ISEJ Indonesian Science Education Journal

ISSN Online: 2716-3350
https://siducat.org/index.php/isej/
Published by Yayasan Darussalam Bengkulu

OPEN ACCESS ARTICLE

Trends in Research on Self-Efficacy in Mathematics Education: A Bibliometric Analysis for 2013–2025

Nike Astiswijaya, Turmudi*, Kusnandi, Dadang Juandi
Department of Mathematic Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
E-mail Corresponding: turmudi@upi.edu

Received: March 26, 2026 | Revised: May 29, 2026 | Accepted: July 24, 2026

Abstract
Self-efficacy has been one of the most widely used psychological constructs in mathematics education research for over three decades. However, the development of research, the intellectual structure of the field, and its relationship to learning approaches and mathematical competence have not been comprehensively developed. This study aims to analyze publication trends, thematic structures, and identify research gaps regarding self-efficacy in mathematics education. The study uses a bibliometric approach to 3,096 Scopus Open Access documents from 2013–2025 that have been screened to ensure their relevance to the field of education. The analysis was conducted using Bibliometrix (R) to broadcast publication performance and VOSviewer to map the co-word network. The results show sharp and consistent growth (Annual Growth Rate 20.47%), with Frontiers in Psychology as the most published platform (197 documents) while EURASIA Journal of Mathematics, Science and Technology Education remains the most relevant core journal for the mathematics education audience specifically. The co-word mapping identified four thematic clusters—self-efficacy, mathematics teaching and achievement; health and behavior; clinical education and medical competence; as well as procedures and pilot studies. However, the most pedagogically significant finding is the lack of explicit integration between self-efficacy, team-based learning, and mathematical communication in the context of statistics education: combined phrases such as ‘collaborative learning in statistics’ and ‘communication skills in mathematics’ were completely absent (n = 0) among all the documents analyzed, while the individual terms rarely appeared alongside self-efficacy. This finding confirms that research interventions that integrate collaborative learning with self-efficacy strengthening in statistics courses—particularly in higher education contexts that are still underrepresented in the global literature such as Southeast Asia—represent a pressing research agenda and have the potential to make significant pedagogical contributions to the teaching of mathematics and statistics in higher education.

Keywords: Bibliometric Analysis; Mathematics Education; Self-Efficacy; Scopus; Vosviewer

INTRODUCTION

Self-efficacy is one of the most influential motivational constructs in educational psychology because it explains how learners judge their capability to organize and execute the actions required to attain particular outcomes. In Social Cognitive Theory, these judgments shape the tasks learners select, the effort they invest, their persistence when difficulties arise, and the ways they regulate cognition, emotion, and behavior during learning (Bandura, 1997; Pajares, 1996; Zimmerman, 2000). Self-efficacy is therefore not equivalent to general confidence or academic self-concept. It is prospective, context-sensitive, and most predictive when measured at a level of specificity that corresponds closely to the target task (Bong & Skaalvik, 2003; Pajares & Miller, 1995). In mathematics education, such specificity is particularly important because students may feel capable in routine computation yet uncertain when required to reason, model, communicate, or solve unfamiliar problems. Mathematics self-efficacy consequently functions as a central psychological mechanism linking prior experience, perceived competence, strategic engagement, and achievement.

A substantial body of evidence confirms that self-efficacy is positively associated with academic performance, although the relationship is reciprocal rather than unidirectional. Systematic reviews and meta-analytic studies show that students with stronger academic self-efficacy tend to display greater engagement, persistence, strategy use, and achievement, while successful performance subsequently strengthens efficacy beliefs (Honicke & Broadbent, 2016; Richardson et al., 2012; Talsma et al., 2018). Mathematics-specific research reaches similar conclusions. Recent reviews identify mathematics self-efficacy as a robust correlate of achievement and as a construct that can be strengthened through carefully designed interventions (Street et al., 2024; Zakariya, 2022). Large-scale and longitudinal studies further demonstrate that self-efficacy and mathematics achievement influence one another across time and that classroom practices, task exposure, and instructional conditions shape the accuracy and strength of students' efficacy judgments (Borgonovi & Pokropek, 2019; Liu et al., 2024; Yang et al., 2024; Zhu & Kaiser, 2022). At the same time, the magnitude and direction of these relationships may vary according to gender, educational level, culture, and assessment design, underscoring the need to examine both general patterns and contextual differences (Bohrnstedt et al., 2024; Huang, 2013).

The development of self-efficacy is also inseparable from the social and instructional environments in which mathematical learning occurs. Bandura's four principal sources of efficacy information—mastery experiences, vicarious experiences, verbal persuasion, and physiological or affective states—operate through classroom tasks, teacher feedback, peer interaction, and students' interpretations of success and failure (Bandura, 1997; Usher & Pajares, 2008). Meta-analytic evidence indicates that these sources make distinctive contributions and are moderated by learner and contextual characteristics (Byars-Winston et al., 2017). Contemporary motivation research further situates self-efficacy alongside expectancy-value beliefs, growth mindset, self-regulation, and perceived usefulness of technology (Blackwell et al., 2007; Schunk & DiBenedetto, 2020; Wigfield & Eccles, 2000). These connections have become increasingly important as mathematics education adopts collaborative learning, digital platforms, artificial intelligence, and technology-supported assessment. Team-based learning, for example, can provide mastery and vicarious experiences through individual preparation, peer explanation, collective problem solving, and immediate feedback, while mathematical communication makes learners' reasoning visible and open to refinement (Charalambous et al., 2021). Academic engagement and critical thinking may also mediate or extend the influence of self-efficacy in university learning (Meng & Zhang, 2023; Vachova et al., 2023).

Because the construct intersects with achievement, motivation, technology, teacher beliefs, and disciplinary practice, research on self-efficacy in mathematics education has expanded across multiple intellectual traditions. Such expansion creates opportunities for theoretical integration but also produces fragmentation across journals, countries, educational levels, and methodological communities. Conventional narrative reviews are useful for interpreting selected findings, yet they cannot by themselves reveal the large-scale structure of a rapidly growing field. Bibliometric analysis addresses this challenge by examining publication output, citation impact, collaboration, source productivity, and conceptual relationships within a corpus of scholarly records (Aria & Cuccurullo, 2017; Donthu et al., 2021; Zupic & Čater, 2015). Performance analysis identifies influential authors, institutions, countries, and journals, whereas science mapping reveals how topics are connected, how thematic clusters emerge, and how research priorities evolve over time. These complementary functions are especially valuable when a field has reached the level of expansion described by the growth of scientific literature and the concentration-dispersion patterns associated with scholarly communication (Bradford, 1934; de Solla Price, 1963; Hallinger & Kovačević, 2019).

Co-word analysis is particularly relevant for identifying the conceptual organization of mathematics self-efficacy research because patterns of keyword co-occurrence can indicate which constructs are frequently investigated together and which potentially important intersections remain weakly developed (Callon et al., 1983). Bibliometrix supports reproducible performance analysis and thematic exploration, while VOSviewer enables the visualization of normalized co-occurrence networks, density structures, and temporal overlays (Aria & Cuccurullo, 2017; van Eck & Waltman, 2010). The interpretation of such maps depends on transparent choices regarding counting methods, thresholds, normalization, and clustering because different settings can influence the prominence and proximity of nodes (Cobo et al., 2011; Perianes-Rodríguez et al., 2016; Waltman et al., 2010). Database coverage also requires explicit consideration. Scopus offers broad multidisciplinary coverage and export compatibility, but no single database represents the complete global literature, and differences among Scopus, Web of Science, Google Scholar, and Dimensions may affect the visibility of disciplines, regions, languages, and journal types (Martín-Martín et al., 2018; Mongeon & Paul-Hus, 2016; Singh et al., 2021). Accordingly, a rigorous bibliometric study must define its corpus carefully and interpret its findings within the boundaries of the selected database and filters.

Bibliometric scholarship in mathematics education has mapped the field's major publication patterns, research themes, collaboration structures, and review traditions. Studies based on Scopus and Web of Science have documented the expansion of mathematics education research and the increasing prominence of technology, teacher education, achievement, problem solving, and STEM-related themes (Cevikbas et al., 2024; Julius et al., 2021). Other analyses have examined specialized areas such as instrumental orchestration and school mathematics education, demonstrating the value of combining bibliometric indicators with substantive disciplinary interpretation (Drijvers et al., 2020; Harahap et al., 2025). Nevertheless, mathematics self-efficacy has usually appeared as one topic among many rather than as the organizing focus of a comprehensive map. Existing systematic reviews have synthesized intervention effects and conceptual findings, but they do not provide an integrated account of publication growth, influential contributors, journal ecosystems, geographic participation, and keyword-based intellectual structure over an extended period (Street et al., 2024; Zakariya, 2022). This leaves researchers without a sufficiently detailed roadmap for locating established concentrations, emerging themes, and neglected combinations of constructs.

The need for such a roadmap is particularly visible in higher education and statistics learning. Separate lines of scholarship support the importance of self-efficacy, collaborative learning, team-based learning, mathematical communication, critical thinking, and technology acceptance, yet these constructs are not always examined within a unified research program. Team-based learning can strengthen efficacy through repeated preparation, peer modeling, and collaborative application, while mathematical communication can transform private reasoning into socially mediated knowledge construction (Charalambous et al., 2021; Vygotsky, 1978). Similarly, technology-related self-efficacy intersects with perceptions of usefulness and ease of use described by the Technology Acceptance Model, creating new questions as artificial-intelligence-supported learning becomes more common (Davis, 1989). These intersections are pedagogically consequential but remain unevenly represented, especially in statistics courses, Southeast Asian higher education, and contexts in which students must articulate quantitative reasoning collaboratively. Mapping their visibility within the global literature can therefore move the research agenda beyond general claims about the importance of self-efficacy toward more precise questions about where, how, and with which learning designs the construct has been studied.

Accordingly, this study conducts a bibliometric analysis of 3,096 Scopus-indexed open-access documents published from 2013 to 2025 using Bibliometrix and VOSviewer. It examines the annual growth of publications; identifies the most productive and influential authors, institutions, countries, and journal sources; maps the conceptual structure of the field through keyword co-occurrence analysis; and determines emerging themes and underdeveloped intersections that warrant further investigation. By integrating performance analysis with science mapping, the study seeks to provide a transparent and reproducible overview of mathematics self-efficacy research and to formulate an evidence-based agenda for future scholarship, with particular attention to collaborative and team-based learning, mathematical communication, statistics education, technology-related self-efficacy, and underrepresented higher-education contexts.

METHODS

Data Sources and Extraction Dates

All data in this study were sourced from the Scopus database, which was selected for its broad coverage, strict indexing quality standards, and export format compatibility with Bibliometrix and VOSviewer (Khudzari et al., 2018). The data search and extraction process was conducted on a single date—May 21, 2026—to ensure consistency and identical temporal exposure for all documents in the dataset.

Search Strings and the Selection Process

The search was conducted using the following string in the TITLE-ABS-KEY field in Scopus: (TITLE-ABS-KEY ("SELF-EFFICACY" OR "SELF EFFICACY" OR "EFIKASI DIRI") AND TITLE-ABS-KEY ("MATHEMATIC*" OR "MATHEMATICAL" OR 'MATH' OR "STATISTIC*" OR "STATISTICAL")). The initial search yielded 21,757 documents. The documents were then filtered in stages: first by publication year (2013–2024), leaving 16,293 documents; then by document type—only articles, review articles, and conference papers were retained (15,939 documents); next by subject area—Social Sciences, Psychology, and Mathematics (7,229 documents); followed by an English language filter (6,773 documents); and finally, an open-access filter, resulting in 3,468 final documents. The entire selection process is presented in Table 1. Because the combination of search terms "MATHEMATIC*" and "STATISTIC*" has the potential to capture documents from the clinical/health domain that mention statistical terms only in a methodological context (e.g., the phrase "statistically significant"), an additional eligibility screening step based on titles and abstracts was applied to these 3,468 documents, resulting in a final dataset of 3,096 documents. The entire selection process is presented in Table 1 and Figure 1.

Table 1. Document Screening Process from the Scopus Database

No.	Kriteria Seleksi	Jumlah Dokumen
1	Initial search (no filters)	21.757
2	Filter by year: 2013–2024	16.293
3	Filter by document type (articles, reviews, conference proceedings)	15.939
4	Filter by subject area (Social Sciences, Psychology, Mathematics)	7.229
5	Filter by language: English	6.773
6	Filter by open access — final dataset	3.468

Additional Eligibility Screening and Selection Flowchart

The search string used combined the term "self-efficacy" with the terms "MATHEMATIC*" and "STATISTIC*" in the TITLE-ABS-KEY field. Further examination of the 3,468 open-access documents returned by the filter revealed that approximately 22.7% of the documents indexed in PubMed/MEDLINE (biomedical literature) and 372 documents (10.7%) contained clinical/health terms (such as patient, clinical, cancer, diabetes, therapy, hospital) without a single education/learning term (such as education, learning, student, teaching, classroom, curriculum, school) in either the title or abstract. A more detailed analysis revealed that 236 of these 372 documents (63.4%) were included in the dataset solely because their abstracts contained the generic methodological phrase "statistically significant," without any substantive connection to mathematics education or statistics. This finding is consistent with and confirms concerns that search strings including the term "STATISTIC*" without educational delimiters risk capturing documents from non-educational domains.

The solution was to apply an additional eligibility screening step to these 3,468 documents: documents were excluded if they contained at least one clinical or health-related term but did not contain any education or learning terms in their title or abstract. This criterion is conservative; documents addressing the intersection of health and education (e.g., statistical self-efficacy among nursing students) were retained because they contained educational terms. Applying this criterion excluded 372 documents, leaving 3,096 documents as the final dataset. A comparison of journal source composition and temporal trends before and after screening revealed proportionally consistent patterns (e.g., the rankings of the top ten journals did not change significantly), indicating that the main findings of this study were not influenced by these contaminating documents. The entire selection process is presented in Figure 1

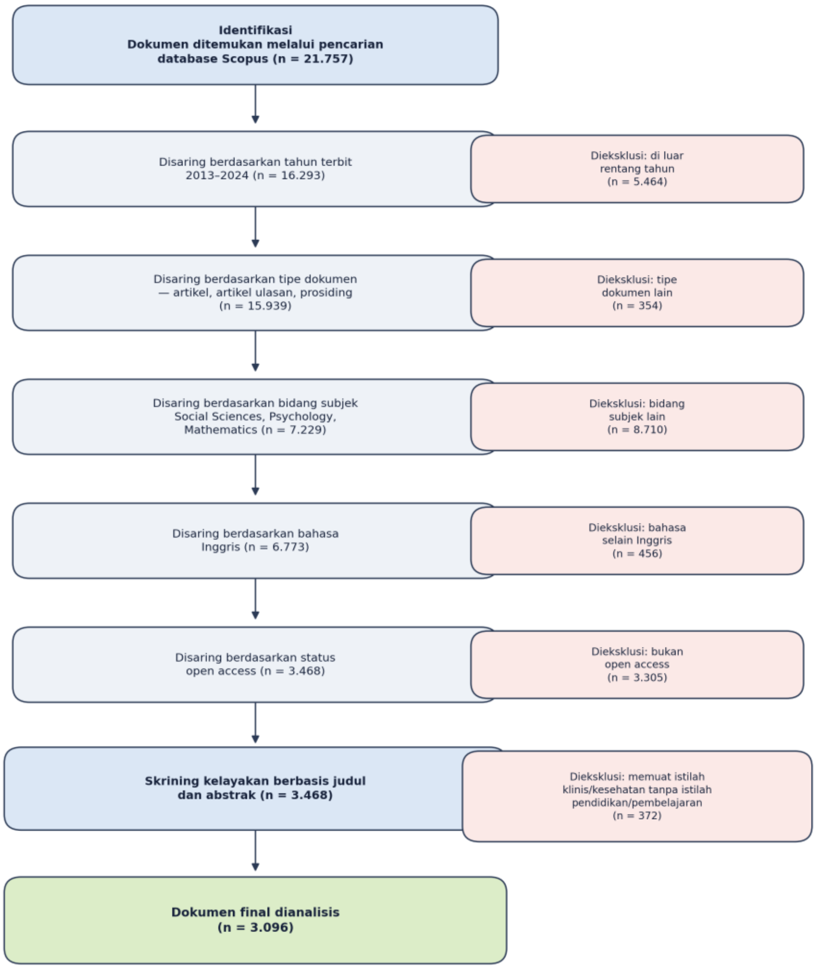

Figure 1. Document Selection Flowchart
(Adapted from PRISMA 2020; Page et al., 2021)

The open-access filter in Stage 6 also has its own methodological implications. This filter was applied based on practical and methodological considerations: the open availability of full-text articles allows for manual verification of abstracts during the eligibility screening stage described above, and supports data openness (the FAIR principles) for readers who wish to examine or replicate the findings without facing institutional access barriers. An examination of the top sources in the dataset reveals a concentration in open-access mega-journals based on article processing charges (Frontiers, BMC, MDPI, SAGE Open, Cogent), which together account for approximately 17.6% of the total documents. Thus, the final dataset in this study represents a subset of openly accessible literature in this field as of May 21, 2026, rather than the entire research field indexed in Scopus—a limitation discussed further in the Limitations section.

This type of coverage bias is not specific to Scopus or open-access filters alone. (Mongeon & Paul-Hus, 2016), in a comparative analysis of the coverage of Web of Science and Scopus journals, found that these two major bibliometric databases systematically cover the fields of natural sciences, engineering, and biomedicine more extensively than the social sciences and humanities, and index more English-language journals. These findings underscore the need for caution when generalizing bibliometric results from a single database, as was done in this study.

Analysis Procedure

The final dataset in CSV format was processed through two parallel analysis pathways. Bibliometrix version 4.2.0 was used for performance analysis: temporal distribution of publications, the ten most productive authors and institutions, the ten most frequently cited journal sources, geographic distribution, and local h-indexes for both authors and journals.

VOSviewer version 1.6.20 was used for science mapping through three types of visualizations: network visualization (co-word networks based on keyword co-occurrence), density visualization (density maps showing research concentration), and overlay visualization (temporal maps showing the average publication year per keyword). The minimum threshold for keyword occurrence was set at 10 times to ensure that only sufficiently representative keywords were included in the maps.

The concurrent use of Bibliometrix and VOSviewer in this study follows the methodological recommendations of (Donthu et al., 2021), who emphasize that performance analysis and science mapping are two complementary approaches in bibliometric research and should ideally be used together, rather than as alternatives to one another. The co-word analysis approach underlying the network, density, and overlay visualizations in this study refers to the method first formulated by (Callon et al., 1983), who argued that patterns of co-occurrence of terms within a document corpus can represent the conceptual structure of a scientific field without requiring subjective interpretation by the researcher. In VOSviewer, the strength of relationships between keywords is calculated using the association strength normalization method (van Eck & Waltman, 2010), which corrects for biases caused by differences in the absolute frequency of occurrence among keywords so that very common keywords do not automatically dominate the map structure. The clustering of nodes into thematic clusters follows a unified approach to mapping and clustering developed by (Waltman et al., 2010) which derives both the VOS mapping technique and the modularity-based clustering technique from the same mathematical principle. The counting method used is full counting, in accordance with the methodological comparison by (Perianes-Rodríguez et al., 2016) which shows that full counting is more appropriate when the goal of the analysis is to map the overall thematic structure of a field, whereas fractional counting is better suited for measuring the relative contributions of individual entities such as authors or institutions.

RESULT AND DISCUSSION

Dataset Overview

From the 3,096 documents analyzed, the majority (73.96%, or 2,290 documents) were research articles; the remainder consisted of review articles (70 documents, 2.26%) and conference papers (36 documents, 1.16%). These documents involved 10,198 authors from 949 unique journal sources, with an average of 3.8 co-authors per document. Cross-national collaboration accounted for 20.96% of the total documents. Cumulatively, all documents have received 58,205 citations, with an average of 18.8 citations per document. This average citation count is sufficient to confirm that research on self-efficacy in mathematics is not a niche topic, but rather a widely recognized mainstream field. A statistical summary of the dataset is presented in Table 2.

Table 2. Summary of Bibliometric Dataset Statistics

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2013:2025
Sources (Journals, Books, etc)	949
Documents	3096
Annual Growth Rate %	20.47
Document Average Age	4.56
Average citations per doc	18.8
References	309506
DOCUMENT CONTENTS	
Keywords Plus (ID)	3888
Author's Keywords (DE)	7482
AUTHORS	
Authors	10198
Authors of single-authored docs	299
AUTHORS COLLABORATION	
Single-authored docs	315

Co-Authors per Doc	3.8
International co-authorships %	20.96
DOCUMENT TYPES	
Article	2990
conference paper	36
Review	70

Note: Compiled from a Scopus export (May 21, 2026) using Bibliometrix (R) v4.2.0.

Annual Publication Growth (2013–2025)

The graph in Figure 2 shows a nonlinear curve: growth started slowly, then surged. From about 50 documents in 2013, the trend rose gradually to nearly 100 documents per year in 2017—a relatively gentle growth pattern during this period. Something changed between 2019 and 2020: the curve began to rise more steeply, reaching about 290 documents in 2021 and peaking temporarily at around 360 documents in 2022, before leveling off slightly in 2023. The most dramatic surge, however, occurred afterward: from about 350 documents in 2023, the number jumped to over 500 in 2024 and approached 600 documents in 2025. An overall AGR of 20.47% places this field among topics in an active expansion phase, rather than merely a mature field experiencing slow growth.

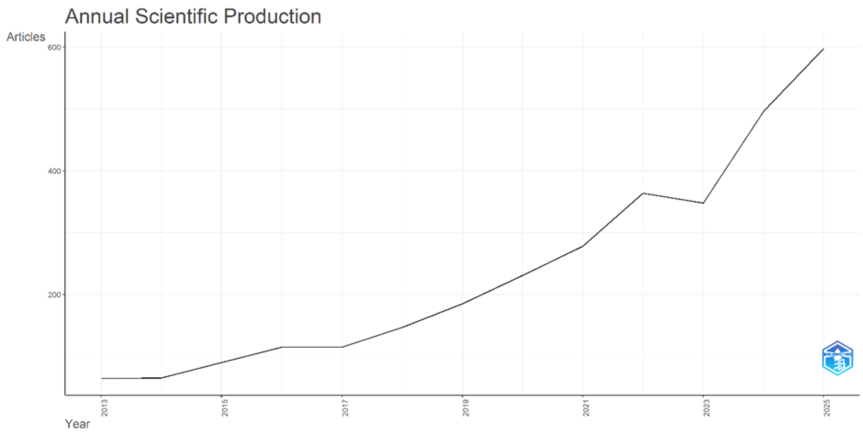

Figure 2. Annual scientific output on research into self-efficacy in mathematics learning (2013–2025).
Source: Bibliometrix (2026)

While Figure 2 shows volume, Figure 3 illustrates the quality of impact from a temporal perspective. Articles published around 2017 received the most citations per year (peaking at nearly 5.6 citations/year), with the 2016–2018 period generally representing a golden age of citation impact (ranging from 3.4 to 5.6). After 2019, the average number of citations declined and fluctuated moderately (around 3.0–3.7) through 2021, before dropping sharply in 2022–2025 to around 1.1. This decline in recent years is an entirely natural phenomenon: new articles have not yet had enough time to enter the citation cycle. This is not a sign of declining quality, but rather a reflection of normal bibliometric dynamics.

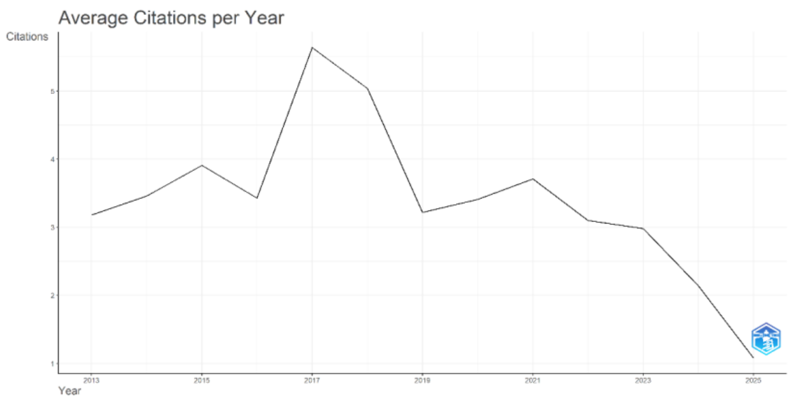

Figure 3. Average citations per article per year (2013–2025).
Source: Bibliometrix (2026).

Most Productive Authors and Institutions

Among the thousands of authors involved, Li X was the most productive with 20 papers, followed by Li Y and Wang X (18 each), Zhang Y (17), Wang Y (15), JR (14), Li J, Singh C, and Yang Y (13 each), and Liu Y (12)—as shown in Figure 4. The dominance of the surnames Li, Wang, Zhang, and Yang reflects the significant flow of research from China, which is also confirmed by the country distribution data. The presence of Singh C remains consistent in the filtered dataset, highlighting the contribution of researchers from South Asia in this landscape.

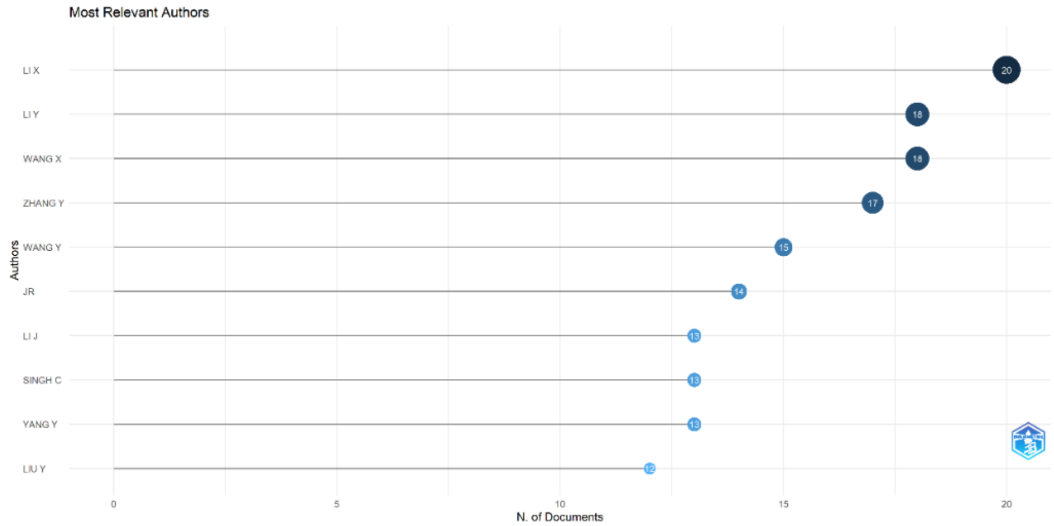

Figure 4. The ten most productive authors by number of publications.
Source: Bibliometrix (2026).

Productivity alone is not sufficient to measure impact. Figure 5 shows the authors' local h-index. The local h-index is a measure that takes into account how many of an author's articles have each been cited at least as many times as the author's h-index. In this dataset, Li X once again leads with h = 9, followed by JR, Wang X, and Wang Y (each with h = 8), then Chen X, Li J, Liu Y, and Singh C (each with h = 7). Li X's consistent presence at the top of both lists—productivity and impact—makes him the most influential figure in this field.

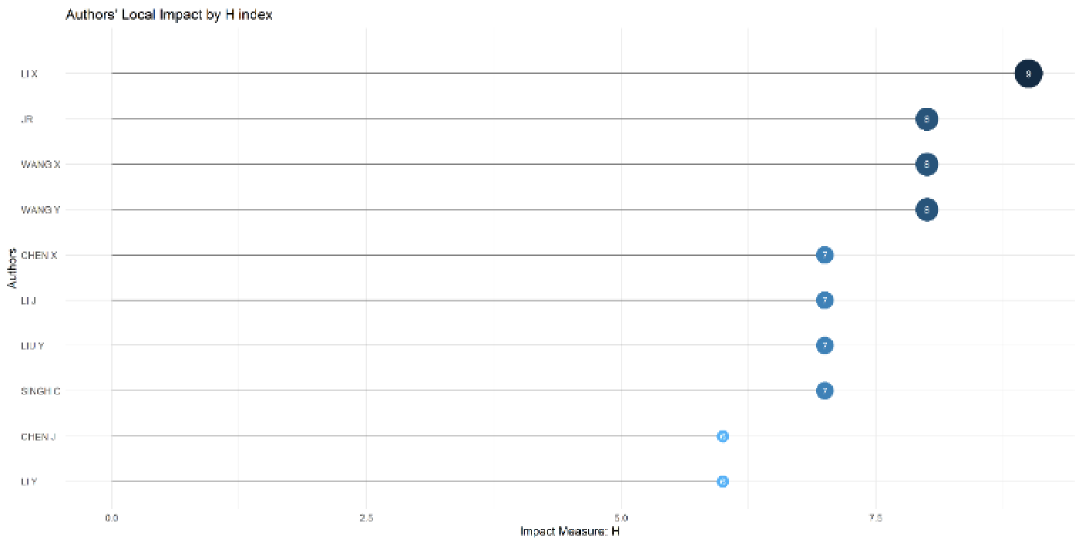

Figure 5. Local impact of authors based on the h-index in the dataset.
Source: Bibliometrix (2026).

At the institutional level, the University of California leads by a wide margin with 91 documents, followed by Beijing Normal University (54), Isfahan University of Medical Sciences and Lawrence Technological University (42 each), and the University of Tartu and the University of Washington (34 each), as shown in Figure 6. Isfahan University of Medical Sciences (a medical institution in Iran) remains in third place even after the dataset was filtered to exclude non-educational documents. This suggests that some of the remaining documents in the dataset still use the construct of self-efficacy in the context of clinical training or medical education that overlaps with education (e.g., teaching statistics to medical students), rather than purely in the context of mathematics education. This should be taken into account in the subsequent interpretation of the thematic clusters.

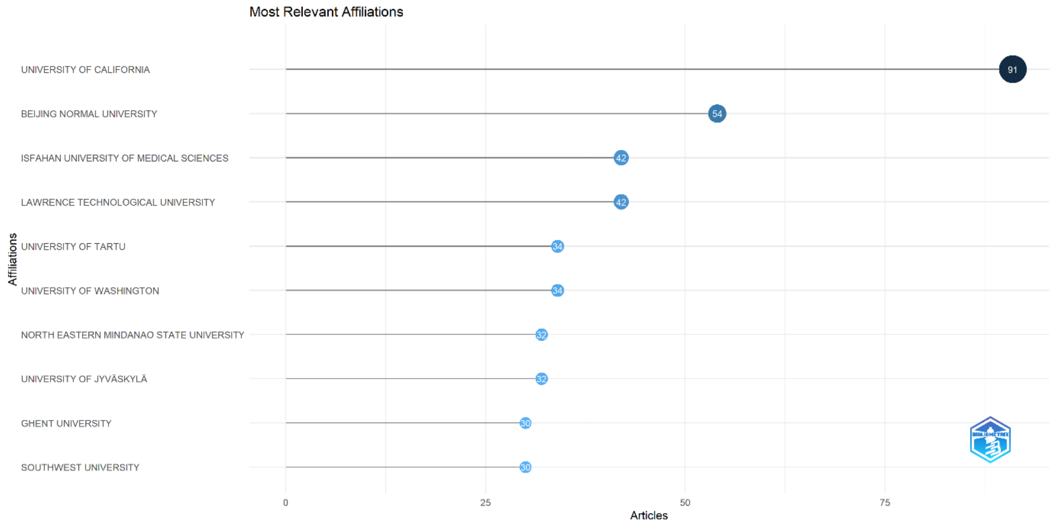

Figure 6. The ten institutions with the largest number of publications.
Source: Bibliometrix (2026).

From a geographic perspective (Figure 7), the United States and China remain the two most productive contributors globally (shown in the darkest shades on the map), a pattern consistent with the dataset prior to additional screening. A number of other countries—including those in Europe, the Middle East, Southeast Asia, Africa, and Latin America—contribute at a moderate level of productivity, as reflected by the widespread light blue shading on the map, including in the region where Indonesia is located. This choropleth map visually displays the geographic distribution but does not include exact figures per country; to update the specific ranking and number of documents previously reported for Indonesia (9th place, 264 documents), the "Most Relevant Countries" table from Biblioshiny—which contains numerical data per country—is required.

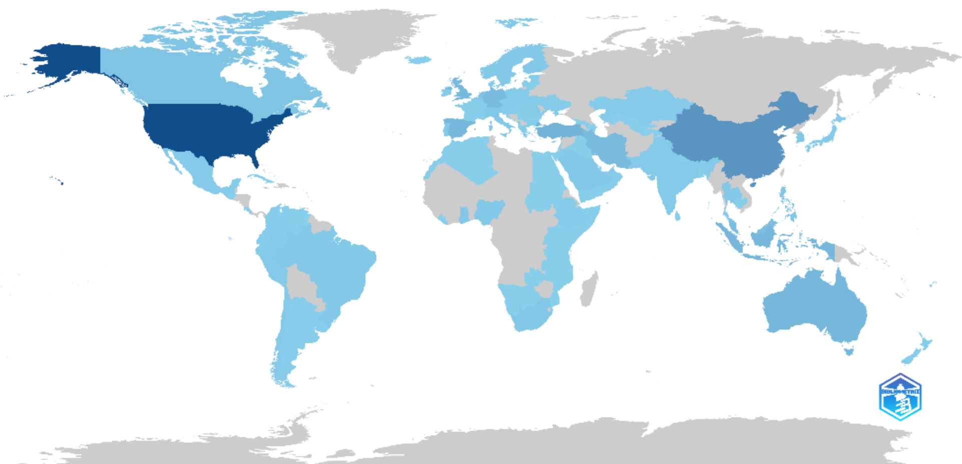

Figure 7. Map of the distribution of scientific output by country.
Source: Bibliometrix (2026).

Most Influential Journal Sources

Of the 949 unique journal sources in the dataset, the top ten are presented in Figure 8. *Frontiers* *in Psychology* tops the list with 197 articles—nearly double that of the second-ranked journal, *BMC Medical Education* (97). Following in order are: *Education Sciences* (70), *Frontiers in Education* (68), *Sustainability (Switzerland)* (61), *Eurasia Journal of Mathematics, Science and Technology Education* (59), *Journal of Education and Health Promotion* (42), *SAGE Open* (41), *CBE Life Sciences Education* (38), and *BMC Psychology* (37). This top ten list is nearly identical to the dataset before the additional screening, confirming that the excluded documents were evenly distributed and not concentrated in any particular journal.

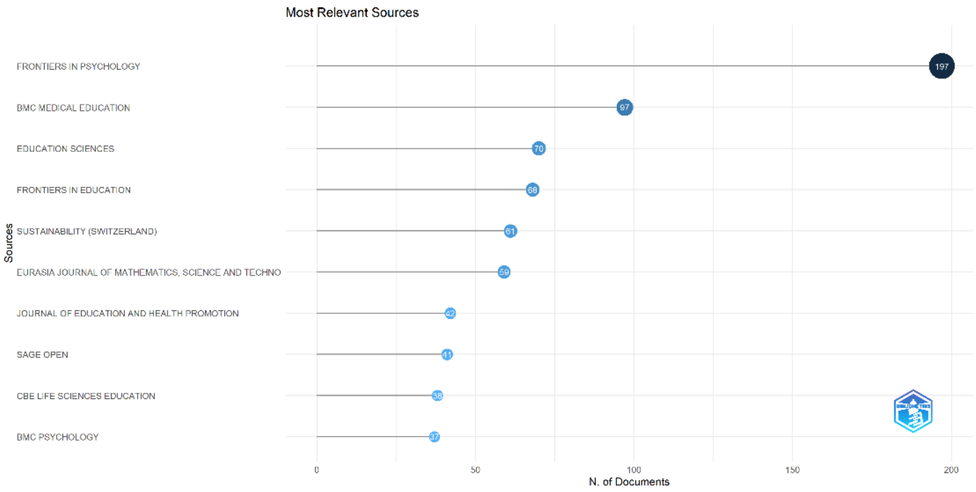

Figure 8. The ten most productive journal sources by number of documents.
Source: Bibliometrix (2026)

However, volume does not always correlate directly with influence. Figure 9 shows the local h-index per journal, and here Frontiers in Psychology remains in the lead (h = 31), followed by BMC Medical Education (h = 24), CBE Life Sciences Education (h = 22), and Sustainability (Switzerland) (h = 22). The *International Journal of STEM Education* has an h-index of 17, while the *Eurasia Journal of Mathematics, Science and Technology Education* and *Frontiers in Education* each have an h-index of 15—lower than the top journals, but still significant for journals that specifically focus on mathematics and science education. EURASIA's consistent standing (in terms of both volume and h-index) confirms its status as the most relevant core journal for researchers seeking to target a specific audience in mathematics education.

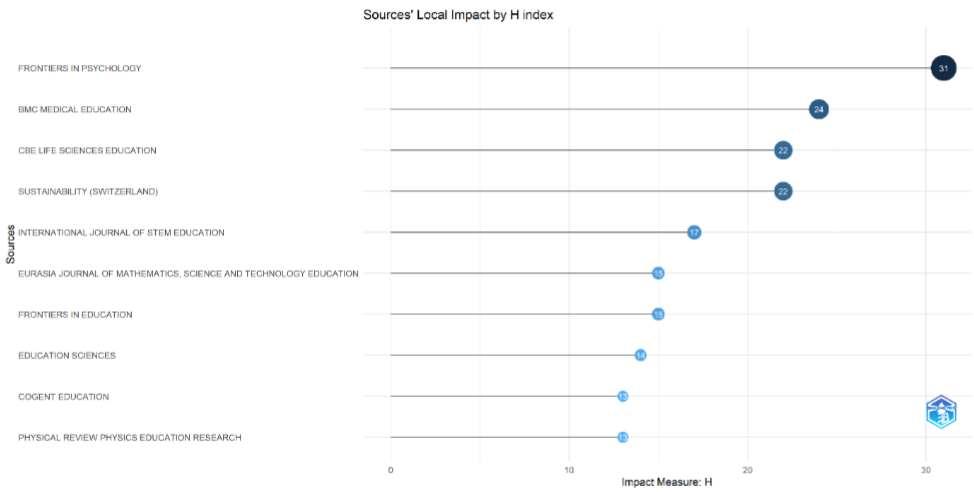

Figure 9. Local impact of journal sources based on the h-index.
Source: Bibliometrix (2026).

The cumulative growth trends by journal (Figure 10) paint a more nuanced picture. Frontiers in Psychology (blue) grew slowly until 2018, then surged sharply—confirming that this platform has become the preferred "home" for self-efficacy research, especially since the pandemic began. BMC Medical Education (red) has shown more stable and consistent growth from the start. Meanwhile, Education Sciences, Frontiers in Education, and Sustainability began to accumulate significant growth only starting in 2019–2020, reflecting their status as relatively new but rapidly growing platforms.

For mathematics education researchers developing publication strategies, this pattern offers practical guidance: EURASIA offers the most targeted audience despite its smaller volume, while Frontiers in Psychology offers a broader readership but carries the risk that articles may get lost among more general psychology topics. The choice of a target journal, therefore, is not merely a matter of prestige, but rather a matter of aligning the audience with the goal of dissemination—whether to reach the mathematics education community directly or to expand visibility across disciplines.

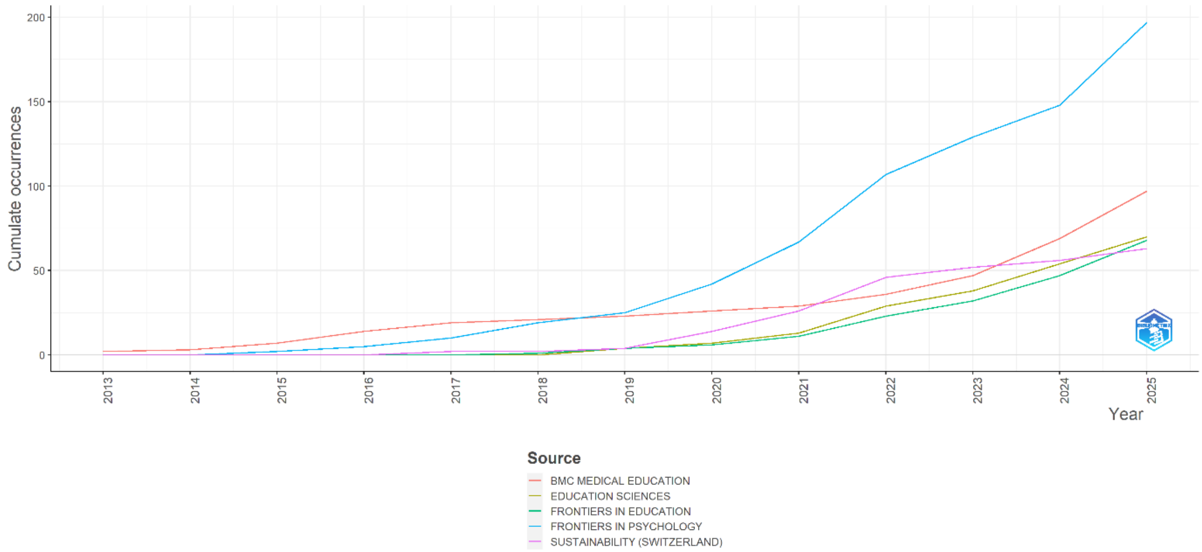

Figure 10. Cumulative trends in journal output (2013–2025).
Source: Bibliometrix (2026)

Figure 11 shows the top ten keywords according to Keywords Plus—keywords automatically extracted by Scopus from article references. What immediately catches the eye is the dominance of demographic keywords: “female” (1,285 occurrences) and “male” (1,222) occupy the top two positions, followed by “human” (923), “adult” (900), and “middle-aged” (477). The occurrence of “self-concept” (781) and “self-efficacy” (583) confirms the thematic relevance of the dataset. However, this dominance of demographic terms also suggests something important: many documents in the dataset come from survey studies that report sample characteristics in detail—and some of them may have a more clinical or psychological background than pure mathematics education.

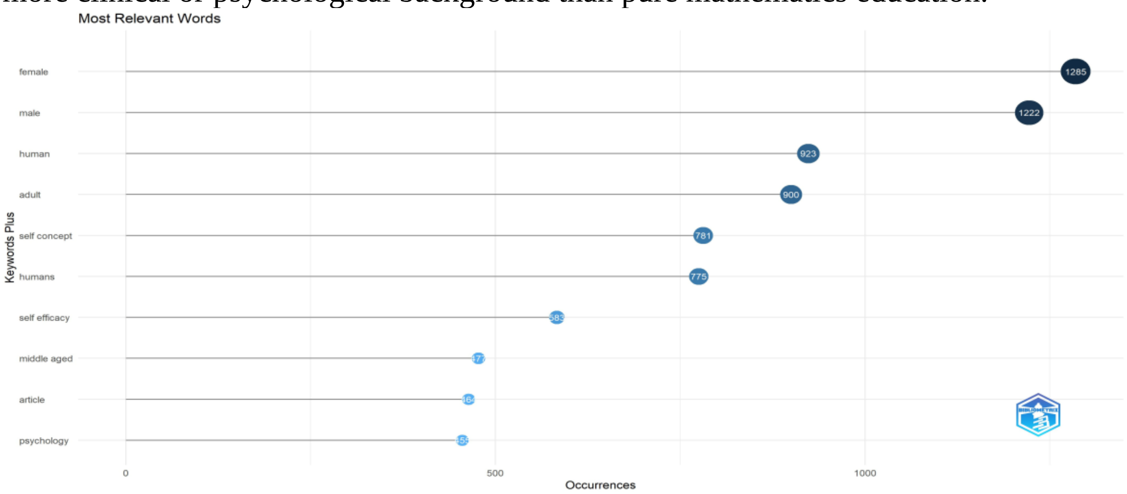

Figure 11. The ten most relevant keywords (Keywords Plus).
Source: Bibliometrix (2026).

Keyword Mapping: Thematic Clusters and Research Gaps

Three visualizations from VOSviewer—network, density, and overlay—each offer a different and complementary perspective; they are now applied to a dataset of 3,096 documents that have been filtered to remove non-educational clinical/health-related content. The network map (Figure 12) shows four thematic clusters formed based on the strength of keyword co-occurrence.

All three maps were created in VOSviewer via the workflow: Create → Create a map based on bibliographic data → Read data from reference manager files (RIS format, exported from 3,096 final documents; see the Methods section). The unit of analysis is the co-occurrence of keywords, which were extracted from the KW field in the RIS files. This field combines Author Keywords and Index Keywords (Keywords Plus) into a single set of keywords (all keywords)—not just one of them—so that the map represents the combined co-occurrence of both types of keywords, not just Keywords Plus as shown in Figure 11. The counting method used is full counting. Of the 10,222 unique keywords identified, the minimum occurrence threshold (minimum number of occurrences = 5) filtered out 971 keywords that met the criteria, and all 971 of these keywords were included in the mapping without further subset selection. Advanced analysis parameters use the default VOSviewer settings: the association strength normalization method, a clustering resolution of 1.00, and a minimum cluster size of 1. No thesaurus file was applied to merge synonyms or spelling variants (e.g., “self-efficacy” vs. “self efficacy,” or singular/plural forms such as “student” vs. “students”); thus, a small amount of node fragmentation due to spelling variations may still be present in the map. This is an explicitly acknowledged technical limitation and can be addressed in future replications by applying a custom thesaurus.

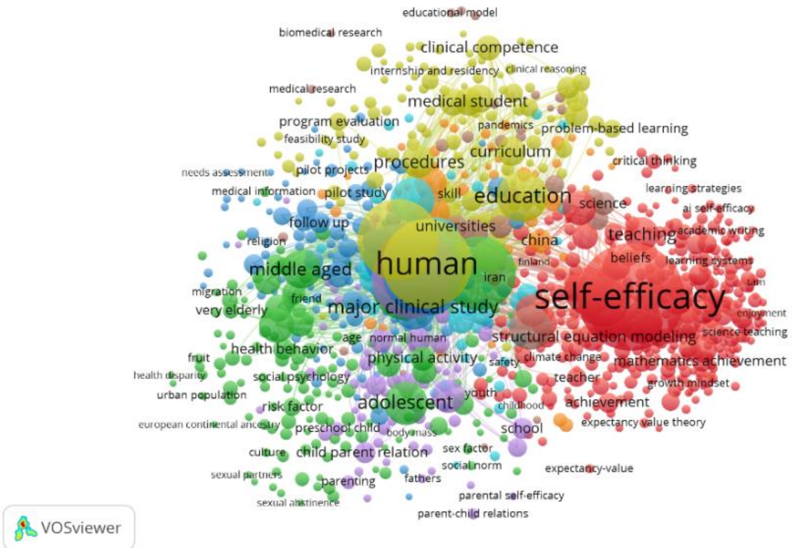

Figure 12. VOSviewer co-word network visualization.
Source: VOSviewer (2026).

Red Cluster — Self-Efficacy, Teaching, and Mathematics Achievement: This is the core cluster most relevant to the research topic, centered on the keywords “self-efficacy,” “teaching,” “beliefs,” “learning systems,” “mathematics achievement,” “achievement,” “teacher,” “growth mindset,” “expectancy-value theory,” and “structural equation modeling.” Interestingly, several new terms that were not prominent in the pre-screening analysis now stand out—including “AI self-efficacy,” “academic writing,” and “TAM” (Technology Acceptance Model)—indicating the emergence of a new subtheme regarding self-efficacy in the context of AI-based learning technologies. This cluster represents both the traditional core and a new direction for research in this field. It is here that the legacy of (Bandura, 1997; Pajares & Miller, 1995) is most palpable, now intersecting with contemporary questions regarding learning technology.

Several terms in this cluster are rooted in established motivation theories whose foundations need to be clarified. "Growth mindset" refers to Dweck's implicit theory of intelligence, which has been empirically shown to predict students' mathematics achievement through interventions based on the belief that ability can be developed through effort (Blackwell et al., 2007). Expectancy-value theory refers to the framework proposed by Wigfield and Eccles (2000), which identifies expectations of success and the subjective value of a task as the two primary proximal determinants of academic choice and achievement. Meanwhile, the emergence of the term "tam" indicates the application of the Technology Acceptance Model (Davis, 1989)—a classic framework that explains user acceptance of technology through perceptions of usefulness and ease of use—which is now being adapted to understand students' self-efficacy in interacting with AI-based mathematics learning tools.

Green Cluster — Health, Behavior, and Demographic Context: Focusing on "human," "middle-aged," "major clinical study," "health behavior," "adolescent," "physical activity," "risk factor," "child-parent relationship," and "parenting." This cluster reflects a research tradition that uses self-efficacy in the context of health and behavioral psychology—which was historically the original domain of this construct before it was adapted to mathematics education. The presence of this cluster in the dataset—even though it has been filtered from clearly non-educational documents—explains why keywords such as "female," "male," and "human" continue to dominate Keywords Plus (Figure 11).

Yellow Cluster — Clinical Education and Medical Competence: Focused on "clinical competence," "medical student," "internship and residency," "clinical reasoning," "curriculum," "problem-based learning," and "education." This cluster formed separately and is quite dense, confirming the findings in the institutional section (Figure 6) that a number of documents in the dataset use the construct of self-efficacy in the context of medical professional education—not mathematics education. The clear separation of this cluster from the red cluster (core mathematical self-efficacy) actually reinforces the validity of the thematic mapping: these two research traditions coexist in the dataset but are conceptually distinct enough to form their own clusters. Cyan Cluster — Procedures and Pilot Studies: The smallest cluster, focusing on "procedures," "pilot studies," "skills," "follow-up," "needs assessment," and "feasibility studies." This cluster represents a methodological subtheme—early-stage studies or trials of intervention procedures—for which there are not yet enough studies to be grouped under any of the main thematic clusters.

Figure 13. Density visualization in VOSviewer. The yellow areas indicate the highest concentrations in the study. Source: VOSviewer (2026).

The density map (Figure 13) adds a layer of information about where research attention is most concentrated. The light yellow-green color—which indicates the highest density—is centered precisely around the keywords "human" and "self-efficacy," the two densest nodes in the entire map. The keywords "education," "major clinical study," "middle-aged," "adolescent," and “teaching” also exhibit fairly high density, confirming that two major domains—education/teaching on one hand, and health/clinical demographics on the other—are both thematic centers of gravity in the dataset, consistent with the four-cluster structure shown in Figure 13.

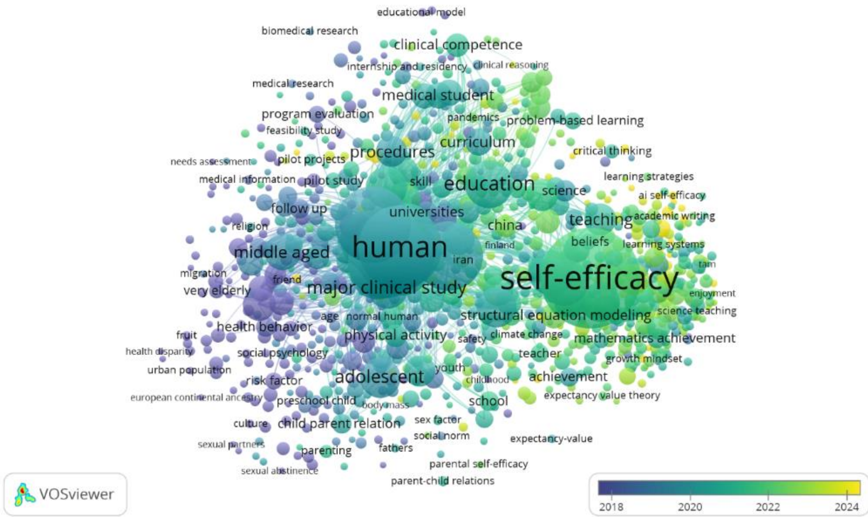

Figure 14. Temporal overlay map (overlay visualization) in VOSviewer. Purple indicates older keywords (around 2016), while yellow indicates newer keywords (around 2022).
Source: VOSviewer (2026).

The temporal overlay map (Figure 14) is the most valuable tool for identifying the direction of theme development. Purple-blue keywords (around 2018–2019), such as “human,” “major clinical study,” and “middle-aged,” represent mature themes that form the long-standing foundation of the dataset. Yellow-green keywords (around 2022–2024)—which mark the most recent themes—are actually concentrated right within the red cluster: “teaching,” “beliefs,” “AI self-efficacy,” “academic writing,” “learning systems,” “TAM,” “growth mindset,” and “mathematics achievement.” This is a significant finding: the sub-theme of self-efficacy in mathematics education is not only a core theme in terms of volume but also the theme that has been developing most actively in recent years—particularly at its intersection with learning technologies (AI self-efficacy, TAM) and advanced motivational constructs (growth mindset, expectancy-value theory).

And here is the most significant finding: keywords such as “team-based learning,” “mathematical communication,” “statistics education,” and “higher education mathematics” barely appear in the co-word map. There is no node for “collaborative learning in statistics.” There is no cluster linking “self-efficacy” to “communication ability in mathematics.” This does not mean these topics are unimportant—quite the opposite. The co-word map displays only keywords that meet the minimum occurrence threshold ($n \geq 5$; see the methodological explanation above), so a term may be present in the corpus but not occur frequently enough to be included in the set of mapped keywords. Table 3 details the actual occurrences of each keyword in the 3,096 final documents.

Table 3. Occurrences of key terms related to research gaps in 3,096 final documents (calculated from the “Author Keywords” and “Index Keywords” fields)

Term	Occurrences (n documents)	Status vs. threshold (n≥5)	Interpretation
team-based learning	1	Below the threshold	It appears in the literature (corpus), but is too rare to be included in the map's set of keywords
mathematical communication	3	Below the threshold	It appears in the literature, but it is too rare to be included in the map's set of keywords
statistics education	6	In compliance with	Included on the map, but may not

		the threshold	appear as a prominent label due to the density of the visualization
collaborative learning	7	In compliance with the threshold	Included on the map, but may not appear as a prominent label due to the density of the visualization
higher education mathematics	0	Not found in the corpus	It is completely absent from the literature (this exact phrase), not merely absent from the map
collaborative learning in statistics	0	Not found in the corpus	Completely absent from the literature (this exact phrase)
communication ability in mathematics	0	Not found in the corpus	Completely absent from the literature (this exact phrase)

The data in Table 3 lead to three conclusions that are more nuanced than the initial claims. First, the phrases "higher education mathematics," "collaborative learning in statistics," and "communication ability in mathematics" were not found at all (n = 0) as exact keywords throughout the dataset—this represents an absence from the literature itself (in the sense of these compound phrases), not merely an absence from the map. Second, "team-based learning" (n = 1) and "mathematical communication" (n = 3) do exist in the corpus, but their frequencies fall below the threshold of n ≥ 5 and thus do not qualify for the set of mapped keywords—the accurate claim for both of these terms is "absent from the map because they are too rare," not "absent from the literature." Third, "statistics education" (n = 6) and "collaborative learning" (n = 7) actually meet the threshold and are included in the set of mapped keywords; however, they likely do not appear as prominent labels in Figures 12–14 because the VOSviewer algorithm prioritizes labels for high-frequency nodes to avoid visual overlap. It is not that individual topics (TBL, mathematical communication, collaborative learning) are absent from the literature on mathematical self-efficacy—rather, that explicit combinations or overlaps between these topics and self-efficacy in the context of statistics, as represented by compound phrases such as "collaborative learning in statistics" and "communication ability in mathematics," is virtually nonexistent in the corpus (n = 0). That is where, more precisely, the opportunity for an original contribution lies.

One document representing a single instance of "team-based learning" in this dataset most likely corresponds to a study of the type described by (Charalambous et al., 2021), which integrates TBL with the development of self-efficacy among undergraduate statistics students (exactly the construct overlap discussed in this article), though conducted in a Western (British) context and without an emphasis on mathematical communication. This reinforces that concrete examples of such a combination do indeed exist, but their number is very limited and does not yet include a Southeast Asian context. As for the link between self-efficacy and critical thinking, it is supported by empirical evidence from (Vachova et al., 2023), who found that academic self-efficacy predicts all dimensions of critical thinking among students—a theoretical reinforcement of the importance of integrating critical thinking skills into the proposed research framework. Thus, research on TBL, mathematical communication, and statistical self-efficacy has not yet been extensive enough to form a distinct cluster. And that is where the opportunity for the most original contribution lies.

In practical terms, the above findings provide clear guidance for designing the curriculum for statistics courses in higher education: that the integration of team-based learning (TBL), an explicit emphasis on the articulation of reasoning (mathematical communication), and the measurement of self-efficacy as an indicator of learning success is not an excessive or purely experimental combination, but rather an intervention consistent with separate lines of evidence already present in the literature—though these have never been tested in an integrated manner, particularly within the context of higher education in Indonesia and Southeast Asia more broadly.

Discussion

Growth Rate: An Expansion Driven by Structural Crisis

An AGR of 20.47% over more than a decade is an unusual figure. This indicates that self-efficacy in mathematics learning is not a topic entering a phase of decline, but rather one that is in the midst of expansion. The post-2020 surge, which coincided with the pandemic, was no coincidence. The pandemic forced mathematics learning to shift to an online environment (which differs from the conventional classroom), making it highly dependent on students' initiative and self-regulation. In this context, self-efficacy became the variable that distinguished students who were able to persevere from those who were not. The high relevance of this issue has prompted researchers to pay greater attention to it, as reflected in the surge in the number of scientific publications in recent years.

This nonlinear growth pattern can be interpreted through two complementary theoretical lenses. First, the shape of the growth curve—a gradual initial phase followed by a sharp acceleration—is consistent with the law of exponential growth in the scientific literature formulated by de Solla Price (1963): new fields of research tend to grow along an S-curve, where acceleration occurs once a critical mass of researchers and supporting infrastructure (databases, measurement instruments, journal communities) is surpassed. Second, the post-2020 inflection point aligns with (Zimmerman, 2000) theory of self-regulated learning, which emphasizes that online learning environments require learners to self-manage their motivation, learning strategies, and monitoring of progress—conditions in which self-efficacy, as a core component of self-regulation, becomes an increasingly crucial predictor. Thus, the surge in publications is not merely an opportunistic response by researchers to a fleeting trend, but rather a reflection of a structural shift in learning practices that elevates the theoretical relevance of self-efficacy itself.

Geography of Knowledge: Unequal Production and Underdeveloped Collaboration

The United States and China are the two most productive contributors globally. The international collaboration rate of 20.96% should be interpreted with caution. On the one hand, this means that about four out of five studies in the dataset were conducted without cross-national partners. This is a limitation that could affect the generalizability of the findings and international visibility. On the other hand, it also means there is enormous room for growth. Indonesian researchers who build collaborations with partners in the United States, Australia, or Europe not only expand their individual impact; they also help shift Indonesia's position from the periphery to the mainstream of global discourse.

The pattern of centralization in scientific production in the United States and China, coupled with a low level of international collaboration, is consistent with the core-periphery structure long documented in the sociology of science: "core" countries produce knowledge independently through dense internal networks, while "peripheral" countries are only beginning to build bridging ties to these centers. The concept of the "invisible college," formulated by de Solla Price and Beaver (1966), also helps explain why low levels of international collaboration risk slowing the diffusion of knowledge: without membership in such informal, transnational networks of researchers, research outputs from peripheral regions risk remaining largely invisible on the global stage even as the volume of their publications continues to grow—a structural dynamic, not merely a matter of research quality alone.

Journal Ecosystem: Visibility and Audience Relevance Are Not the Same

The dominance of *Frontiers in Psychology* (197 documents, h = 31) reflects an interesting phenomenon: research on self-efficacy in mathematics, although substantively educational in nature, often finds its publication home in psychology journals. This is partly because *Frontiers in Psychology* is a more open-access journal with a broad scope. However, for researchers seeking to reach a specific audience in mathematics education, EURASIA (59 articles, h = 15) is a far more targeted choice. EURASIA's solid position at number 6 confirms its status as one of the most relevant and stable platforms for this topic in the Asian region.

The phenomenon of *Frontiers in Psychology*'s dominance can be explained by Bradford's Law (Bradford, 1934) regarding the distribution of scientific literature, which states that articles on a given topic are distributed across a small group of highly productive "core" journals, surrounded by zones of journals with increasingly broader scopes but that publish on that specific topic with decreasing frequency. Self-efficacy in mathematics learning, as a psychological construct applied to an educational context, naturally spans two Bradford zones simultaneously: broad-scope general psychology journals (such as *Frontiers in Psychology*) and more specialized mathematics education journals (such as *EURASIA*). This pattern of cross-disciplinary distribution is not an anomaly but rather a defining characteristic of a topic that ontologically lies at the intersection of two academic fields—a characteristic researchers should consider when selecting target journals for publication.

Research Gap

The richest finding in this analysis is, paradoxically, what is not in the map. Co-word maps function on the principle of co-occurrence: keywords that rarely appear together form no node, let alone a cluster. When 'team-based learning', 'mathematical communication', 'statistics education higher education', and 'collaborative learning in statistics' are nearly absent from the visualization—despite being individually important and theoretically well-developed concepts—it means precisely one thing: research exploring the intersection of these constructs with mathematical self-efficacy has not yet reached the critical mass required to leave a visible trace in the global literature This is the most relevant section for the agenda of future research. The identified gaps are not merely the absence of keywords from the map, but rather an absence verified down to the level of occurrence counts (Table 3): compound phrases such as "collaborative learning in statistics" and "communication ability in mathematics" are completely absent (n = 0) across all 3,096 documents, while individual terms such as "team-based learning" and "mathematical communication" are present but extremely rare (n = 1 and n = 3). This represents the absence of an entire ecosystem of research questions integrating these constructs: How do team-based learning models such as TBL foster students' self-efficacy in the context of statistics? How does self-efficacy moderate mathematical communication ability in collaborative learning environments? How different are these patterns in Southeast Asian universities compared to the Western contexts that dominate the literature? Interestingly, this map actually reveals new, emerging subthemes around the core clusters—"AI self-efficacy," "academic writing," and "TAM"—indicating that questions about mathematical self-efficacy in the era of AI-assisted learning remain wide open. These questions remain unanswered, and that is why the dissertation research currently being developed is not only relevant—it stands as one of the few voices filling that silence.

The argument that the integration of TBL, mathematical communication, and statistical self-efficacy represents a gap worth filling is not merely a claim based on a lack of data, but can be built upon the foundation of Bandura's (1997) own theory of self-efficacy. Bandura identifies four main sources of self-efficacy: direct mastery experience, vicarious learning from observing others, verbal persuasion, and physiological/affective states. Structurally, TBL activates at least two of these four sources simultaneously: students gain mastery experience through the Team Readiness Assurance Test and group applications, while also gaining vicarious experience from observing their teammates' problem-solving strategies—a mechanism that is theoretically predicted to strengthen self-efficacy more effectively than individual learning. Mathematical communication skills themselves—articulating reasoning both orally and in writing during TBL group discussions—align with Vygotsky's (1978) social constructivism, which positions conceptual understanding as the result of language mediation and social interaction within learners' zones of proximal development. Within this dual framework—Bandura's theory of self-efficacy and Vygotsky's social constructivism—the identified research gap is not merely a statistical void in the co-word map, but rather the intersection of two psychological-pedagogical mechanisms that are theoretically mutually reinforcing yet have not been extensively tested together empirically, particularly in the context of higher education in Southeast Asia.

Overall, the four findings above can be interpreted as a reflection of reciprocal determinism in Bandura's (1997) Social Cognitive Theory, applied at the level of the academic field itself: the collective belief of the research community regarding the relevance of this topic (analogous to self-efficacy at the individual level) interacts reciprocally with publication behavior and the academic, geographic, and technological conditions of the environment. The pandemic transformed the learning environment; these environmental changes altered researchers' publication behavior; and that publication behavior, in turn, shaped the structure of the field—specific geographic dominance, specific journal ecosystems—which now serves as the new environment for the next generation of researchers. It is within this reciprocal framework that the opportunity for Southeast Asian researchers to enter and help reshape this balance must be understood: not merely as an effort to catch up, but as a point of intervention within a system that is constantly reshaping itself.

Some limitations of this study include the fact that the open-access filter applied reduced the dataset from 6,773 to 3,468 documents—meaning that about half of the English-language publications on this topic were not included because they were not openly available, with a significant concentration (approximately 17.6%) in open-access mega-journals based on article processing charges, such as Frontiers, BMC, MDPI, SAGE Open, and Cogent. The final dataset of this study should therefore be interpreted as a snapshot of the open-access literature landscape as of May 21, 2026, rather than a complete representation of the entire research field indexed in Scopus; established closed-access journals in the field of educational psychology may be underrepresented. Furthermore, although a title/abstract-based eligibility screening stage was implemented to exclude 372 documents from the clinical/health domain unrelated to education (see the Methods section and Figure 1), it is possible that a small number of documents remain that use self-efficacy as one variable in broader studies without a primary focus on mathematics education, as automated keyword-based screening does not fully replace expert assessment of the full text. Further research with full institutional access is recommended to replicate this analysis without the open-access filter to test the consistency of the findings.

CONCLUSION

From the 3,096 Scopus documents analyzed between 2013 and 2025, it is clear that research on self-efficacy in mathematics learning is currently in a phase of rapid growth, with an AGR of 20.47%. The United States and China remain the two most productive contributors globally. In terms of publications, *Frontiers in Psychology* is the most prolific journal for this topic with 197 documents; however, when it comes to relevance to mathematics education specifically, the *EURASIA Journal of Mathematics, Science and Technology Education* remains the most consistent in maintaining its position. The co-word mapping itself reveals four thematic clusters—self-efficacy/teaching/mathematics achievement, health/behavior/demographics, clinical education/medical competencies, and procedures/pilot studies. But what is most interesting about this map is not what is there, but rather what is missing: the integration of self-efficacy, team-based learning, mathematical communication, and statistics education in higher education is virtually absent from the global knowledge map—even phrases such as "collaborative learning in statistics" or "communication ability in mathematics" do not appear at all (n = 0) among the thousands of documents examined. It is important to view this gap not merely as a descriptive observation, but as a reason to take action. Research that integrates team-based learning, self-efficacy, critical thinking skills, and mathematical communication within the context of an Introduction to Statistics course at Indonesian universities has the potential to fill this gap, while also adding another node to a knowledge map that has thus far remained incomplete. This also presents a tangible opportunity for Southeast Asian researchers to voice their perspectives in a field that has long been dominated by Western and East Asian viewpoints; therefore, this direction deserves to be a priority on the future research agenda.

REFERENCES

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

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development, 78*(1), 246–263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review, 15*(1), 1–40. https://doi.org/10.1023/A:1021302408382

Bohrnstedt, G. W., Zhang, J., Li, M., Ikoma, S., Park, B. J., & Broer, M. (2024). Mathematics motivation and mathematics performance: Does gender play a role? *AERA Open, 10*. https://doi.org/10.1177/23328584241298272

Borgonovi, F., & Pokropek, A. (2019). Seeing is believing: Task-exposure specificity and the development of mathematics self-efficacy evaluations. *Journal of Educational Psychology, 111*(2), 268–283. https://doi.org/10.1037/edu0000280

Bradford, S. C. (1934). Sources of information on specific subjects. *Engineering, 137*, 85–86.

Byars-Winston, A., Diestelmann, J., Savoy, J. N., & Hoyt, W. T. (2017). Unique effects and moderators of effects of sources on self-efficacy: A model-based meta-analysis. *Journal of Counseling Psychology, 64*(6), 645–658. https://doi.org/10.1037/cou0000219

Callon, M., Courtial, J.-P., Turner, W. A., & Bauin, S. (1983). From translations to problematic networks: An introduction to co-word analysis. *Social Science Information, 22*(2), 191–235. https://doi.org/10.1177/053901883022002003

Cevikbas, M., Kaiser, G., & Schukajlow, S. (2024). Trends in mathematics education and insights from a meta-review and bibliometric analysis of review studies. *ZDM–Mathematics Education, 56*, 165–188. https://doi.org/10.1007/s11858-024-01587-7

Charalambous, M., Hodge, J. A., & Ippolito, K. (2021). Statistically significant learning experiences: Towards building self-efficacy of undergraduate statistics learners through team-based learning. *Educational Action Research, 29*(2), 226–244. https://doi.org/10.1080/09650792.2020.1782240

Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the fuzzy sets theory field. *Journal of Informetrics, 5*(1), 146–166. https://doi.org/10.1016/j.joi.2010.10.002

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

de Solla Price, D. J. (1963). *Little science, big science*. Columbia University Press. https://doi.org/10.7312/pric91844

de Solla Price, D. J., & Beaver, D. D. (1966). Collaboration in an invisible college. *American Psychologist, 21*(11), 1011–1018. https://doi.org/10.1037/h0024051

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research, 133*, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Drijvers, P., Grauwin, S., & Trouche, L. (2020). When bibliometrics met mathematics education research: The case of instrumental orchestration. *ZDM–Mathematics Education, 52*, 1455–1469. https://doi.org/10.1007/s11858-020-01169-3

Hallinger, P., & Kovačević, J. (2019). A bibliometric review of research on educational administration: Science mapping the literature, 1960 to 2018. *Review of Educational Research, 89*(3), 335–369. https://doi.org/10.3102/0034654319830380

Harahap, R. L., Nasution, A. K. P., & Mandasari, L. (2025). Trends of school mathematics education research in the last decade: A bibliometric analytic review. *Al-Jabar: Jurnal Pendidikan Matematika, 16*(1), 221–244. https://doi.org/10.24042/ajpm.v16i1.27167

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational Research Review, 17*, 63–84. https://doi.org/10.1016/j.edurev.2015.11.002

Huang, C. (2013). Gender differences in academic self-efficacy: A meta-analysis. *European Journal of Psychology of Education, 28*(1), 1–35. https://doi.org/10.1007/s10212-011-0097-y

Julius, R., Abd Halim, M. S., Abdul Hadi, N., Alias, A. N., Mohd Khalid, M. H., Mahfodz, Z., & Ramli, F. F. (2021). Bibliometric analysis of research in mathematics education using Scopus database. *Eurasia Journal of Mathematics, Science and Technology Education, 17*(12), em2040. https://doi.org/10.29333/ejmste/11329

Khudzari, J., Kurian, J., Tartakovsky, B., & Raghavan, G. S. V. (2018). Bibliometric analysis of global research trends on microbial fuel cells using Scopus database. *Biochemical Engineering Journal, 136*, 51–60. https://doi.org/10.1016/j.bej.2018.05.002

Liu, R., Jong, C., & Fan, M. (2024). Reciprocal relationship between self-efficacy and achievement in mathematics among high school students. *Large-scale Assessments in Education, 12*, Article 14. https://doi.org/10.1186/s40536-024-00201-2

Martín-Martín, A., Orduña-Malea, E., Thelwall, M., & Delgado López-Cózar, E. (2018). Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories. *Journal of Informetrics, 12*(4), 1160–1177. https://doi.org/10.1016/j.joi.2018.09.002

Meng, Q., & Zhang, Q. (2023). The influence of academic self-efficacy on university students' academic performance: The mediating effect of academic engagement. *Sustainability, 15*(7), 5767. https://doi.org/10.3390/su15075767

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: A comparative analysis. *Scientometrics, 106*(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*, n71. https://doi.org/10.1136/bmj.n71

Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research, 66*(4), 543–578. https://doi.org/10.3102/00346543066004543

Pajares, F., & Miller, M. D. (1995). Mathematics self-efficacy and mathematics performances: The need for specificity of assessment. *Journal of Counseling Psychology, 42*(2), 190–198. https://doi.org/10.1037/0022-0167.42.2.190

Perianes-Rodríguez, A., Waltman, L., & van Eck, N. J. (2016). Constructing bibliometric networks: A comparison between full and fractional counting. *Journal of Informetrics, 10*(4), 1178–1195. https://doi.org/10.1016/j.joi.2016.10.006

Richardson, M., Abraham, C., & Bond, R. (2012). Psychological correlates of university students' academic performance: A systematic review and meta-analysis. *Psychological Bulletin*, *138*(2), 353–387. https://doi.org/10.1037/a0026838

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, *60*, 101832. https://doi.org/10.1016/j.cedpsych.2019.101832

Singh, V. K., Singh, P., Karmakar, M., Leta, J., & Mayr, P. (2021). The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics, 126*(6), 5113–5142. https://doi.org/10.1007/s11192-021-03948-5

Street, K. E. S., Malmberg, L.-E., & Schukajlow, S. (2024). Students' mathematics self-efficacy: A scoping review. *ZDM–Mathematics Education*, *56*, 265–280. https://doi.org/10.1007/s11858-024-01548-0

Talsma, K., Schüz, B., Schwarzer, R., & Norris, K. (2018). I believe, therefore I achieve (and vice versa): A meta-analytic cross-lagged panel analysis of self-efficacy and academic performance. *Learning and Individual Differences*, *61*, 136–150. https://doi.org/10.1016/j.lindif.2017.11.015

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of Educational Research, 78*(4), 751–796. https://doi.org/10.3102/0034654308321456

Vachova, L., Sedlakova, E., & Kvintova, J. (2023). Academic self-efficacy as a precondition for critical thinking in university students. *Pegem Journal of Education and Instruction*, *13*(2), 328–334. https://doi.org/10.47750/pegegog.13.02.36

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

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Waltman, L., van Eck, N. J., & Noyons, E. C. M. (2010). A unified approach to mapping and clustering of bibliometric networks. *Journal of Informetrics, 4*(4), 629–635. https://doi.org/10.1016/j.joi.2010.07.002

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology*, *25*(1), 68–81. https://doi.org/10.1006/ceps.1999.1015

Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self-efficacy and mathematics achievement: Multilevel analysis with NAEP 2019. *Large-scale Assessments in Education*, *12*, Article 16. https://doi.org/10.1186/s40536-024-00204-z

Zakariya, Y. F. (2022). Improving students' mathematics self-efficacy: A systematic review of intervention studies. *Frontiers in Psychology*, *13*, 986622. https://doi.org/10.3389/fpsyg.2022.986622

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology*, *25*(1), 82–91. https://doi.org/10.1006/ceps.1999.1016

Zhu, Y., & Kaiser, G. (2022). Impacts of classroom teaching practices on students' mathematics learning interest, mathematics self-efficacy and mathematics test achievements: A secondary analysis of Shanghai data from the international video study Global Teaching InSights. *ZDM–Mathematics Education*, *54*, 581–593. https://doi.org/10.1007/s11858-022-01343-9

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*(3), 429–472. https://doi.org/10.1177/1094428114562629