

EDITORIAL

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Nine years of development in establishing the journal as a learning and research hub in STEM education

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Abstract

From August 2014 to July 2023, the *International Journal of STEM Education* went through nine publication cycle years. In this editorial, I provide a brief summary of the journal's development up to and including its ninth publication cycle year (August 2022–July 2023), and share insights about the journal's efforts in establishing itself as a worldwide learning and research hub for the broad STEM education community.

Keywords Authorship, Diversity, Impact, Learning, Readership, STEM education research, Trends

Introduction

In previous yearly editorials (Li, 2018, 2019, 2020, 2021, 2022), I summarized and shared the journal's publication performance based on the journal's publication cycle (PC) year since August 2014. Over the years, the journal has continued its growth trends in terms of multiple performance measures, reflecting on-going development of STEM (science, technology, engineering, and mathematics) education research and the journal's international leadership. In the ninth PC year from August 2022 to July 2023, the *International Journal of STEM Education* (IJSTEM) has furthered its growth and leadership. In this editorial, I will provide an update on the journal's performance and development, and discuss the journal's efforts in building itself as a worldwide learning and research hub for the broad STEM education community.

The journal's performance measured by major indexing services

Figure 1 shows the journal's citation performance measured by impact factor (IF) from Clarivate since IF year 2019. Clarivate provides two IF measures: 2-year IF and 5-year IF that differ in terms of the number of years being covered for calculating IF. The journal did not receive 5-year IF until 2020. Figure 1 shows that the journal reached new highs in IF year 2022 in both IF measures, as reported at the end of June 2023. The 2-year IF value (6.7) placed the journal at #11 out of 269 journals covered by SSCI (Social Science Citation Index) in the category of "Education & Educational Research", and #3 of 42 journals indexed in the category of "Education: Scientific Disciplines" of SCIE (Science Citation Index Expanded). The 2-year IF continues to place the journal in Journal Impact Factor (JIF) Quartile 1 (Q1) among these 269 journals in IF year 2022.

Figure 2 summarizes the journal's performance trajectory over the past five years since it was accepted for inclusion in Elsevier's Scopus. As reported in June 2023, the journal continued to reach new highs in 2022 in terms of Scopus CiteScore (CS) and had slight declines in the other two metrics of Scopus: Source Normalized Impact per Paper (SNIP), and SCImago Journal Rank (SJR). The CS of 9.9 earned the journal #36 (97th percentile) out of

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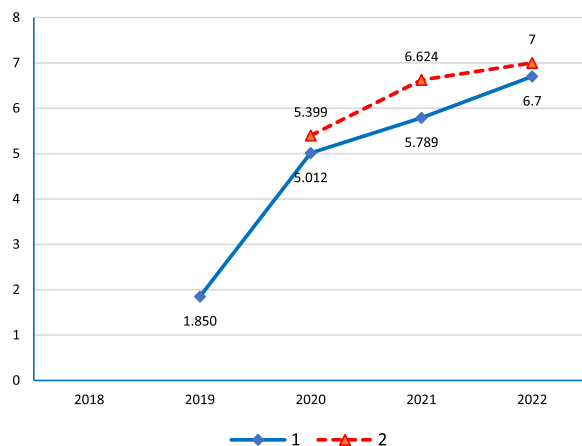


Fig. 1 Clarivate's IF by calendar year (1 = 2-year IF, 2 = 5-year IF). Source: Clarivate's journal citation reports

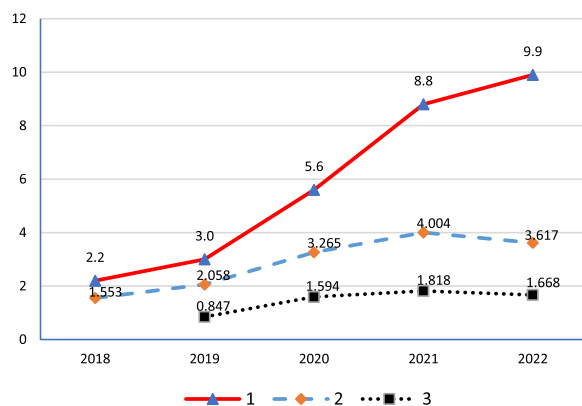


Fig. 2 Scopus metrics by calendar year (Note: 1 = Scopus CiteScore, 2 = SNIP, 3 = SJR). Source: scopus.com website

1469 journals in Education covered in 2022. SJR is calculated with weighted citations to provide a measure of the journal's citation performance that is comparable across different fields. The SJR value continues to place the journal in Quartile 1 (Q1) in the category of Education covered by Scopus since 2019.

Both the measures of Clarivate's IF and Elsevier's Scopus show the consistent and steady progress of the journal's publication citation performance over the past several years. Specifically, the journal's publication citation performance over the past nine PC years provides a clear indication of the journal's leadership in sharing and promoting STEM education research internationally, consistent with what we can learn from other research reviews (e.g., Li et al., 2020, 2022a, 2022b).

To get some insights about the journal's publication citation performance, we can take a closer look at some of its most-cited publications. Clarivate's journal citation reports provided a list of citation counts for different

articles in a journal. Based on the 2023 Clarivate's journal citation report, Table 1 shows the top 10 most-cited articles in descending order for IF year 2022 out of all articles published in 2020–2021. The 10 most-cited publications had an average of 21.3 citations per article with a range of 15 to 45 citations in 2022. In comparison with the IF year 2021 (Li, 2022), the average citations for the top 10 most-cited articles were improved from 18 (with a range of 9 to 55) in 2021 to 21.3 in 2022.

Moreover, 4 of these top 10 most-cited articles in the 2022 list were also on the 2021 list (Gao et al., 2020; Kelley, et al., 2020; Kricorian et al., 2020; Li et al., 2020), and all four articles' citation counts in 2022 were also elevated further from their citations in 2021. The results indicate these four articles' high quality and impact in the field. If taking a further look at the topics of these four articles, we can note that they are on diverse topics in STEM education. Specifically, the article by Li et al. (2020) is a comprehensive review of 798 articles in STEM education published between 2000 and the end of 2018 in 36 journals. It was the first review in such a large scope to examine the status and trends in STEM education research internationally. The article by Kelley et al. (2020) is an empirical study that investigated the impact of a teacher professional development program ("teachers and researchers advancing integrated lessons in STEM") on teacher self-efficacy. The article by Gao et al. (2020) is a comprehensive review of 49 empirical research articles published between 2000 and 2019 on the assessment of student learning in interdisciplinary STEM education. The article by Kricorian et al. (2020) is a short report of a pilot study that examined the beliefs and experiences of underrepresented US students pursuing STEM through a survey on their mentorship experiences and preferences.

In fact, most of these 10 most-cited articles in the 2022 list (see Table 1) are on different topics in STEM education rather than on one of the component disciplines of STEM, consistent with what was revealed from examining the most-cited publications in previous editorials (e.g., Li, 2020, 2021, 2022). The result further confirms the journal's original focus on interdisciplinary STEM education publication (Li, 2014).

The 2022 list contained 7 (out of these 10 most-cited) articles published in 2020 (Chevalier et al., 2020; Gao et al., 2020; Kelley, et al., 2020; Kricorian et al., 2020; Li et al., 2020; Limeri et al., 2020; Reinholz & Andrews, 2020), with an average of 23.6 citations per article in 2022. The 2021 top-10 list had 6 articles published in 2020 with an average of 15 citations per article (see Li, 2022). The results suggest that more publications in 2020 have made it to the top 10 most-cited list in 2022 and were cited more in 2022, in comparison with the 2021 list. Three articles published in 2021 made it into the 2022 top-10

Table 1 Top 10 most-cited articles published in 2020–2021 for IF year 2022

Title (publication date)	Author(s)**	Citations for IF year 2022*
Research and trends in STEM education: a systematic review of journal publications (2020–03–10)	Y. Li, et al. (USA)	45 (23)
Fostering computational thinking through educational robotics: a model for creative computational problem solving (2020–08–03)	M. Chevalier et al. (Switzerland)	25
Change theory and theory of change: what's the difference anyway? (2020–01–17)	D. L. Reinholz et al. (USA)	22
Increasing high school teachers' self-efficacy for integrated STEM instruction through a collaborative community of practice (2020–04–16)	T. R. Kelley, et al. (USA)	20 (12)
Reviewing assessment of student learning in interdisciplinary STEM education (2020–06–09)	X. Gao, et al. (China)	18 (13)
Factors influencing participation of underrepresented students in STEM fields: matched mentors and mindsets (2020–04–21)	K. Kricorian, et al. (USA)	18 (13)
Growing a growth mindset: characterizing how and why undergraduate students' mindset change (2020–07–08)	L. B. Limeri et al. (USA)	17
STEAM in education: a bibliometric analysis of performance and co-words in Web of Science (2021–06–25)	J.A. Marin-Marín et al. (Spain)	17
Using design thinking to cultivate the next generation of female STEAM thinkers (2021–03–22)	R. Kijima et al. (Canada)	16
A scoping review of literature assessing the impact of the learning assistant model (2021–02–25)	A. P. Barrasso et al. (USA)	15

* Citation counts in IF year 2022 were retrieved from 2023 Clarivate's journal citation reports. The number of citations in 2022 used to identify the list of top 10 most-cited articles, and its number of citations in IF year 2021 is provided in parentheses if it was also included in the 2021 list of top 10 most-cited articles

** Country/region refers to where the leading author's research organization or institution was located at the time of publication

list (Barrasso & Spiliotis, 2021; Kijima et al., 2021; Marín-Marín et al., 2021). In comparison with the number (6) of articles in 2020 that made it into the 2021 list, there were less recent publications in 2021 which made it into the 2022 top-10 list. The result suggests that a journal's publications and citation performance can vary from year to year in response to many different contributing factors.

In the 2022 list (see Table 1) 6 of the top 10 most-cited articles were contributed by authors in the United States, consistent with what was reported before about the leading position of US authorship nationality in contributing to the most-cited articles in this journal (Li, 2022; Li et al., 2019). Meanwhile, it is important to note that the 2022 list includes four articles contributed by scholars from Canada, China, Spain, and Switzerland. In comparison, there were only three articles in the 2021 list and two articles in the 2020 list contributed by scholars from countries other than the USA (Li, 2021, 2022). The results suggest that the journal continues its international expansion in terms of not only how many article accesses took place (readership), but also who contributed the most-cited articles (authorship).

The journal's performance measured in terms of the number of article accesses

The number of full-text article accesses is another important measure of a journal's performance as used in previous editorials (e.g., Li, 2021, 2022; Li et al., 2019). Figure 3 shows the total number of accesses by year for this journal's publications. The journal publication accesses present a steady upward trend over the years,

attracting many more views and downloads in 2022, with a total of 1,402,826 full-text accesses, which is about a 19% increase, or a net 223,071 more than the 1,179,755 accesses in 2021.

To further examine journal publication accesses, we can take a closer look at some highly accessed articles. Table 2 provides a list of top 10 most-accessed articles in 2022 in descending order. There were an average of 40,113 full-text accesses for each of these articles with a range of 30,615 to 54,626 accesses, indicating the high popularity and interest of these articles on diverse topics to the journal's international readership. In comparison with the top 10 list in 2021 (Li, 2022), the average accesses for the top 10 most-accessed articles were elevated from 35,470 (with a range of 23,739 to 67,178) in 2021 to 40,113 in 2022. Among the top 10 most-accessed articles in 2022, eight also made it into the top-10 list in 2021. Accesses to these eight articles show five increased and three decreased from 2021 to 2022, reflecting ongoing changes in article accesses on various topics.

The bold titles in Table 2 refer to those 4 articles that also made the list of the top 10 most-accessed publications in 2020 and 2021 (Li, 2021, 2022). In comparison, these 4 articles had an average of 44,095 accesses per article, exceeding the overall average article accesses of 40,113. The result suggests the on-going high interest in these 4 articles over the years on diverse topics in the global community.

Table 2 shows that the leading authors for seven of the 10 articles were from the United States, and the other three from other countries. In comparison, there

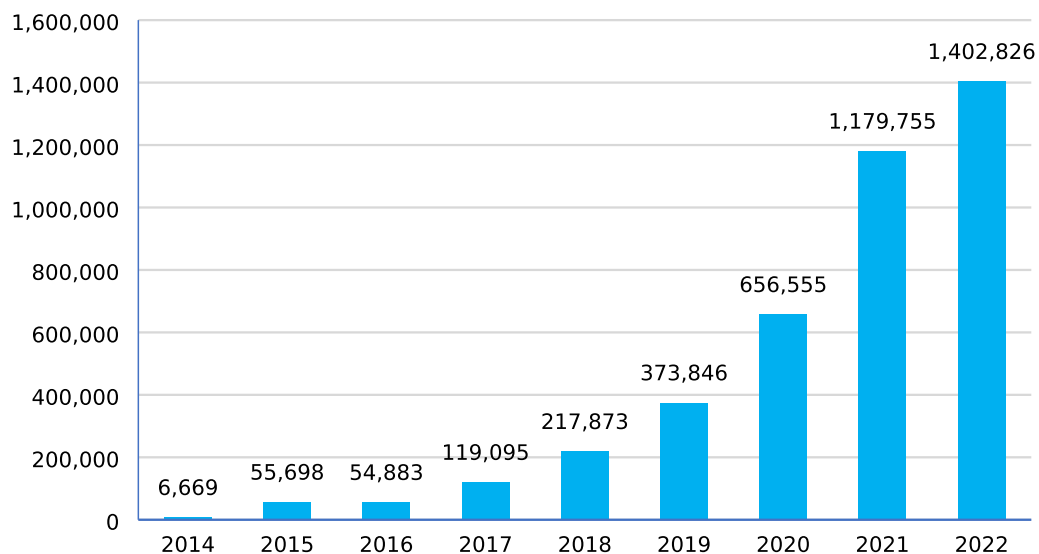


Fig. 3 Number of full-text accesses* by calendar year (Source: Springer) Note *: Accesses are defined as the number of times full text or PDF versions of articles are accessed directly from the journal website and SpringerLink. Downloads are defined as HTML, LookInside, PDF, and Epub clicks. Note that accesses do not include article downloads from mirror databases such as PubMed Central

Table 2 Top 10 full-text article accesses in 2022(2021)*

Title (publication date)	Author (country/region**)	# of full-text accesses
Multiple-true-false questions reveal more thoroughly the complexity of student thinking than multiple-choice questions: a Bayesian item response model comparison (2019–05-10)	C. E. Brassil et al. (USA)	54,626 (67,178)
Exploring the factors that influence the career decision of STEM students at a university in South Africa (2020–12-01)	E. N. Abe et al. (South Africa)	51,292 (25,410)
Research and trends in STEM education: a systematic review of journal publications (2020–03-10)	Y. Li et al. (USA)	48,666 (39,225)
Students' reasons for STEM choices and the relationship of mathematics choice to university admission (2019–12-13)	Satu Kaleva et al. (Finland)	42,926 (35,080)
Teachers' roles and identities in student-centered classrooms (2018–09-14)	L. S. Keiler (USA)	42,105 (45,478)
Developing student 21st Century skills in selected exemplary inclusive STEM high schools (2019–11-25)	S. M. Stehle et al. (USA)	36,910 (32,411)
Mathematics anxiety among STEM and social sciences students: the roles of mathematics self-efficacy, and deep and surface approach to learning (2020–09-07)	D. Rozgonjuk et al. (Germany, Estonia)	31,508
Change theory and theory of change: what's the difference anyway? (2020–01-17)	D. L. Reinholz et al. (USA)	31,498 (25,089)
Problematizing teaching and learning mathematics as "given" in STEM education (2019–12-19)	Y. Li & A. H. Schoenfeld (USA)	30,984 (31,498)
Growing a growth mindset: characterizing how and why undergraduate students' mindsets change (2020–07-08)	L. B. Limeri et al. (USA)	30,615

* Number of accesses in 2022 used to identify the top 10 most-accessed articles, and its number of accesses in 2021 is provided in parentheses if it was also included in the 2021 list of top 10 most-accessed articles. (Source: Springer)

** Country/region refers to where the leading author's research organization or institution was located at the time of publication

were three articles in the 2021 list and only two in the 2020 list contributed by scholars from other countries (Li, 2021, 2022). The result may suggest an on-going slowly increasing tendency in the international community to learn about views and research works from publications contributed by scholars outside of the United States.

An examination of the subject content covered by these 10 most-accessed articles reveals that the majority are about STEM, rather than a specific individual STEM discipline. The content focus on STEM is generally consistent with the top 10 most-cited list (see Table 1). The results confirm that the journal has been valued for its leadership role in sharing and promoting STEM

education research, as noted in previous editorials (e.g., Li, 2022).

The journal's efforts in establishing itself as a worldwide learning and research hub in STEM education

The existence of an academic journal is to meet the needs of publishing, serve as a means of communication, and provide a permanent repository of scholarly work (Rallison, 2015). The same applies to the *International Journal of STEM Education*. IJSTEM embodies these purposes that are common and normal for all academic journals. At the same time, these purposes can easily restrict the conception of an academic journal as providing professional services, especially when looking at a journal from a professional publisher's perspective. Indeed, professional publishing is a vital business. But viewing a journal from an academic perspective provides a broader and richer view about the development and progress of the *International Journal of STEM Education*. In the following sub-sections, I summarize and share five aspects of the journal's efforts, including those from both the editorial board and Springer, in establishing itself as a worldwide learning and research hub in STEM education.

Serving as a leading knowledge resource in multidisciplinary STEM education research worldwide

IJSTEM was established to promote the multidisciplinary research needed to complement the individual discipline-based journals in STEM education (Li, 2014). The journal's development over the years has shown the success in establishing itself as a leading journal in STEM education research since 2019, as the first journal in STEM education covered in SSCI (Li, 2019). The measures of ever-increasing article accesses and citation performance, as discussed above, are important indices of the journal's impact as a leading knowledge resource for both readers and researchers worldwide.

Moreover, the journal's leadership in publishing impactful STEM education research is also evidenced in other reviews of publications (e.g., Li et al., 2020, 2022b). While impactful research in STEM education has also been published in many other journals, especially those well-established journals with a long history (Li et al., 2022a, 2022b), It should be noted that IJSTEM has risen quickly with a clear focus on publishing and promoting impactful research in STEM education.

Pursuing high quality in scholarly output through a rigorous process of screening, reviewing, and publishing

To establish the journal as a worldwide learning and research hub needs to go beyond a focus on the number

of publications. The journal's efforts in pursuing high quality scholarly output have focused on: rigorous reviews and quality publications. For those manuscripts that passed initial screenings, the journal employs a double-blinded peer review process to help ensure a manuscript's quality. The peer-review process has been working well as it also serves as a learning process for both reviewers and the author(s). All these reviews with subsequent revisions help the handling editor(s) make informed editorial decisions about the required quality for publishing in this journal.

The excellent-quality production provided by Springer has been an important process that helps contribute to the journal's quality and ensures accessibility, storage, and easy retrieval. It is an essential feature for the journal as a learning and research hub to support international readers and researchers with worry-free access to high-quality research in STEM education.

Engaging researchers and educators with diverse disciplinary, educational, and cultural backgrounds to address diverse issues in STEM education worldwide

IJSTEM's success cannot be separated from its efforts to engage researchers and educators to address diverse issues in STEM education worldwide. In previous editorials (Li, 2022; Li & Xiao, 2022), the journal's diversity trends were reviewed and discussed in terms of research topics, school level focus, and corresponding author's nationality/region and profession. The diversity trends reflect the journal's years of efforts in welcoming and engaging international researchers and readers from different disciplines (Li, 2022).

Moreover, the journal has strived to identify and involve more and diverse scholars in the manuscript peer-review process. It is a process not only helping provide different perspectives about a manuscript, but also helping bring the journal to the attention of more international scholars in diverse disciplines. Finally, it should be noted that the journal also benefits from having an editorial board of scholars with diverse professional backgrounds from eight different countries/regions. This diversity has become an important feature of the journal, and in return, enabled the journal to serve the diverse needs of learning and research in STEM education around the globe.

Elevating the journal's article visibility, accessibility, and impact with diverse approaches, including Open-Access publications

To establish the journal as a worldwide learning and research hub, it is important to not only ensure article quality, but also elevate the journal's international visibility, accessibility, and impact. To achieve this, the journal

has employed diverse approaches. First of all, the journal benefits from publishing all articles as Open Access (OA), which carries multiple benefits including free access, consequent increased researcher engagement and greater impact (see <https://www.springernature.com/gp/open-research/about/benefits>). While there is an unavoidable financial concern for some authors to publish OA articles, Springer provides a free service to help identify possible support.

In addition to OA publications, the journal also promotes publications on the journal website. Springer has consistently been encouraging readers to sign up on the journal website to receive free email alerts for every new publication, promote new publications regularly through X (formerly, “Twitter”), and share selected research highlights through blogs. In addition, IJSTEM has initiated monthly updates on the journal website to provide a list of the five most popular (measured in terms of online access) articles published over the last 9 months and a list of the five most cited articles of the past two years. These rolling monthly updates provided by Springer keep researchers and readers up to date about the impactful research published in this journal, an important feature for the journal as a leading knowledge source in STEM education research.

Keeping a professional commitment and dedication in promoting research excellence in STEM education worldwide as a distinct field

It is a common practice for scholars in an academic field to document their scholarly performance and productivity in terms of the number of publications and where they publish. The reputation and prestige of a journal, as often measured by impact performance, carry much weight in a scholar's choice and decision of where to submit and publish manuscripts. It is very difficult for a young journal like IJSTEM to reach such a premier status, as there are many well-established high quality journals available for scholars to choose from (Li et al., 2020). It has been critical for the journal to maintain a professional commitment to move forward with a vision, as shared in previous editorials (Li, 2018, 2019, 2020, 2021, 2022). IJSTEM has dedicated itself to promote the development of STEM education as a distinct field, and at the same time to serve the scholarly needs of readers and researchers in STEM education worldwide.

IJSTEM is dedicated to supporting researchers in submitting and publishing manuscripts, providing assistance at various stages and elevating the publication's visibility and potentially greater impact. With the ever-increasing manuscript submissions and publications, learning takes place in many different ways, including from accessing and reading an article, navigating the journal, submitting

and publishing a manuscript, and reviewing a manuscript. The on-going strong support from international readers and researchers has enabled the journal to be not only a gathering place, but also a learning and research hub in STEM education.

Coda

The journal's stellar performance in the ninth PC year in terms of both citation indexing measures and the number of article accesses/downloads are clear indications of the on-going development of STEM education research and the journal's solid leadership in the field. Building upon a reflection of the journal's development over the years, I summarized five aspects of the journal's efforts to establish itself as a worldwide learning and research hub in STEM education.

Last but not least, I want to take this opportunity to thank all authors, reviewers, members of the journal's editorial board, Springer staff members, and readers around the world for all the strong and on-going support and contributions. Thank you all for making the journal's success possible. This editorial reveals that the journal continues its positive development trajectory. I sincerely hope that the journal will further its expansion as a hub to support more and more researchers and readers to learn about and develop research in STEM education around the globe.

Abbreviations

CS	CiteScore
IF	Impact factor
IJSTEM	International Journal of STEM Education
JIF	Journal impact factor
K-12	Kindergarten-Grade 12
PC	Publication cycle
SCIE	Science Citation Index Expanded
SJR	SCImago Journal Rank
SNIP	Source normalized impact per paper
SSCI	Social Science Citation Index
STEAM	Science, Technology, Engineering, Arts, and Mathematics
STEM	Science, Technology, Engineering, and Mathematics

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Declarations

Competing interests

The author declares no competing interests.

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