various evaluations on the relationship between science and religion, there are also remarkable studies on the specific fields of STEM. Among these, a research that evaluates reproductive technology in the perspective of Catholicism, Evangelicalism, Judaism and Islam (Godoy Vazquez, 2014), a research that talks about innovative searches in education in Islamic countries and puts forward a new listening software in this context (Yaniafari et al., 2020), a research on the use of ISTE standards for students studying in faculties of education at a university in Gaza, Palestine (Aqel, 2021) are some of the articles written on the subject in recent years.

Method

In this study, bibliometric analysis of studies published in the field of STEM Education was conducted. This analysis is a method of analysis based on scanning some information in documents, then counting and ranking them according to certain principles. This analysis method is important in terms of facilitating a better understanding of the studies and obtaining different data on the studies. It is an important method especially in determining the studies with the highest impact level (Karataş at al., 2024).

Bibliometric analysis of studies published in STEM Education involves examining 6008 publications in this field, focusing on keywords, authors, institutions, countries, citation counts, and publication counts to identify relationships among them. This analysis was conducted using the VOSviewer program, employing mapping and tabulation methods with data from the Web of Science database. Some studies have also been utilized in the interpretation of the maps (Perianes-Rodriguez et. al., 2016; Rezazade et al., 2020; Tural & Yıldırım, 2024; van Eck & Waltman, 2010).

The analysis covers studies published until February 2024. The database of these studies was retrieved from Web of Science. For this database, the words "education*", "science*", "math*", "engineer*" and "technolog*" were searched in the Topic section at the same time and studies that may be related to STEM Education were reached. Apart from this, no filtering was used. Version 1.6.20 of the VOSviewer programme was used to create tables and maps from the database.

According to the above information, the studies published in the Web of Science database according to years are as follows: The first year in which the number of publications in the field of STEM Education reached double digits was 1997, with a total of 11 publications. In 2011, this number increased to 179, marking the first instance of a triple-digit figure. However, there has yet to be a year in which the number of publications reached 1000. The year 2019 saw the highest number of publications, with 687 publications. Following 2019, the subsequent most published years were 2021 with 642 publications and 2020 with 611 publications. The number of publications published from 2018 to 2011 are as follows, respectively: 526, 463, 357, 321, 290, 208, 187, and 179.

A total of 34 studies were selected for content analysis, including the 10 most cited and 10 most recent studies, along with 7 studies each related to Islam and to the intersection of STEM Education and religions in general. These studies were analyzed using the content analysis method, focusing on their aims and results.

Analysis of Studies in Web of Science by Mapping and Tabulation Method

Most Used Keywords in Publications

Table 1 was prepared to show the frequency of keywords used in the studies. While compiling this table, the 10 most frequently repeated keywords were selected from those that appeared at least 40 times. In this context, the most frequently used keyword was 'STEM' with 1158 occurrences. The second most frequent keyword was 'STEM Education' with 661 occurrences, followed by 'Education' with 354 occurrences.

According to the map, it is evident that 'STEM,' the most frequently used keyword, is represented by the largest circle and exhibits the strongest connection with 'Education,' the third most used keyword. Additionally, it is observed that 'STEM' has strong connections with the keywords 'Engineering,' 'Science,' and 'Gender'.

Upon examining the temporal chart on the same map, it is observed that studies in the field of STEM Education were predominantly conducted between 2017 and 2020. The initial studies focused on Educational Technology, e-Learning, Assessment, and Engineering Education. Notable keywords include STEAM, STEM Education, Computational Thinking, Augmented Reality, Virtual Reality, and Equity. From this, it is inferred that the earlier studies primarily centered around the intersection of education and technology, while current studies tend to emphasize STEM more broadly.
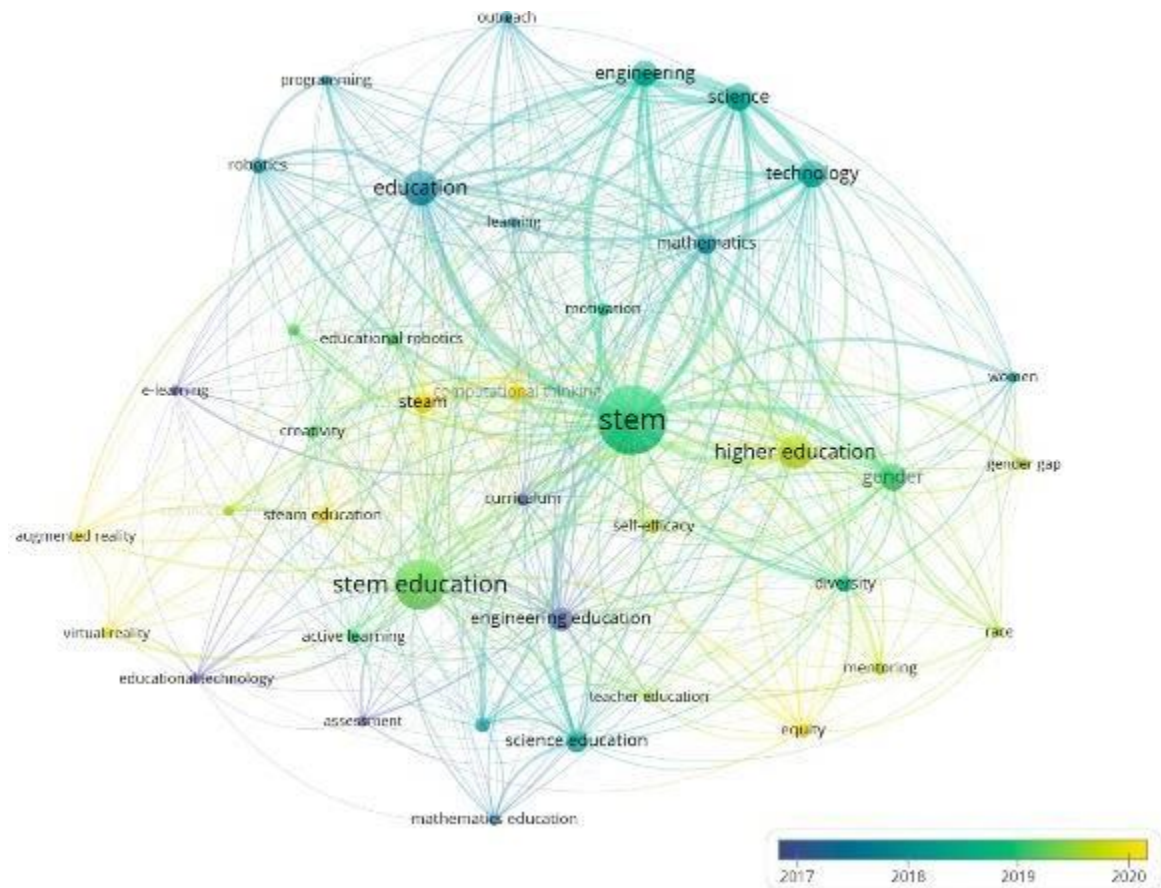
Table 1

Number of Key Words Used in Publications

Keywords	Number of Uses
STEM	1158
STEM Education	661
Education	354
Higher Education	324
Gender	233
Science	225
Technology	223
Engineering	207
Engineering Education	170
Science Education	155

Source: *Obtained from the VOSviewer program using the WoS database*.

Figure 1

Relationship between Keywords in Publications

Source: *Obtained from the VOSviewer program using the WoS database.*

Countries with the Most Publications and the Number of Citations to These Publications

Table 2 was compiled to show the number of countries with the highest number of publications. In creating this table, 10 countries with at least 1 publication and a minimum of 135 citations were selected. The United States of America ranks first with 3114 publications, followed by Spain with 320 publications, and China with 254 publications. Turkey ranks eighth with 127 publications.

The United States of America is the most cited country with 58301 citations, followed by the United Kingdom with 3463 citations, and Australia with 3334 citations. Turkey ranks ninth with 1090 citations.

Significant disparities exist between the United States and other countries in terms of both the number of publications and citations. The United States has published 2794 more publications than Spain, the country with the closest number of publications. Similarly, the United Kingdom, the closest country in terms of citations, has received 54838 fewer citations than the United States. Although these differences can be attributed to various factors, it is evident that the United States of America places the highest importance on STEM Education based solely on the number of publications and citations. In Map 2, the United States is depicted with the largest circle, consistent with the aforementioned data. It exhibits strong connections with Spain, England, Australia, and China. Additionally, the United States has close ties with Austria, Portugal, and Greece.
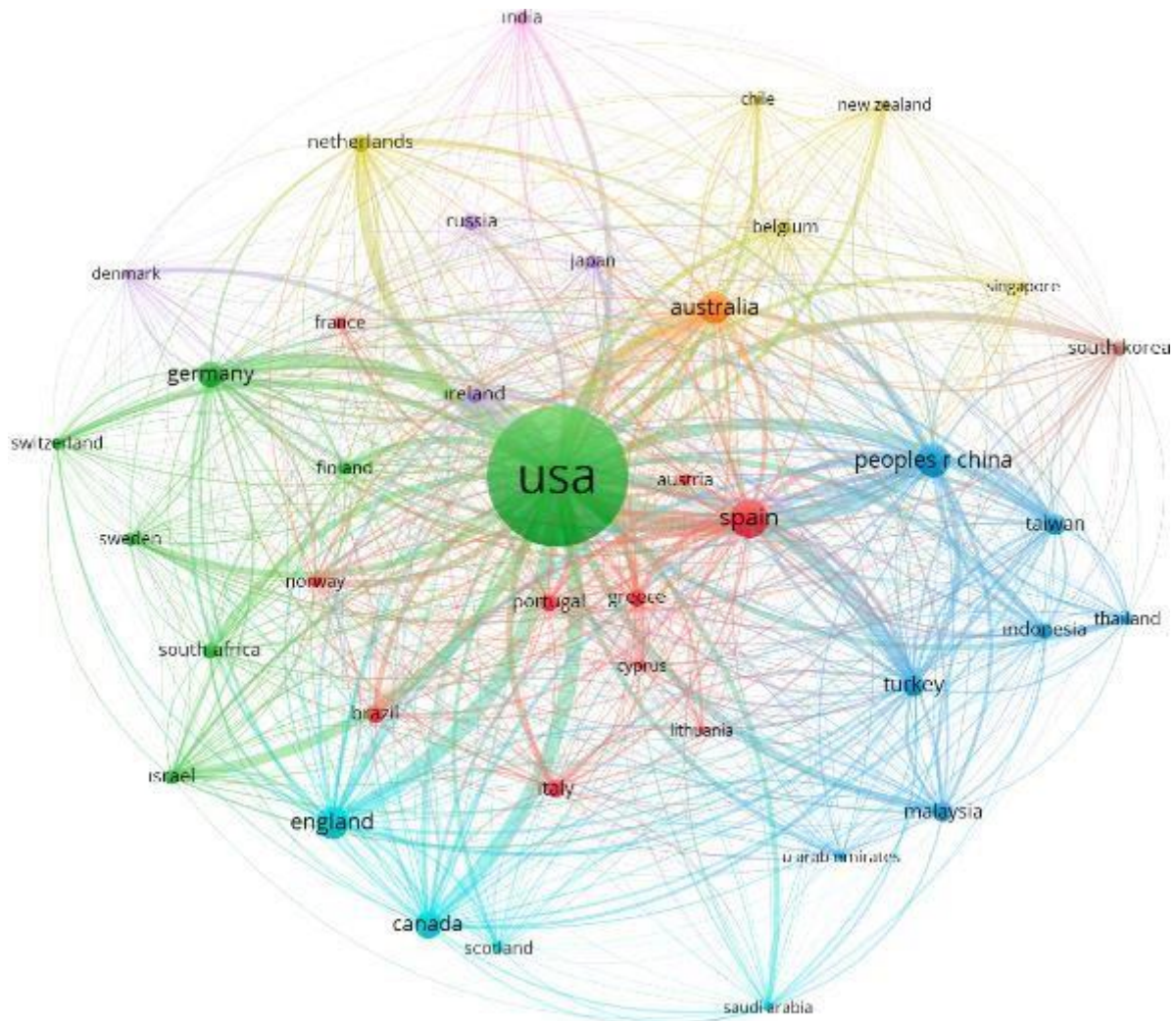
Table 2

Publication and Citation Numbers of Countries

Country	Number of Publications	Number of Citation
United States of America	3114	58301
Spain	320	2598
China	254	1589
England	249	3463
Australia	238	3334
Canada	171	1843
Germany	168	1572
Turkey	127	1090
Taiwan	113	1196
Malaysia	104	532

Source: *Obtained from the VOSviewer program using the WoS database.*

Figure 2

Relations of Countries with Each Other in Publications

Source*: Obtained from the VOSviewer program using the WoS database.*

Institutions with the Most Publications and the Number of Citations to These Publications

Table 3 was compiled to display the number of institutions with the most publications. In compiling this table, 10 institutions with at least 1 publication and a minimum of 594 citations were selected. Purdue University ranks first with 117 publications, followed by the University of Wisconsin-Madison with 80 publications, and Texas A&M University with 78 publications.

The most cited institution is the University of Washington with 5819 citations, followed by the University of Maine with 3822 citations, and Northwestern University with 3105 citations.

Although Purdue University has the highest number of publications, it is not the most cited institution. The University of Washington, although not in the top 10 in terms of publications, ranks first in terms of citations. The Human Sciences and Technologies Advanced Research Institute received the most citations per publication. Although it has only one article published, this article has been cited 1010 times in total. Map 3 illustrates that Purdue University has strong ties with the University of Wisconsin-Madison and Texas A&M University. It also has close connections with The University of Melbourne and Cornell University.
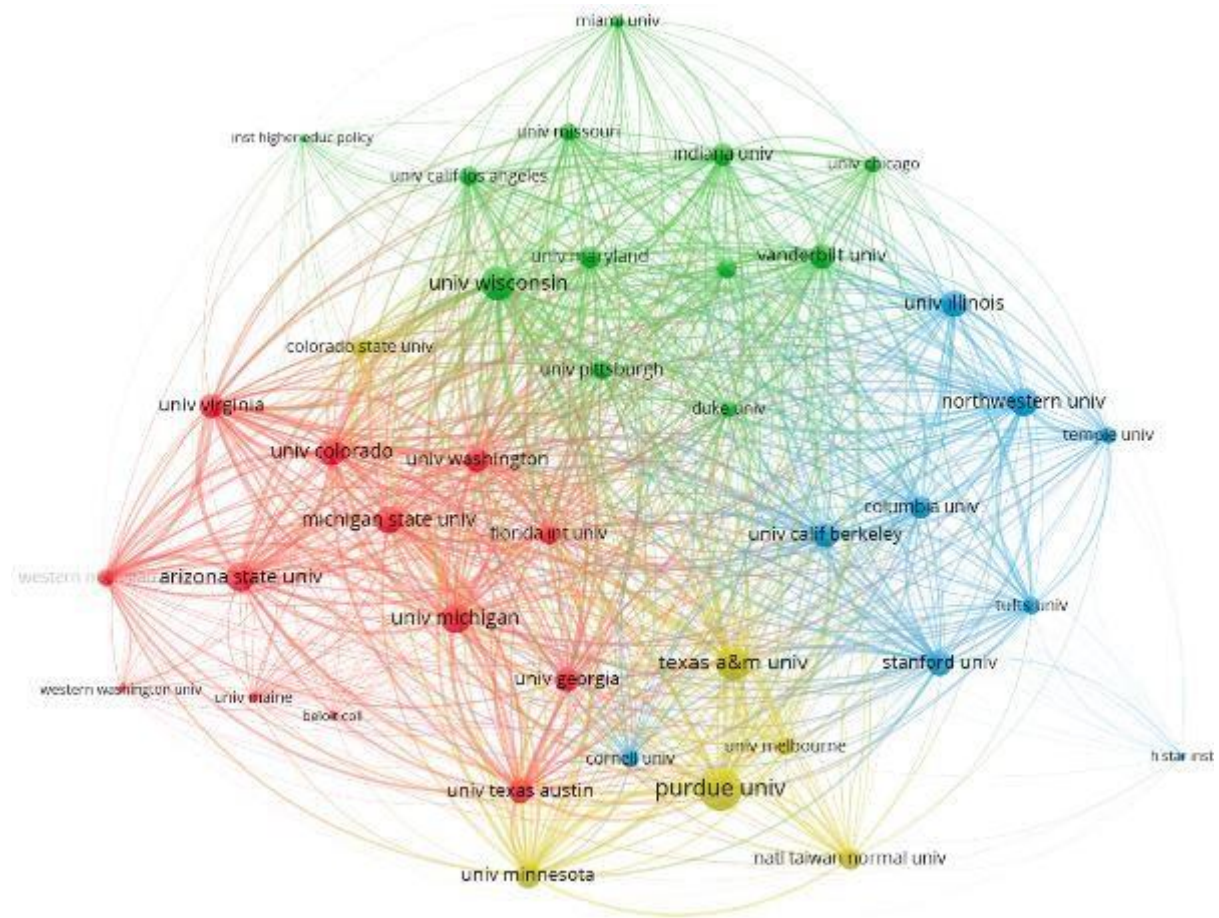
Table 3

Publication and Citation Numbers of Institutions

Institution	Number of Publications	Number of Citation
Purdue Univ.	117	2177
Univ. of Wisconsin-Madison	80	2919
Texas A&M Univ.	78	1695
Univ. of Michigan	64	923
Arizona State Univ.	61	696
Northwestern Univ.	58	3105
Michigan State Univ.	55	719
Univ. of Colorado	53	1429
Univ. of Illinois	52	681
Vanderbilt Univ.	46	2613

Source: *Obtained from the VOSviewer program using the WoS database.*

Figure 3

Relationships between Institutions in Publications

Source: *Obtained from the VOSviewer program using the WoS database.*

Most Published and Most Cited Authors

Table 4 was compiled to present the number of authors with the most publications. In compiling this table, 10 researchers with at least 1 publication and a minimum of 515 citations were selected. Charles Henderson ranks first with 11 publications, followed by David H. Uttal and Amanda B. Diekman, each with 9 publications. The differences between the researchers in terms of the number of publications they have made are not significant, with only a two-publication difference between the top-ranked author and the closest following author.

The most cited researcher among the authors is Scott Freeman with 4708 citations, followed by Hannah Jordt with 4136 citations, and Sarah I. Eddy with 3956 citations. Among the top 10 most cited researchers, there is a significant difference in the number of citations between the first and last authors, with 3436 citations. There is a difference of 572 citations between the first-ranked researcher and the second-ranked researcher. Miles Mcdonough and Nnadozie Okoroafor stand out in the list ranked according to the number of citations, as they received 3660 citations from a single publication on STEM Education. Map 4 illustrates Charles Henderson's close relationship with Amanda B. Diekman and his connections with David Lubinski and David H. Uttal. However, the map also indicates a lack of strong connections between the authors in terms of citations.
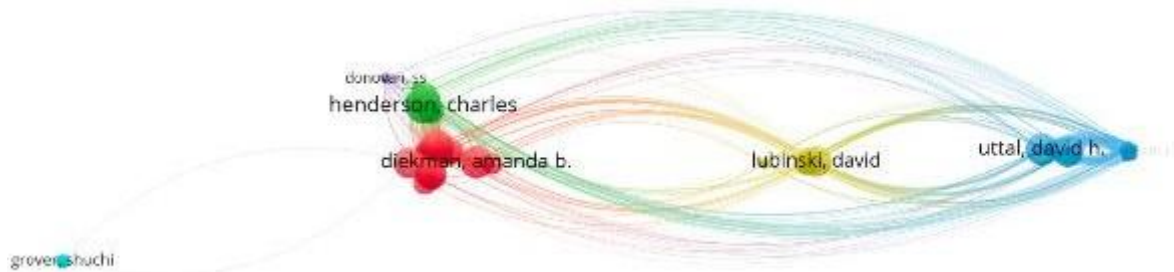
Table 4

Researchers with the Most Publications and Most Cited Researchers

Author	Number of Publications	Author	Number of Citation
Charles Henderson	11	Scott Freeman	4708
David H. Uttal	9	Hannah Jordt	4136
Amanda b. Diekman	9	Sarah I. Eddy	3956
Xueli Wang	9	Michella K. Smith	3761
Nora S. Newcombe	8	Mary Pat Wenderoth	3757
David Lubinski	8	Miles Mcdonough	3660
Judith M. Harackiewicz	8	Nnadozie Okoroafor	3660
Janet S. Hyde	8	David Lubinski	1462
Paul R. Hernandez	8	David H. Uttal	1450
Scott Freeman	6	Camilla P. Benbow	1272

Source: *Obtained from the VOSviewer program using the WoS database.*

Figure 4

Researchers' Relationships with Each Other

Source: *Obtained from the VOSviewer program using the WoS database.*

Most Published Journals and Citation Counts

Table 5 was compiled to present the number of journals with the most publications. In compiling this table, 10 journals with at least 1 publication and a minimum of 373 citations were selected. Cbe-Life Sciences Education ranks first with 114 publications, followed by Education Sciences Uttal with 111 publications, and the International Journal of Stem Education with 103 publications. There are not significant differences between the journals in terms of the number of publications, with only a three-publication difference between the top-ranked journal and the closest following journal. However, the same cannot be said for the number of citations, as there is a difference of 2613 citations between the two aforementioned journals. Although it did not make the list below, the most cited journal is the Proceedings of the National Academy of Sciences of the United States of America, with 14 publications in the field of STEM Education and a total of 5400 citations. Following this journal, the most cited journal is Cbe-Life Sciences Education, which also happens to be the journal with the most publications.

When observing Map 5, one cannot help but notice the strong link between the Cbe-Life Sciences Education journal and the International Journal of Stem Education. Examining the temporal chart of the same map, it becomes apparent that studies in the field of STEM Education were predominantly conducted between 2014 and 2020. In recent years, journals such as the International Journal of Stem Education, Education Sciences, Sustainability, and Frontiers in Psychology have shown a higher level of importance towards the field of STEM Education compared to other journals.
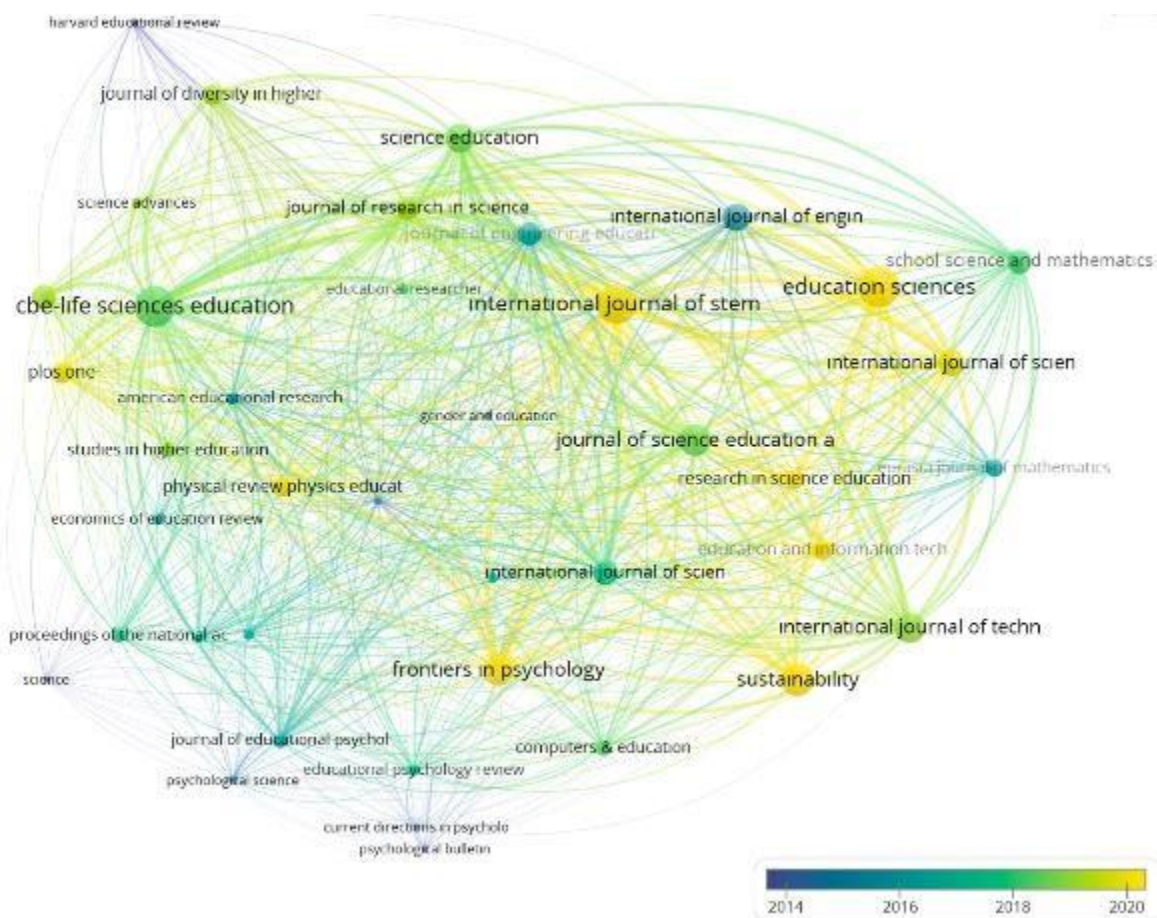
Table 5

Journals with the Most Publications and Most Cited Journals

Journals	Number of Publications	Number of Citation
CBE-Life Sciences Education	114	3287
Education Sciences	111	674
International Journal of Stem Education	103	2483
Sustainability	75	523
Journal of Science Education and Technology	69	1151
Frontiers in Psychology	67	750
International Journal of Technology and Design Education	63	1168
Science Education	57	2701
International Journal of Engineering Education	53	439
International Journal of Science and Mathematics Education	50	917

Source: *Obtained from the VOSviewer program using the WoS database.*

Figure 5

Relationships between Journals

Source: *Obtained from the VOSviewer program using the WoS database.*

Most Cited Studies

Table 6 was compiled to present the number of most cited studies. In compiling this table, 10 studies with the highest number of citations were selected, each cited at least 206 times. The most cited study, with 3660 citations, is by (Freeman et al., 2014) has been. The second study, with 1010 citations, is by (Grover & Pea, 2013) followed by (Wai et al., 2009) with 955 citations. The study by (Haak et al., 2011) with 486 citations, is ranked tenth.

Map 6 illustrates the most cited study, (Freeman et al. 2014). It is evident that this study has the highest number of citations, as indicated by the largest circle. However, it does not exhibit strong connections with other studies. According to the map, the strongest links are observed between (Xie et al., 2015) and (Wang & Degol, 2017), spanning across two countries. Additionally, a close relationship is noted between (Freeman et al., 2014) and (Springer et al., 1999).

Table 6

Most Cited Studies and Number of Citations

Publication	Number of Citations
Freeman et al., (2014)	3660
Grover & Pea, (2013)	1010
Wai et al., (2009)	955
Springer et al., (1999)	949
Uttal et al., (2013)	908
Blickenstaff, (2005)	781
Ceci & Williams, (2011)	610
Diekman et al., (2010)	499
Maltese & Tai, (2011)	491
Haak et al., (2011)	486

Source: *Obtained from the VOSviewer program using the WoS database.*

Figure 2

Relationships between the Most Cited Studies
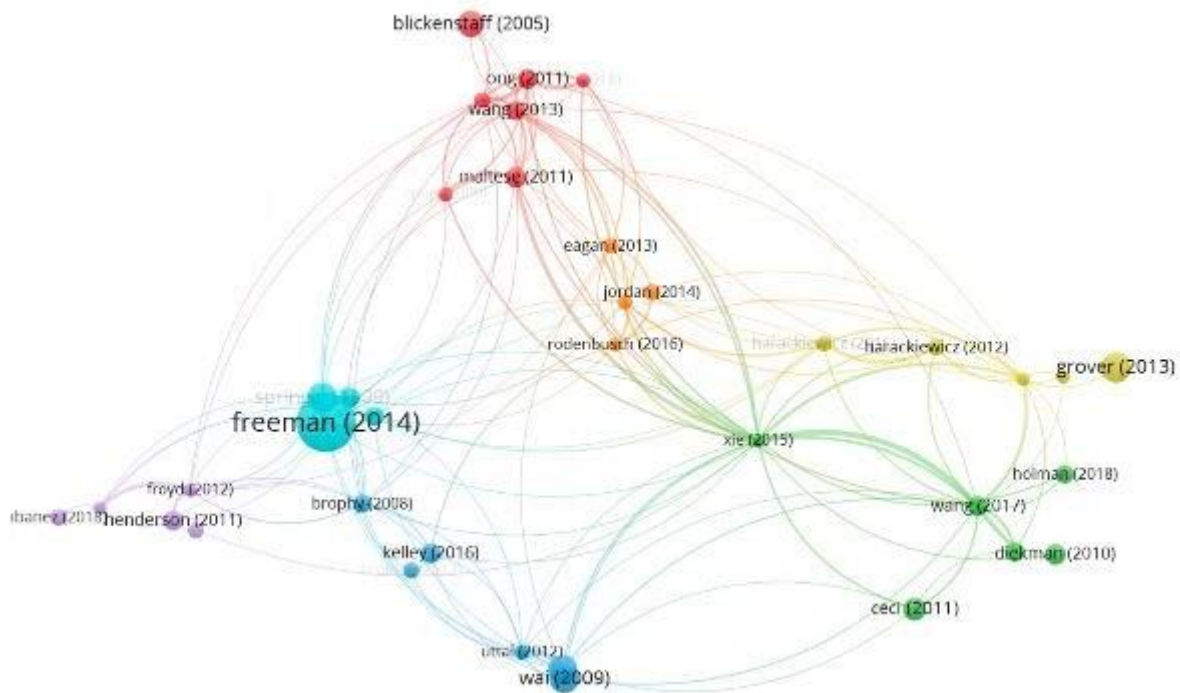
Source: *Obtained from the VOSviewer program using the WoS database.*

Content Analysis of Studies in Web of Science

Content Analysis of the 10 Most Cited Studies

Freeman et al., (2014), This research comprises a meta-analysis of 225 studies conducted to evaluate the difference between traditional lecturing and active learning in

undergraduate science, technology, engineering, and mathematics (STEM) courses. These studies were analyzed using data such as exam scores and failure rates. The results revealed that students who received traditional lectures were 1.5 times more likely to fail than students who engaged in active learning. Therefore, it was concluded that active learning positively affects student performance. Heterogeneity analyses indicate that these results are generally valid across STEM disciplines. Furthermore, active learning was found to increase concept inventory scores more than lecture exams, with this effect being particularly significant in small classes. It is emphasized that this study represents the most comprehensive research to date on this topic.

Grover & Pea, (2013) In her article on computational thinking, Jeannette Wing advocates for the integration of STEM learning into every child's analytical ability. Building upon Wing's work, Grover and Pea utilized her article as a foundational piece to explore recent academic literature and shape the ongoing discourse surrounding computational thinking in K-12 education.

Wai et al., (2009) In their paper, the researchers examined the significance of spatial ability in both education and business, with a particular focus on its relevance to STEM fields. For their study's data, randomly selected participants from high schools in the United States were followed for more than 11 years. The results confirm the theory that an individual's spatial ability plays a crucial role in the development of expertise in STEM fields. Additionally, the study underscores the importance of including spatial ability in modern talent research, as it may lead to the discovery of numerous individuals with untapped STEM potential.

Springer et al., (1999), This study presents the results of a meta-analysis of STEM education studies conducted at the undergraduate level between 1980 and 1999. The researchers conclude that various small group learning methods are effective in enhancing academic achievement, fostering positive attitudes toward learning, and improving retention rates in STEM courses and programs.

Uttal et al., (2013) The researchers conducted a meta-analysis of 217 studies to examine the impact, magnitude, moderators, robustness, and generalizability of education on spatial skills. Their aim was to assess the potential of education and experience in enhancing spatial skills and determine the extent to which such improvement is achievable. This investigation stems from the understanding that strong spatial abilities significantly influence achievement in STEM fields. The study concludes that spatially enriched education has the potential to yield significant gains by boosting participation in mathematics, science, and engineering.

Blickenstaff, (2005), The author contends that women are underrepresented in STEM fields and careers. The paper examines the reasons cited for this underrepresentation over the past 30 years. It argues that while some reasons are unfounded, others are multifaceted. Consequently, the paper concludes that reforms in science education are crucial to increase women's involvement in STEM disciplines.

Ceci & Williams, (2011), The researchers investigate current factors contributing to the underrepresentation of women in STEM fields, analyzing data spanning 20 years since their study's publication. Their research challenges the relevance of discrimination as a significant factor, suggesting that such assertions may obscure the true underlying causes. They argue that society's emphasis on addressing historical issues detracts from addressing contemporary challenges. Instead, the researchers advocate for institutions to adopt an approach that prioritizes education and policies aligned with biological realities to address the underrepresentation of women in STEM fields.

Diekman et al., (2010), The study examines factors influencing women's preference for STEM careers, noting the disparity in gender representation compared to other disciplines. It argues that STEM fields are less aligned with societal goals, which are prioritized by women, leading to their underrepresentation in these disciplines. The researchers propose a new perspective on the underrepresentation of women in STEM, highlighting the importance of societal goals in career preferences.

Maltese & Tai, (2011), The article investigates the correlation between American students' pursuit of degrees in STEM fields and their educational backgrounds. Employing an analytical method, the researchers focused on students who opted for STEM fields. The study reveals that students' decisions to concentrate in STEM fields are often made during high school and are primarily driven by their interest in STEM rather than their academic achievement. Consequently, the article suggests that policies emphasizing advanced course-taking and achievement may not effectively encourage STEM participation.

Haak et al., (2011) In their study, the researchers aimed to address the achievement gap between advantaged and disadvantaged STEM students by implementing a course focused on developing higher-order cognitive skills through daily and weekly practice. This study found that their approach improved the performance of all students in a university-level introductory biology class. Additionally, they found evidence that it reduced the achievement gap between disadvantaged and advantaged students. Finally, the research indicates that active learning methods provide positive benefits for all students.

Content Analysis of the 10 Most Recent Studies

Abramowitz et al., (2024) The study aims to explore the inclinations of scientists engaged in K-12 outreach and interested in STEM disciplines. Utilizing data from 50 studies conducted between 1990 and 2021, the research highlights the need for more comprehensive and detailed scientific studies to enhance understanding of best practices and challenges faced by K-12 outreach scientists in STEM disciplines. Furthermore, the study argues that integrating outreach activities more effectively into educational practices could lead to the development of more impactful outreach programs that promote participation in STEM.

Martella et al., (2024), The study aims to investigate the impact of lecturing and active learning intensity on learning outcomes in the active learning literature. Two experiments were conducted for this purpose. In the first experiment, students were either exposed to course information solely through lecture or solely through active learning, and their performance was evaluated. The results indicated that students exposed only to lecture achieved higher scores than those exposed only to active learning. In the second experiment, students experienced multiple learning methods, and it was concluded that individuals exposed to learning under interspersed conditions achieved higher scores compared to others.

Bryson et al., (2024), The researchers aimed to investigate how Latino and Black graduate students studying in STEM fields perceive changes in their relationships with their advisors over time and identify the factors influencing these changes. Data were collected through individual interviews conducted over three years, transcribed, and analyzed. The results revealed that most participants were aware of changes in their relationships with their advisors. Factors such as accessibility, trust, and communication were identified as influential in shaping these relationships.

Murthi et al., (2024) The study aims to explore the experiences of autistic and non-autistic students participating in STEM activities within engineering clubs. The research findings indicate that students, regardless of neurodiversity, demonstrated a strong interest in the STEM curriculum. They also acquired scientific concepts and actively engaged in the engineering design process using these concepts.

Dawson et al., (2024) Drawing upon theories developed by Foucault, Gee, and Sedgewick, the researchers aim to examine the influence of social justice discourses on educators in non-science learning contexts. Within this framework, three primary discourses—Inclusion for STEM, inclusion for the institution, and inclusion for minority youth—were identified. The study reveals that educators utilize these discourses in tandem, leading to productive outcomes and the development of broader visions for equitable practices.

Zhu et al., (2024), This study focuses on the effect of spatial thinking on sixteen children's thinking about design through a five-week process. Based on the findings, the researchers offer some suggestions to support children's comparative reasoning and spatial

thinking activities. Because the researchers observed spatial thinking processes related to design and open-ended problem solving in the participants.

Chun et al., (2024), This study focuses on the career development of students with disabilities who receive STEM education in STEM fields. In this respect, it aims to investigate the effects of career development activities on students' quality of life, goals, expectations and self-efficacy in STEM education. The findings of the study suggest that fostering collaboration among students, strengthening students' support systems and increasing their access are very important and critical factors in facilitating students' career exploration in STEM fields.

Kizilay et al., (2024), The study aimed to underscore the significance of integrating technological elements, particularly virtual reality, in STEM education. Science teachers were tasked with designing and constructing roller coasters after witnessing a real-life roller coaster accident. Subsequently, they utilized virtual reality to test their creations and identify any design flaws. The study found that virtual reality facilitated error detection and correction, leading to the conclusion that it plays a crucial role in enhancing STEM education.

Wessner et al., (2024) The study investigates the significance of incorporating artistic activities into STEM education. STEM students were tasked with creating a COVID-19-themed art gallery and exhibiting their work. The findings suggest that engaging in this art exhibition prompted deeper reflection on the pandemic among students. The study concludes that integrating art exhibitions into STEM education can yield benefits for both students and the public.

Cammeraat et al., (2024), The researchers investigate the relationship between industries' investments in institutional capital and labor skills and productivity. The findings reveal a positive correlation between employees' STEM skills and productivity.

Content Analysis of 7 Studies on Islam

Nathie & Abdalla, (2020) The study examines the course choices and career preferences of nine Year 11 and Year 12 Islamic school students in Australia. The findings indicate that students preferred subject clusters align with STEM disciplines, with medicine, engineering, law, and business being the most preferred occupations. However, Arabic and Islamic Studies were not significantly preferred. The study acknowledges gender-based differences without elaborating on their nature or extent.

Vasinayanuwatana et al., (2021) The paper presents a case study where Islamic Shura practice was incorporated into a Professional Learning Community to enhance the professional development of STEM teachers in an Islamic school in Thailand. The study demonstrates how integrating Shuratic practices strengthened teachers' understandings and beliefs in STEM teaching. The findings suggest implications for establishing STEM Professional Learning Communities in Islamic school contexts, which can assist science teachers in embracing and addressing challenges in STEM education.

Yakob et al., (2022), This study examines the integration of STEM elements into the Islamic Education curriculum, emphasizing the importance of merging science and technology with Islamic teachings for the advancement of the ummah and Islamic civilization. Recognizing the critical role of STEM in engaging students' interest in science and technology, the paper discusses the incorporation of STEM elements in the Islamic Education curriculum. This integration includes incorporating scientific content, teaching scientific skills, promoting a scientific attitude, utilizing technology in teaching and learning, highlighting the connection between Islamic teachings and scientific phenomena, and providing a comprehensive understanding of biology and human life, including terms such as sperm, egg, zygote, embryo, and fetus.

Rane et al., (2022), The article examines the correlation between individuals' educational background and their understanding of Islamist jihad, based on a survey of 1034 Muslim Austrians. The results indicate that individuals educated in STEM fields are more inclined to accept ideas related to Islamism and jihad compared to those educated in humanities and social sciences. Additionally, individuals without higher education degrees are more receptive to jihad-

related ideas compared to those educated in STEM or social-humanities fields.

Mardiyah et al., (2021), The study investigates the perceptions of Islamic high school chemistry teachers in South Tangerang, Indonesia, regarding STEM education. A questionnaire comprising 17 questions was employed for data collection. The findings indicate that teachers hold a positive perception regarding the significance of STEM education in the learning process. This suggests their acknowledgment of the importance of integrating science, technology, engineering, and mathematics subjects into their teaching practices.

Satterley et al., (2023) The article investigates the correlation between individuals' educational interests and Islamist-jihadist ideology. The research reveals that individuals interested in STEM education exhibit greater identification with political Islamist and militant typology compared to those interested in humanities and social sciences. Furthermore, they are more likely to believe in defending Islam as a political system, consider the caliphate a religious responsibility, and perceive jihad as both defensive and offensive.

Fathin, (2021), The study investigates the influence of STEM learning models on the cultivation of clean and healthy living behaviors in Islamic Boarding Schools. Conducted among students in a specific class of an Indonesian Islamic Boarding School, the results indicate that STEM education positively impacts students' behaviors related to clean and healthy living. Specifically, there was an observed increase in students' actions supporting a healthy and clean lifestyle following STEM education.

Analysis of 7 Studies on Religion

Pavic & Suljok, (2022), The study aims to examine the variance in beliefs regarding vaccine conspiracy theories between students in social sciences and humanities versus those in STEM fields. The results indicate that students in social sciences and humanities exhibit a higher inclination towards vaccine conspiracy theories compared to their counterparts in STEM fields. Furthermore, being female and having a religious personality were identified as factors supporting the tendency to believe in vaccine conspiracy theories.

Donmez et al., (2022), The researchers aimed to explore variations in students' orientation towards STEM fields in Turkey based on gender, grade level, place of residence, school type, family education level, and family income level. The study revealed several key findings: male students exhibited a higher interest in STEM fields compared to female students; gifted students showed greater interest in STEM than those without religious orientation; students' interest in STEM fields was positively correlated with their parents' educational level; however, interest in STEM decreased as grade level increased; finally, there was an observed increase in the tendency towards STEM fields with higher family income levels.

Barnes et al., (2020), The researchers aimed to investigate how the religious backgrounds of students of color influenced their acceptance of evolution. The results revealed that American Black students exhibited higher levels of religiosity compared to other ethnic groups. Additionally, as the level of religiosity increased, the acceptance of evolution decreased. This suggests an inverse relationship between religious background and acceptance of the theory of evolution.

Imaduddin & Zuhaida, (2019), This paper advocates for the implementation of the STREAMIN (Science Education, Regarding Technology, Religion, Engineering, Arts, Mathematics, Indigenous Culture, Nationalism) Model as an innovative approach to science education in Indonesia. By reviewing literature across various domains including science education, technology, religion, engineering, arts, mathematics, indigenous culture, and nationalism, the study emphasizes the importance of integrating the arts alongside STEM fields to foster innovative thinking. Given Indonesia's diverse cultural landscape and national identity rooted in religious beliefs, the paper argues for an educational model that reflects these core values. Thus, it concludes that Indonesia requires an educational approach that goes beyond traditional STEM education to embrace innovation, religious values, and national identity.

Vebrianto et al., (2019), This study aims to create a STEMR (Science, Technology, Engineering, Mathematics, Religion) biology textbook through an integrated approach that meets competency and competitiveness standards. Evaluation results indicated strong agreement among experts and pre-service teachers regarding the requirements and usability of the STEMR module. The developed STEMR module was deemed suitable for implementation in educational institutions, facilitating knowledge integration and fostering the professional development of pre-service teachers.

Kerr et al., (2018) The researchers aim to investigate the low enrollment of native Hawaiians and Pacific Islanders in university STEM courses. Findings reveal several contributing factors: some students face familial opposition rooted in traditional beliefs or religious practices, hindering their pursuit of higher education; geographic barriers, such as limited access to high schools on remote islands, impede educational opportunities; inadequately trained STEM teachers diminish student interest and achievement; financial constraints, including transportation and housing costs, deter participation in university and STEM courses.

Barnes et al., (2017) The researchers investigated factors influencing the retention of Judeo-Christian students in biology courses, finding that some students experienced a conflict between course content and their religious identity. These students expressed distrust in biology courses due to perceived conflicts with their religious beliefs, citing instructors' rigid attitudes towards religion and evolution. The study suggests that religious beliefs may pose challenges for students in STEM fields, potentially impacting their learning experience. Further research is recommended to better understand this phenomenon and create supportive educational environments for students with religious beliefs.

Discussion and Conclusion

STEM Education has become increasingly important due to the constant advancements in science, technology, and engineering, leading to the discovery of new information and the development of new theories. As STEM fields are continually evolving, new challenges emerge, necessitating the discovery of solutions. Therefore, it is imperative to expand and enhance STEM Education to address these evolving needs.

Only the Web of Science database was utilized for this study. Web of Science was selected due to its status as one of the most influential databases globally, offering reliable and user-friendly data analysis and evaluation tools. Accordingly, the terms Education, Science, Technology, Engineering, and Mathematics were simultaneously queried within the Web of Science database. Consequently, this study encompassed articles pertinent to STEM Education for analysis and evaluation. As of the research date, 6008 publications were identified in the Web of Science database, spanning from 1992 to 2024. Notably, the highest number of articles was recorded in 2019.

In the keywords of the 6008 publications analyzed, "STEM" and "STEM Education" emerged as the most frequently used terms. While these words exhibit connections with various other terms, it's notable that they are particularly linked with the term "Gender." The associations established with other words can be attributed to the direct relevance of STEM to these concepts. The presence of "Gender" alongside STEM Education may stem from the observed gender disparities in the field, as evidenced by some of the highly cited articles examining the underrepresentation of women.

A chronological analysis of keywords reveals shifting trends over time. Recent years have witnessed increased emphasis on terms such as "e-Learning," "Virtual Reality," and "Equity." The heightened focus on e-learning is likely linked to the COVID-19 pandemic, which prompted a surge in online education. The emphasis on Virtual Reality aligns with the rapid advancements in this technology, with some articles advocating its integration into STEM Education for enhanced efficiency. The recent prominence of the keyword "Equity" may also be attributed to the gender-related discussions, given that "Gender" emerged as the most frequently used keyword.

The analysis revealed that the United States of America leads in both the number of

publications and citations in the field of STEM Education. Purdue University emerged as the institution with the highest number of publications, while the University of Washington garnered the most citations among institutions worldwide.

Charles Henderson emerged as the most prolific author, while Scott Freeman was identified as the most cited author in the field of STEM Education.

The journal with the highest number of publications in the field of STEM Education is Cbe-Life Sciences Education, whereas the most cited journal is Proceedings of the National Academy of Sciences of the United States of America. In recent years, it has been observed that journals such as the International Journal of STEM Education, Education Sciences, Sustainability, and Frontiers in Psychology have gained prominence in the field of STEM Education.

From these articles, the 10 most cited, 10 most recent, 7 articles related to Islam, and 7 articles directly related to religion in general were selected and subjected to content analysis. The content analysis focused on the aims of the studies and the results they reached. It is observed that the most cited studies primarily focus on the effectiveness and success rates in STEM Education, as well as the gender representation within STEM fields.

Conversely, the most recent studies tend to concentrate more on the efficacy of STEM Education, curriculum enhancements, and the overall advancement of STEM education methodologies
.
In studies on STEM Education specific to the religion of Islam, attention was mostly focused on the relationship between Muslims and Islam, and STEM fields. Conversely, STEM Education articles related to religion in a broader sense mostly highlighted individuals' religious perspectives, the impact of STEM Education, and the relationship between religion and STEM Education. Based on these studies, it can be concluded that STEM Education needs to be updated and developed in accordance with the changing living conditions, sociological, political, and historical backgrounds of the countries where it is provided. Therefore, STEM Education in Muslim societies, for example, should differ from that in non-Muslim societies. Integrating religious themes into STEM Education in Muslim societies and mitigating rigid attitudes of STEM educators towards religion will enhance efficiency in this field.

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