

Mathematics Education and Giftedness: A Bibliometric Study (1986–2025)

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Abstract

This study presents a comprehensive bibliometric analysis of research on mathematics education for gifted students published between 1986 and 2025 in the Web of Science database. A total of 153 peer-reviewed journal articles were examined using VOSviewer to identify publication trends, citation impact, leading authors, institutions, countries, and conceptual orientations. Findings reveal that the field, once marginal, expanded significantly after the mid-2000s and gained strong international visibility from 2015 onward. The United States leads the country-level analysis in publication output and citations, while South Korea shows substantial bibliographic linkages. Keyword and abstract analyses highlight connections between mathematics, assessment, curriculum design, policy, and student-centered learning. By mapping the intellectual structure and historical development of the field, this study provides a benchmark for future comparative and interdisciplinary research on educating mathematically gifted learners.

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1. Introduction

Gifted students often excel in mathematics due to their advanced cognitive abilities and original problem-solving skills, making their mathematics education a distinctive area of inquiry in educational research. Mathematics plays a central role not only in everyday life but also across science, technology, engineering, and mathematics (STEM) fields, and the development of mathematical thinking supports reasoning, inquiry, and critical thinking among gifted learners (Bilgiç & Baloğlu, 2025; Forde et al., 2023; Goos et al., 2023; Haeruman et al., 2024; Yanuari & Turmudi, 2023). However, the early identification of mathematically gifted students and their placement into suitable educational pathways remain significant challenges in the field (Budínová, 2024; Koshy et al., 2009). Although no single definition of giftedness is universally accepted, one of the most influential frameworks is Renzulli's Three-Ring Conception, which defines giftedness as the intersection of above-average ability, high motivation, and creativity (Renzulli, 1978). Tannenbaum (2003), by contrast, conceptualized giftedness as the transformation of potential abilities into exceptional performance and productivity.

1.1. Giftedness in Mathematics

Within this broader understanding, mathematics has emerged as one of the most prominent domains in which gifted students may demonstrate advanced abilities. Mathematical giftedness has been defined in different ways, reflecting variations in how students display mathematical potential (Gavin et al., 2013; Leikin, 2021a, 2021b). Sriraman (2005) defined mathematically gifted individuals as those

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capable of working at an in-depth and expert level in mathematics. In the literature, its identification is generally approached from two perspectives: one emphasizes outstanding performance on mathematics tests, while the other focuses on mathematical creativity, original problem-solving styles, and distinctive cognitive processes (Lubinski & Benbow, 2006; Suherman & Vidákovich, 2022). Miller (1990) similarly associated mathematical giftedness with exceptional curiosity about numerical concepts, rapid learning and application of mathematical ideas, and the ability to understand abstract relationships. These characteristics indicate the need to support mathematically gifted students from an early age through appropriate educational opportunities; otherwise, their potential may remain unrealized within the education system (Özdemir et al., 2024).

Research on mathematical giftedness has a history spanning more than a century, beginning with Burnell's 1917 article on mathematics instruction for gifted students. From the mid-20th century onwards, scholarly interest in the field expanded across disciplines (Leikin, 2021b). In recent years, the overall number of publications in gifted education has increased (Rius et al., 2025), yet studies specifically addressing mathematical giftedness have stagnated or even declined (Özdemir et al., 2024). This situation underscores the need for systematic analyses that trace the field's developmental trajectory, assess its international visibility, and identify research gaps.

1.2. Bibliometric Analysis

Bibliometric analysis is widely used to examine publication trends and provide a quantitative perspective on the development of a research field. It involves the statistical analysis of publications produced within a defined area and period, as well as the relationships among them. By revealing the historical development, current state, and possible future directions of a field, bibliometric analysis can guide researchers in identifying dominant themes, influential works, and research gaps (Van Raan, 1993). Reliable citation indexes such as the Web of Science (WoS) are central to this process because they provide access to high-impact journals and robust citation data (Gavel & Iselid, 2008).

Several studies have applied bibliometric approaches to mathematical giftedness. Bilgiç and Baloğlu (2025), for instance, examined Scopus-indexed studies to map the overall research landscape. Özdemir et al. (2024) revealed the intellectual structure and collaboration networks of the field and highlighted the recent decline in publication output. In the Turkish context, Arı et al. (2023) analyzed 104 nationally published articles between 2010 and 2023 and identified trends in domestic scholarship. Although these studies provide valuable insights, there remains a need for a systematic international analysis based on the WoS database, which offers broad coverage of highly cited and influential studies.

1.3. Research Aim

Against this background, the present study aims to provide a comprehensive overview of the international literature on mathematics education for gifted students within the WoS database. It examines the distribution of studies over time, identifies the most frequently cited articles, highlights the journals in which publications are concentrated, and maps the contributions of leading authors, institutions, and countries. It also analyzes keywords and frequently occurring concepts in abstracts to reveal the intellectual and conceptual structure of the field. By doing so, the study identifies current trends, traces the development of the field, and points to potential gaps for future research.

2. Methodology

2.1. Research Model

In this study, the bibliometric analysis method, a quantitative research approach, was employed. Bibliometric analysis systematically examines various aspects of academic publications, including authorship, year of publication, field of study, keywords, and cited sources (Van Eck & Waltman, 2010). This approach enables the identification of research trends, prominent themes, and gaps in a field through objective indicators. To evaluate the literature on mathematics education for gifted students, several bibliometric indicators were used. Keyword analysis was conducted to determine the main research orientations, while publication trends were examined to trace changes over time.

The study reviewed articles published between 1986 and 2025, thereby offering a long-term assessment of the field. In this way, it presents the historical development of research on mathematics education for gifted students, identifies leading researchers, maps citation networks, highlights international collaborations, and reveals conceptual concentrations. Consequently, both the overall profile of the existing literature and the research gaps for the future were identified on the basis of concrete data. Since the first relevant publication in the WoS database appeared in 1986, this year was taken as the reference point of the analysis.

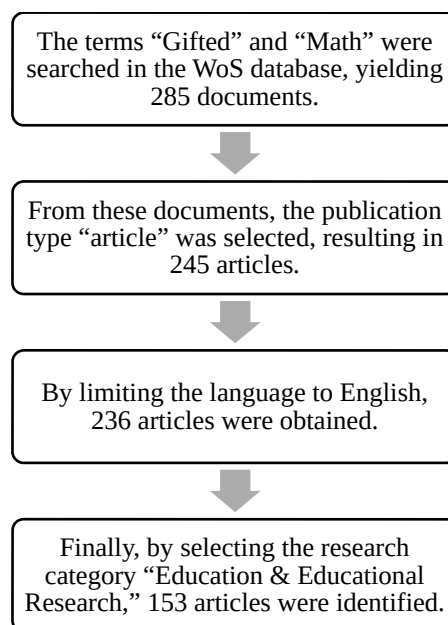
2.2. Data Collection Process

The data set for this bibliometric analysis was obtained from the WoS database. In the first stage, the Topic field was selected, and a search was conducted using the keywords “gifted” and “math.” The selection flowchart in Figure 1 reports 285 records at this stage. The data set was then refined by publication type, with only journal articles retained, resulting in 245 records. This decision was based on the assumption that articles, particularly those published in peer-reviewed journals, undergo rigorous scientific scrutiny and therefore offer higher reliability.

Only English-language articles were retained to keep the language of the analyzed records consistent; this restriction also limits the coverage of non-English research. After this step, the number of eligible articles was reduced to 236. Finally, to focus specifically on the educational domain, the Education & Educational Research category in WoS was applied, producing a final data set of 153 articles. The article selection process is illustrated in Figure 1.

Figure 1

Data Collection Process



2.3. Ethics Approval and Consent to Participate

Ethical approval and informed consent were not required because this study is based exclusively on the bibliometric analysis of publicly available bibliographic data and did not involve human participants.

2.4. Data Analysis Process

In this study, the WoS database was searched to examine research on mathematics education for gifted students. WoS is a widely recognized academic database that indexes studies published in high-impact journals and provides reliable citation data for bibliometric research (Falagas et al., 2008). The retrieved data were analyzed using VOSviewer, a software tool developed for constructing and visualizing bibliometric networks (Van Eck & Waltman, 2010). VOSviewer enables the analysis of citation, co-citation, collaboration, and keyword co-occurrence networks, thereby helping to identify

research patterns and conceptual structures within a field (Aria & Cuccurullo, 2017; Zupic & Čater, 2015).

The articles were analyzed in terms of publication year, country of origin, affiliated institution, citation count, author, and journal. In addition, frequently used keywords and terms in article abstracts were examined to construct a conceptual map of the field. These analyses were used to identify the historical development, international distribution, influential contributors, and potential research gaps in mathematics education for gifted students.

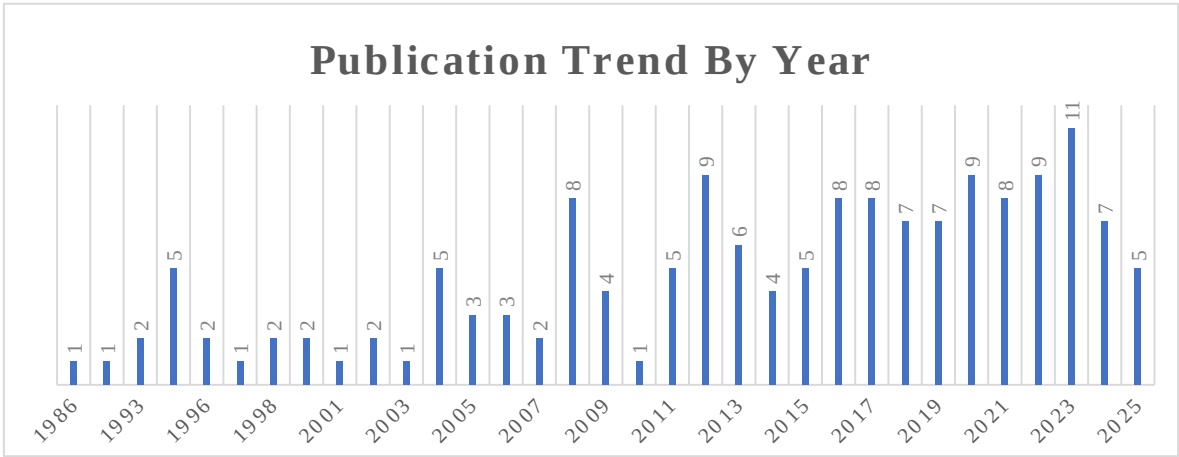
3. Results

This section presents the results of a bibliometric analysis of articles on mathematics education for gifted students published between 1986 and 2025. The analysis first examines the distribution of publications by year to reveal developmental trends in the field. It then identifies the most-cited articles and the journals contributing most to the literature. The productivity of prominent authors is assessed alongside their affiliated universities, faculties, and institutes, and the international distribution of studies is analyzed. In addition, the keywords used in the articles and the most frequently occurring concepts in the abstracts are reviewed to map the conceptual structure of the field.

3.1. Publication Trend by Year

Figure 2

Distribution by Year



As shown in Figure 2, the year-by-year distribution of articles published between 1986 and 2025 on mathematics education for gifted students reveals an irregular but generally increasing pattern. Between 1986 and 2000, publications were extremely limited, averaging only one or two articles per year, which suggests that the topic had limited visibility in the academic literature during this period. A noticeable increase began in the mid-2000s, with 2008 marking a turning point when the number of publications rose to eight. Another peak occurred in 2012 with nine publications.

From 2015 onward, research output became more consistent. Between 2016 and 2024, the annual number of studies remained relatively high, reaching its highest level in 2023 with 11 publications. Although the 2025 data are incomplete, the current record of seven publications indicates that interest in the topic has continued.

Overall, the findings show that research on mathematics education for gifted students gained momentum after 2008 and became a more sustained area of inquiry after 2015. This development points to the growing visibility of the literature within international research

3.2. Articles by Citation Performance and Link Strength

The article-level perspective of the bibliometric analysis was examined using the bibliographic coupling technique. Total link strength (TLS) was used to indicate the combined strength of an item's

links in the bibliographic network. In VOSviewer, under the “documents” option, the threshold for the minimum number of citations of a document was set to 1. The reported document-level network visualization included 46 articles at this threshold; this analysis-specific count is distinct from the complete set of 153 articles described in Section 2.2. This filtering produced a clearer network structure that revealed the connections among cited articles and visualized the distribution of research at the article level.

Table 1

Articles by Number of Citations and Link Strength

Article Author and Year	Number of Citations	TLS
Bergold et al. (2020)	30	43
Saß et al. (2025)	1	43
Cash and Lin (2022)	12	37
Preckel et al. (2017)	21	34
Andersen (2014)	21	29
Crabtree et al. (2019)	31	25

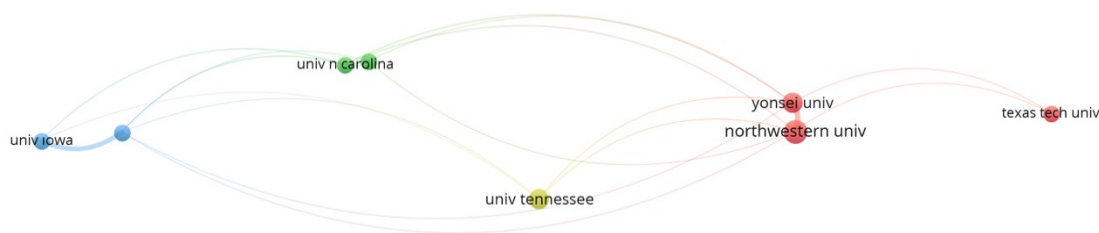
Note. Only articles with a link strength value of 25 or greater are included in the table.

As shown in Table 1, one of the articles with the highest link strength is Bergold et al. (2020) (30 citations, TLS = 43). This study stands out not only for its citation count but also for its strong network ties, which place it at a central position in the field. Likewise, Saß et al. (2025) (1 citation, TLS = 43) is noteworthy for achieving a very high link strength despite having relatively few citations, suggesting that it is already strongly embedded in the international literature. The studies by Cash and Lin (2022) (12 citations, TLS = 37) and Preckel et al. (2017) (21 citations, TLS = 34) also rank among the leading works in terms of both citation counts and link strength. From a bibliometric standpoint, these articles play a key role in shaping research trends.

In addition, Andersen (2014) (21 citations, TLS = 29) and Crabtree et al. (2019) (31 citations, TLS = 25) demonstrate strong connections supported by notable citation counts. Overall, articles with high TLS values occupy central positions in the literature regardless of their citation numbers, actively shaping the research agenda in mathematics education for gifted students. This finding highlights that academic impact should be assessed not only by citation frequency but also by the strength of a study’s bibliographic connections. The bibliographic coupling network among the articles is shown in Figure 3.

Figure 3

Bibliometric Links Between Articles



3.3. Distribution by Journals

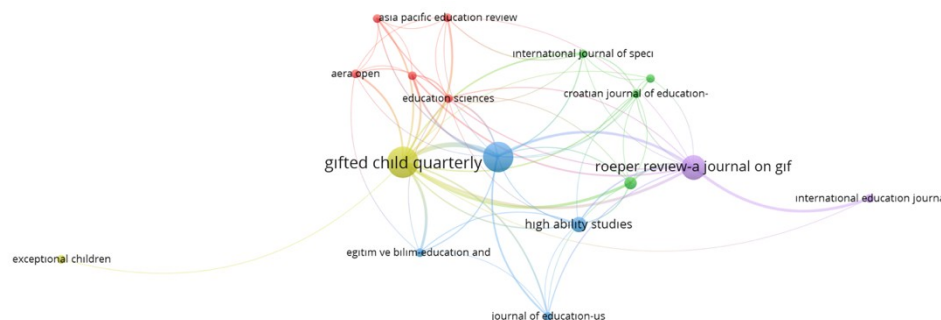
In the analysis process, the threshold values were intentionally kept very low to avoid narrowing the scope. A source was required to contain at least one article, regardless of its citation count. This approach allowed all journals meeting the stated threshold in the analyzed records to be included in the network visualization. As a result, all 17 journals in the dataset were incorporated into the analysis, and the network of relationships among journals publishing studies on “mathematics education for gifted students” was visualized, highlighting the most prominent publication outlets in the field.

Table 2*Number of Articles, Citations, and Link Strength of Articles by Journals*

Journal Title	Number of Articles (n)	Citations	TLS
Gifted Child Quarterly	13	366	161
Journal for the Education of the Gifted	12	130	104
Roeper Review – A Journal on Gifted Education	8	141	83
International Perspectives on Science	2	2	36
Journal of Advanced Academics	1	31	29

Note. Only the five journals with the highest TLS values are included in the table.

As shown in Table 2, *Gifted Child Quarterly* is the leading journal, with 13 articles, 366 citations, and a TLS of 161, making it both the most productive and the most influential outlet. The *Journal for the Education of the Gifted* ranks second, publishing 12 articles with 130 citations and a TLS of 104, reflecting a strong role in international scholarly interaction. *Roeper Review – A Journal on Gifted Education* contributed 8 articles, received 141 citations, and reached a TLS of 83, underscoring its importance in the field. By contrast, *International Perspectives on Science* produced only 2 articles with 2 citations, yet it attracted attention with a relatively high TLS of 36. Finally, the *Journal of Advanced Academics* contributed just one article, but this article received 31 citations and achieved a TLS of 29, securing a notable position within the scientific network. The bibliographic links among journals are shown in Figure 4.

Figure 4*Bibliometric Links of Articles by Journals*

3.4. Distribution by Authors

The author-level dimension of the bibliometric analysis was examined using the bibliographic coupling method. For this purpose, the author's option in VOSviewer was applied, with thresholds set at a minimum of two documents per author and no minimum citation requirement. Under these criteria, only 5 of the 138 authors in the dataset were included in the analysis. This filtering revealed the network structure of scholars publishing on “mathematics education for gifted students” and visualized their bibliographic-coupling relationships, as shown in Figure 5.

Table 3*Number of Articles, Citations, and Link Strength of Authors*

Author Name	Number of Articles (n)	Number of Citations	TLS
Bell, Sherry Mee	2	35	189
McCallum, R. Steve	2	35	189
Lee, Seon-Young	3	66	163
Olszewski-Kubilius, Paula	3	66	163
Mun, Rachel U.	2	62	163

As presented in Table 3, Bell, Sherry Mee, and McCallum, R. Steve stand out with two publications each, a combined total of 35 citations, and a very high link strength (TLS = 189). These values indicate prominent positions in the reported bibliographic-coupling network but do not directly establish co-authorship relationships or research quality. Similarly, Lee, Seon-Young (n = 3, 66 citations, TLS = 163), Olszewski-Kubilius, Paula (n = 3, 66 citations, TLS = 163), and Mun, Rachel U. (n = 2, 62 citations, TLS = 163) also exhibit relatively high citation counts and bibliographic link strengths in this analysis. Their publication output, citation counts, and bibliographic connections describe their visibility within the analyzed bibliographic network.

Overall, the authors listed in Table 3 have high reported citation counts and TLS values, illustrating that publication volume alone does not describe an author's position in the bibliographic-coupling network. The bibliometric connections among authors are illustrated in Figure 5.

Figure 5

Bibliometric Links Among Article Authors



3.5. Distribution by Organizations

A bibliographic coupling analysis was conducted in VOSviewer using the organizations option to examine the institutional distribution of publications. At this stage, the thresholds were set at a minimum of one document per organization and no minimum citation requirement. Under these criteria, all 75 organizations in the dataset were included in the analysis. This approach revealed which universities and other organizations are represented in studies on “mathematics education for gifted students” and visualized their bibliographic-coupling network.

Table 4

Number of Articles, Citations, and Link Strength of Organizations

Organizations	Number of Articles (n)	Number of Citations	TLS
Ball State Univ	1	21	506
College of William & Mary	1	21	506
Kansas State Univ	1	21	506
NAGC	1	21	506
TAG	1	21	506
Wyoming Assoc Gifted Educ	1	21	506
Indiana Acad Sci Math & Humanities	1	21	506

Note. NAGC = National Association for Gifted Children; TAG = The Association for the Gifted (Council for Exceptional Children). Only organizations with a link strength value above 500 are included in the table.

As shown in Table 4, organizations such as Ball State University, the College of William & Mary, Kansas State University, the National Association for Gifted Children (NAGC), The Association for the Gifted (TAG), the Wyoming Association for Gifted Education, and the Indiana Academy of Science, Mathematics & Humanities are each associated with one article in the analyzed records (n = 1). However, they all reached very high link strengths (TLS = 506), indicating that they have strong reported bibliographic-coupling links within the analyzed network. These results show that document

counts and bibliographic-coupling links measure different aspects of the network; a high TLS does not by itself establish institutional collaboration or research quality.

3.6. Distribution of Articles by Countries

The country-level dimension of the bibliometric analysis was examined in VOSviewer using the countries option with the bibliographic coupling method. The dataset was reported to contain 16 countries; Table 5 presents the available results for five of them. This analysis revealed the bibliographic coupling links among countries contributing to research on “mathematics education for gifted students”.

Table 5

Distribution of Articles by Countries According to Citation Count and Link Strength

Country	Number of Articles (n)	Number of Citations	TLS
USA	35	863	434
South Korea	5	90	282
Bahrain	1	4	204
Egypt	1	4	204
UAE	2	7	17

As shown in Table 5, there are marked differences among countries in terms of citation counts and link strength. The United States leads the field, with 35 articles, 863 citations, and a TLS of 434, giving it the highest document and citation counts among the five countries listed in Table 5. South Korea follows with 5 articles and 90 citations, supported by substantial bibliographic links reflected in a TLS of 282. By contrast, Bahrain and Egypt, although represented by only one publication each, achieved notable bibliographic linkages with TLS values of 204. Finally, the United Arab Emirates (UAE) contributed 2 articles and 7 citations but displayed a lower level of bibliographic connectivity, with a TLS of 17.

The five countries differ in publication volume, citation counts, and bibliographic-coupling strength; these statistics do not directly measure co-authorship collaborations. The bibliographic connections among countries are shown in Figure 6.

Figure 6

Bibliometric Connections Among the Countries of Article Authors



3.7. Most Frequently Used Topics in Keywords

In the bibliometric analysis, a co-occurrence analysis was performed in VOSviewer using the author keywords option to identify the concepts emphasized in the articles. The threshold was set at a minimum of two keyword occurrences. Under this condition, 22 of the 138 keywords in the dataset were included in the analysis, enabling the visualization of the main concepts preferred by authors in studies on “mathematics education for gifted students” and the relationships among these concepts.

As shown in Table 6, the keyword with the highest TLS is mathematics ($n = 6$, $TLS = 16$), confirming that the research is primarily concentrated around mathematics-focused themes. Among the keywords listed in Table 6, gifted education occurs most frequently ($n = 8$, $TLS = 11$); other prominent keywords include identification ($n = 2$, $TLS = 11$), special populations ($n = 2$, $TLS = 11$), and underserved gifted ($n = 2$, $TLS = 11$). Notably, gifted education serves as a central focal point, underscoring the diversity

of approaches in educating gifted students. Additional concepts such as assessment, curriculum, reading, and talent (each $n = 2$, $TLS = 9$) are also well represented in the literature.

Table 6

Most Frequently Used Keywords in the Articles

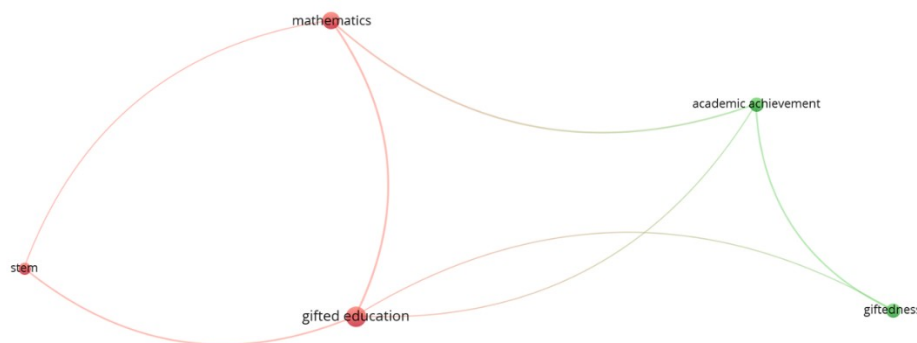
Keywords	Occurrences	TLS
Mathematics	6	16
Gifted education	8	11
Identification	2	11
Special populations	2	11
Underserved gifted	2	11
Assessment	2	9
Curriculum	2	9
Reading	2	9
Talent	2	9
Elementary	2	7
Hierarchical linear modeling	2	7
Academic achievement	2	7
Giftedness	4	6
Gifted	3	5
STEM	3	5

Note. Only keywords with a link strength of 5 or greater are included in the table.

Keywords including elementary, hierarchical linear modeling, and academic achievement ($n = 2$, $TLS = 7$) appear mainly in the context of early education, achievement measurement, and statistical modeling. Meanwhile, terms like giftedness ($n = 4$, $TLS = 6$), gifted ($n = 3$, $TLS = 5$), and STEM ($n = 3$, $TLS = 5$) reflect broader orientations and policy-related perspectives. Overall, the use of these keywords demonstrates that research on mathematics education for gifted students extends beyond mathematics content to include wider dimensions such as special education, identification, curriculum design, assessment, and achievement. This indicates that the field exhibits a distinctly interdisciplinary structure, encompassing diverse sub-themes in both theoretical and applied contexts. The keyword co-occurrence network is shown in Figure 7.

Figure 7

Bibliometric Co-Occurrence Network of the Most Frequently Used Keywords in the Articles



3.8. Most Frequently Repeated Terms in Abstracts

A co-occurrence analysis was conducted in VOSviewer to identify prominent terms in the abstracts of the articles, using all terms option. To ensure each repetition was counted only once, the binary counting method was applied. The threshold was set at a minimum of ten occurrences, and under this criterion, 9 of the 1,035 terms in the dataset were included in the analysis. The term-relevance score provided by VOSviewer reflects the specificity of a term to the analyzed text corpus and can take decimal values. This procedure enabled the identification of the key concepts most frequently emphasized in abstracts on “mathematics education for gifted students”.

Table 7

Most Frequently Occurring Terms in Abstracts

Term	Occurrences	Relevance score
difference	16	1.31
study	30	1.09
student	33	1.09
school	17	0.85
math	24	0.66

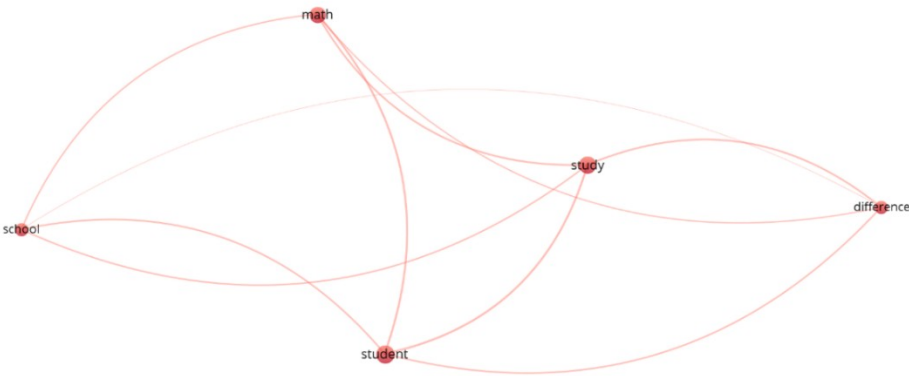
Note. Five of the nine terms meeting the occurrence threshold are shown, ordered by their reported relevance scores. Decimal values are VOSviewer relevance scores, not TLS values.

Among the five terms shown in Table 7, student occurs most often (33 occurrences, relevance score = 1.09), indicating that research in this area primarily focuses on students’ experiences, needs, and achievements. The frequent appearance of study (30 occurrences, relevance score = 1.09) and school (17 occurrences, relevance score = 0.85) highlights the centrality of educational institutions and learning processes. The prominence of math (24 occurrences, relevance score = 0.66) confirms that these studies are situated specifically within the context of mathematics education. Meanwhile, difference (16 occurrences, relevance score = 1.31) has the highest relevance score among the displayed terms; however, this general word does not reveal which differences the underlying studies examined.

Together, the reported terms suggest an emphasis on students, school settings, mathematics, and comparisons. Because individual word frequencies cannot establish the specific contexts in which those terms were used, more detailed thematic conclusions require further examination of the abstracts. The co-occurrence network of terms in article abstracts is shown in Figure 8.

Figure 8

The Most Frequently Occurring Terms in the Abstracts of the Articles



4. Discussion

The findings show that research on mathematics education for gifted students has gained increasing attention over the past four decades. Although publications were scarce between 1986 and 2000, the marked growth observed after 2008 may be associated with the increasing policy emphasis on gifted and STEM education, the expansion of specialized educational programs and research centers, and greater institutional and funding support for identifying and educating gifted learners. However, because the present bibliometric data do not permit causal inference, these factors should be regarded as plausible contextual explanations rather than direct causes. The consistent production of studies after 2015 further indicates that mathematics education for gifted learners has become a sustained area of inquiry, aligning with trends reported in earlier reviews (Bilgiç & Baloğlu, 2025; Özdemir et al., 2024).

Country-level analysis shows that the United States remains the leading contributor in both publication output and citations, reflecting its historical dominance in gifted education and

mathematics-related research (Subotnik et al., 2011). South Korea also displays substantial bibliographic connectivity (TLS = 282), while Bahrain and Egypt show relatively high TLS values (204 each) despite having only one publication each. These results point to differences in bibliographic linkages across the five countries presented in Table 5 rather than directly documenting co-authorship collaborations or temporal growth in specific countries.

The author- and organization-level analyses show that bibliographic-coupling strength does not necessarily follow publication volume. An author or organization associated with relatively few publications can still have strong links through shared cited references. This distinction supports reporting productivity measures alongside network-based indicators while avoiding direct inferences about research quality or co-authorship. Similar observations have been made in prior work, which points to the role of particular authors and institutions in shaping the intellectual structure of research on mathematical giftedness (Leikin, 2021b; Rius et al., 2025).

Keyword and abstract analyses highlight the main conceptual orientations of the literature. Frequent terms such as mathematics, gifted education, and identification show that research in this area is anchored in mathematical content while also intersecting with assessment, curriculum design, and special education policies (Hong & Aquí, 2004; Swanson et al., 2024). Frequent student-related terms indicate attention to learners, although the co-occurrence results do not by themselves establish the prevalence of individual psychological constructs such as self-efficacy. Overall, these findings suggest that research on mathematics education for gifted students has developed a clearer identity while expanding toward broader educational and psychological themes.

5. Conclusion

This study provides a comprehensive bibliometric overview of research on mathematics education for gifted students indexed in WoS, offering insights into its historical trajectory, international distribution, and intellectual structure. Alongside publication and citation counts, bibliographic-coupling analyses describe relationships based on shared cited references. These relationships should not be interpreted as direct evidence of co-authorship or research quality.

The findings indicate that mathematics education for gifted students is a globally relevant and interdisciplinary research area. Its conceptual focus extends beyond mathematics to include curriculum development, assessment, and educational policy, reflecting its relevance to different dimensions of educational practice. By using an international citation database, this study offers a systematic basis for future comparative and collaborative research on mathematically gifted learners.

6. Recommendations

Building on these findings, several directions for future research can be identified. First, although bibliometric analysis provides valuable insights into quantitative trends, it cannot capture the qualitative depth of studies. Future research should therefore combine bibliometric mapping with content analysis, case studies, or meta-synthesis to offer a more comprehensive understanding of mathematics education for gifted students. Second, cross-national comparative studies should be prioritized. Examining mathematics performance, identification processes, and educational policies across different systems may provide a clearer understanding of how cultural, institutional, and policy contexts shape educational opportunities for gifted learners. Such research could also support the development of more globally informed strategies for nurturing mathematical talent. Finally, future studies could examine international co-authorship networks directly and explore opportunities for cross-national research partnerships. Policymakers, curriculum developers, and teacher educators may benefit from such collaborations, particularly in designing student-centered approaches that address individual differences and promote equitable access to advanced mathematics education. In this respect, future scholarship can contribute both to academic knowledge and to improving learning opportunities for gifted students.

Declarations

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Thesis and conference disclosure: This article is not derived from a thesis or dissertation and has not been presented at a conference.

AI declaration: Artificial intelligence (AI) tools were used solely for language editing and to improve the clarity and readability of the manuscript. AI tools were not used in the research design, data collection, data analysis, interpretation of findings, or generation of research results. The authors reviewed and take full responsibility for the final content of the manuscript.

Data availability: The data that support the findings of this study are available from the Web of Science database. Data are available from the authors upon reasonable request.

References

- Andersen, L. (2014). Visual–spatial ability: Important in STEM, ignored in gifted education. *Roeper Review*, 36(2), 114–121. <https://doi.org/10.1080/02783193.2014.884198>
- Arı, A. A., Demir, B., & Çakır, E. (2023). Mathematics education research on gifted students: A bibliometric analysis (2010–2023). *Journal for the Education of Gifted Young Scientists*, 11(3), 439–465. <https://doi.org/10.17478/jegys.1356545>
- Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Bergold, S., Wirthwein, L., & Steinmayr, R. (2020). Similarities and differences between intellectually gifted and average-ability students in school performance, motivation, and subjective well-being. *Gifted Child Quarterly*, 64(4), 285–303. <https://doi.org/10.1177/0016986220932533>
- Bilgiç, S., & Baloğlu, M. (2025). A bibliometric analysis of research on giftedness and mathematics. *International Journal of Mathematical Education in Science and Technology*, 56(3), 382–398. <https://doi.org/10.1080/0020739X.2023.2236611>
- Budínová, I. (2024). Risks in identifying gifted students in mathematics: Case studies. *Open Education Studies*, 6(1), 20220218. <https://doi.org/10.1515/edu-2022-0218>
- Burnell, E. F. (1917). Instruction in mathematics for gifted pupils. *The Pedagogical Seminary*, 24(4), 569–583.
- Cash, T. N., & Lin, T.-J. (2022). Psychological well-being of intellectually and academically gifted students in self-contained and pull-out gifted programs. *Gifted Child Quarterly*, 66(3), 188–207. <https://doi.org/10.1177/00169862211032987>
- Crabtree, L. M., Richardson, S. C., & Lewis, C. W. (2019). The gifted gap, STEM education, and economic immobility. *Journal of Advanced Academics*, 30(2), 203–231. <https://doi.org/10.1177/1932202X19829749>

- Falagas, M. E., Pitsouni, E. I., Malietzis, G. A., & Pappas, G. (2008). Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *The FASEB Journal*, 22(2), 338–342. <https://doi.org/10.1096/fj.07-9492LSF>
- Forde, E. N., Robinson, L., Ellis, J. A., & Dare, E. A. (2023). Investigating the presence of mathematics and the levels of cognitively demanding mathematical tasks in integrated STEM units. *Disciplinary and Interdisciplinary Science Education Research*, 5(1), 1–18. <https://doi.org/10.1186/s43031-023-00072-3>
- Gavel, Y., & Iselid, L. (2008). Web of Science and Scopus: A journal title overlap study. *Online Information Review*, 32(1), 8–21. <https://doi.org/10.1108/14684520810865958>
- Gavin, M. K., Casa, T. M., Firmender, J. M., & Carroll, S. R. (2013). The impact of advanced geometry and measurement curriculum units on the mathematics achievement of first-grade students. *Gifted Child Quarterly*, 57(2), 71–84. <https://doi.org/10.1177/0016986213477190>
- Goos, M., Carreira, S., & Namukasa, I. K. (2023). Mathematics and interdisciplinary STEM education: Recent developments and future directions. *ZDM–Mathematics Education*, 55(7), 1199–1217. <https://doi.org/10.1007/s11858-023-01553-6>
- Haeruman, L. D., Salsabila, E., & Kharis, S. A. A. (2024). The impact of mathematical reasoning and critical thinking skills on mathematical literacy skills. *KnE Social Sciences*, 542–550. <https://doi.org/10.18502/kss.v8i8.13348>
- Hong, E., & Aquí, Y. M. (2004). Cognitive and motivational characteristics of adolescents gifted in mathematics: Comparisons among students with different types of giftedness. *Gifted Child Quarterly*, 48(3), 191–201. <https://doi.org/10.1177/001698620404800304>
- Koshy, V., Ernest, P., & Casey, R. (2009). *Mathematics for gifted learners*. Routledge.
- Leikin, R. (2021a). Intertwining creativity and expertise in teaching and learning mathematics: Contributions of research on giftedness. *International Journal of Science and Mathematics Education*, 19(Suppl. 1), S27–S45. <https://doi.org/10.1007/s10763-020-10097-9>
- Leikin, R. (2021b). When practice needs more research: the nature and nurture of mathematical giftedness. *ZDM–Mathematics Education*, 53(7), 1579–1589. <https://doi.org/10.1007/s11858-021-01276-9>
- Lubinski, D., & Benbow, C. P. (2006). Study of Mathematically Precocious Youth after 35 years: Uncovering antecedents for the development of math–science expertise. *Perspectives on Psychological Science*, 1(4), 316–345. <https://doi.org/10.1111/j.1745-6916.2006.00019.x>
- Miller, A. I. (1990). *Insights of genius: Imagery and creativity in science and art*. Springer.
- Özdemir, A., Sipahi, Y., & Bahar, A. K. (2024). The past, present, and future of research on mathematical giftedness: A bibliometric analysis. *Gifted Child Quarterly*, 68(3), 206–225. <https://doi.org/10.1177/001698622412447>
- Preckel, F., Schmidt, I., Stumpf, E., Motschenbacher, M., Vogl, K., & Schneider, W. (2017). A test of the reciprocal-effects model of academic achievement and academic self-concept in regular classes and special classes for the gifted. *Gifted Child Quarterly*, 61(2), 103–116. <https://doi.org/10.1177/0016986216687824>
- Renzulli, J. S. (1978). What makes giftedness? Reexamining a definition. *Phi Delta Kappan*, 60(3), 180–184.
- Rius, I., Ferrándiz, C., & Prieto, M. D. (2025). Mapping gifted education research in psychology and education journals: A bibliometric analysis (2000–2023). *Psychology in the Schools*, 62(1), 45–63. <https://doi.org/10.1002/pits.23145>
- Saß, S., Köller, O., & Zimmermann, F. (2025). Smart but maladapted? Differences in the psychological functioning of intellectually gifted students compared with average-ability

students. *Gifted Child Quarterly*, 69(3), 219–236.
<https://doi.org/10.1177/00169862241310871>

- Sriraman, B. (2005). Are giftedness and creativity synonyms in mathematics? *Journal of Secondary Gifted Education*, 17(1), 20–36. <https://doi.org/10.4219/jsge-2005-389>
- Subotnik, R. F., Olszewski-Kubilius, P., & Worrell, F. C. (2011). Rethinking giftedness and gifted education: A proposed direction forward based on psychological science. *Psychological Science in the Public Interest*, 12(1), 3–54. <https://doi.org/10.1177/1529100611418056>
- Suherman, S., & Vidákovich, T. (2022). Assessment of mathematical creative thinking: A systematic review. *Thinking Skills and Creativity*, 44, 101019. <https://doi.org/10.1016/j.tsc.2022.101019>
- Swanson, H. L., Kong, J. E., & Lussier, C. M. (2024). Cognitive characteristics of mathematically gifted children: Evidence from bilingual learners. *Journal of Experimental Child Psychology*, 240, 105833. <https://doi.org/10.1016/j.jecp.2023.105833>
- Tannenbaum, A. J. (2003). Nature and nurture of giftedness. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (3rd ed., pp. 45–59). Allyn & Bacon.
- Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523–538. <https://doi.org/10.1007/s11192-009-0146-3>
- Van Raan, A. F. (1993). Advanced bibliometric methods to assess research performance and scientific development: basic principles and recent practical applications. *Research Evaluation*, 3(3), 151–166.
- Yanuari, N. F., & Turmudi, T. (2023). Critical thinking in mathematics education: A bibliometric analysis. *International Journal of Trends in Mathematics Education Research*, 6(2), 191–197. <https://doi.org/10.33122/ijtmer.v6i2.241>
- Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429–472. <https://doi.org/10.1177/1094428114562629>