International Journal of STEM Education

EDITORIAL Open Access

Seven years of development as building a foundation for the journal's leadership in promoting STEM education internationally

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Abstract

The *International Journal of STEM Education* went through seven publication cycle years from August 2014 to July 2021. The journal's performance has consistently reflected the rapid development in STEM education research internationally. In this editorial, I share the journal's performance since August 2020 and discuss possible future developments.

Keywords: Identity, Impact, Leadership, Scholarship, SSCI journal, STEM education research

Introduction

In previous editorials (Li, 2018a, 2019, 2020), I summarized the journal's performance in publications over its first four-, five-, and then six-publication cycle (PC) years since August 2014, respectively. The journal's steady growth and performance over the years reflected the rapid development of STEM (science, technology, engineering and mathematics) education research and the journal's international reach. Adding the seventh year of development, the *International Journal of STEM Education (IJ-STEM)* is well positioned to expand its leading role in promoting STEM education research internationally.

In this editorial, I will share the journal's recent development, especially in its seventh PC year from August 2020 to July 2021. In light of the journal's on-going development and performance, I will further discuss the needs and benefits of elevating and expanding the exchange of STEM education research globally. Thus, the following sections are organized in two main parts, the first about the journal's progress and the second about possible aspects that can get more attention and effort for elevating and broadening the sharing of STEM education research. The editorial will again conclude with acknowledgements to STEM education researchers and readers around the world for the on-going strong support that makes the journal's accomplishment possible.

Multiple measures of the journal's performance

Performance progress measured by indexing services

Because the *IJ-STEM* has been covered first in Elsevier's Scopus and then in Web of Science's Social Sciences Citation Index (SSCI) by Clarivate Analytics, Table 1 summarizes the journal's performance progress over the past 3 years as measured by these two indexing services.

The journal received its very first Scopus CiteScore (CS) with its 2018 citation metrics. Over the past 3 years, the journal's CS has consistently improved from 2.4, 3.0, and to 5.6 with citation performances in 2018, 2019, and 2020, respectively. In 2020, the journal received its first Source Normalized Impact per Paper (SNIP) of 2.058 and SCImago Journal Rank (SJR) of 0.847 based on citation metrics in 2019. With the calculation of weighted citations, SJR provides a measure of the journal's performance comparable across different fields. The SJR value of 0.847 (in 2019) placed the journal in Quartile 1 (Q1) in the category of Education covered by Scopus. The journal's performance in 2020 clearly improved with SNIP of 3.265 and SJR of 1.594. The journal is again being placed

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Table 1 Summary of the journal's performance measured by indexing services

	2020	2019	2018
Scopus CiteScore	5.6	3.0	2.4*
SNIP	3.265	2.058	
SJR	1.594 (Q1)	0.847 (Q1)	
(2 years) Impact Factor	5.012 (Q1)	1.850 (Q2)	

Sources: scopus.com website and Clarivate's journal citation reports

*The value was reported in 2019 using the previous formula, and would be 2.2 if using the current new formula

in Q1 in the category of Education with the updated SJR measure.

As the *IJ-STEM* was evaluated for coverage in SSCI starting in 2019, the journal received its first impact factor (IF) of 1.850 based on its performance metrics in 2019. This IF value placed the journal at #100 out of 263 journals then-covered by SSCI in the category of "Education & Educational Research," #15 out of 41 journals in the sub-category of "Scientific Disciplines." And the journal was placed in Journal Impact Factor (JIF) Quartile 2 (Q2) among these 263 journals. The journal received a new IF of 5.012 this year based on its performance metrics in 2020. Consistent with the CS measure, the IF shows the journal's dramatic improvement in citation performance from 2019 to 2020. The new IF now places the journal at #16 out of 264 journals currently covered by SSCI in the category of "Education & Educational Research," #4 out of 44 journals in the sub-category of "Scientific Disciplines." The IF has positioned the journal in JIF Quartile 1 (Q1) among these 264 journals.

Both the measures from Elsevier's Scopus and Clarivate's Web of Science clearly indicate the steady improvement of the journal's publication citation performance over the past several years. Specifically, the journal's publication citation performance in the seventh PC year provides a further confirmation about the journal's leadership in promoting STEM education research internationally as discussed before (Li, 2020).

To learn further about the journal's publication citation performance, we can take a closer look at some of the most-cited publications. For articles published in 2020, Table 2 shows the top 10 most-cited publications in descending order. Consistent with what we can learn from the most-cited publications in 2019 (Li, 2020), the vast majority of these 10 most-cited publications in 2020 are again about STEM rather than one of the component disciplines of STEM. The result further confirms what we learned before about the journal's publication focus on STEM education in previous years (Li et al., 2019).

Table 2 also shows that these most-cited articles in 2020 were contributed by scholars not only from the United States, but also several other countries/regions (i.e., Hong Kong, Japan, mainland China, Switzerland, and Taiwan). In contrast to all top 10 most-cited articles published in 2019 that were contributed by scholars only from the United States (Li, 2020), Table 2 presents an interesting new development that we hoped to see (Li, 2020; Li et al., 2019). These highly cited publications contributed by researchers from diverse countries/regions suggest not only some exciting development in authorship in STEM education research internationally, but also a growing acknowledgement to the value of diverse perspectives and approaches in STEM education research contributed by scholars around the world. Indeed, the journal has become a gathering place for international

Table 2 Top 10 most-cited articles published in 2020*

Title	Author(s)	Country/Region**
Research and trends in STEM education: a systematic review of journal publications	Y. Li et al.	U.S.A
Evidence of STEM enactment effectiveness in Asian student learning outcomes	B. Wahono et al.	Taiwan
Conceptual framework of STEM based on Japanese subject principles	C. Yata et al.	Japan
Increasing high school teachers self-efficacy for integrated STEM instruction through a collaborative community of practice	T. R. Kelley et al.	U.S.A
Rubrics to assess critical thinking and information processing in undergraduate STEM courses	G. Reynders et al.	U.S.A
Fostering computational thinking through educational robotics: a model for creative computational problem solving	M. Chevalier et al.	Switzerland
Integrating science and engineering practices: outcomes from a collaborative professional development	B. R. Brand	U.S.A
Research and trends in STEM education: a systematic analysis of publicly funded projects	Y. Li et al.	U.S.A
Reviewing assessment of student learning in interdisciplinary STEM education	X. Gao et al.	China
Boundary crossing pedagogy in STEM education	A. Leung	Hong Kong

*Based on citation counts that were retrieved from Springer Nature Insights/Dimensions in early Oct, 2021

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

researchers and readers in STEM education more than ever before (Li, 2018a).

Performance progress measured in terms of the number of publications and downloads

Figure 1 shows the journal's growth in terms of the number of articles published in each cycle year from August 2014 to July 2021. The *IJ-STEM* published a total of 71 articles (including research articles, reviews, commentaries, etc.) in its seventh PC year (August 2020 to July 2021). Viewing across the past seven PC years, it is clear that the journal has made further progress in terms of the number of published articles. The journal is likely getting to a position of receiving and publishing more high-quality manuscripts as the next step with the on-going strong support from researchers in STEM education internationally.

In addition to the increasing number of article publications, the journal's performance can be examined in terms of the number of article accesses. Figure 2 shows the total number of times that the journal publications were accessed by year. It is clear that the journal publications continued to attract many more views and downloads in 2020, with a total of 656,555 accesses, which is about a 76% increase, or a net of 282,709 more accesses than the 373,846 accesses in 2019.

Although we do not have the access information yet for the year of 2021, we can still get a glimpse of publication accesses based on recent months. Figure 3 shows the total number of times journal publications were accessed in the first 9 months of 2019, 2020, and 2021, respectively. It presents a clear trend of dramatically increased accesses over the years, a pattern consistent with what we can find from Fig. 2. It is also interesting to note that the number of publication accesses (822,862) in the first 9 months of 2021 is already more than the number of publication accesses (656,555) in the entire year of 2020. The steady increasing trend provides a clear indication about the journal's popularity that benefits from its high-quality publications and its leading role in promoting STEM education globally.

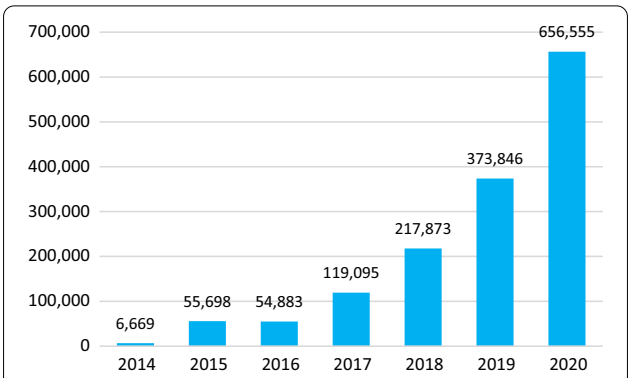

Fig. 2 Number of accesses* by calendar year (Source: Springer). *Accesses are defined as the number of times full text or PDF versions of articles are accessed directly from the journal website and SpringerLink. Downloads are defined as HTML, LookInside, PDF, and Epub clicks. Please note that accesses do not include article downloads from mirror databases, such as PubMed Central

To further examine journal publication accesses, we can take a closer look at some most-accessed articles. Table 3 shows the top 10 most-accessed articles in 2020 in descending order. Different from what we noticed about the top 10 most-accessed lists in previous years (Li et al., 2019), the top 10 list in 2020 has dramatic overlap with the top 10 list in 2019 (Li, 2020). In fact, only two new articles joined the top 10 most-accessed article list in 2020. They are (1) the article of "Research and trends in STEM education: a systematic review of journal publications" (Li et al., 2020) and (2) the article of "Problematizing teaching and learning mathematics as 'given' in STEM education" (Li & Schoenfeld, 2019). The other eight articles were also on the list of top 10 most-accessed articles in 2019. The result indicates that international readers may search for specific types of topics and publications in STEM education research, and the list suggests

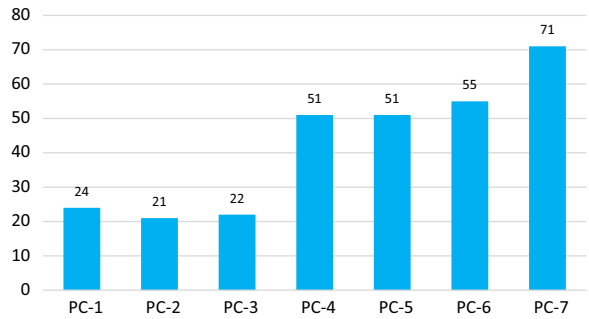

Fig. 1 Number of articles by publication cycle year

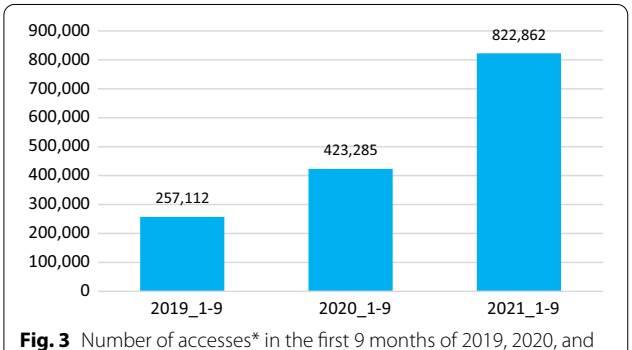

Fig. 3 Number of accesses* in the first 9 months of 2019, 2020, and 2021 (Source: Springer)

Table 3 Top 10 most-accessed articles in 2020

Title (year of publication)	Author(s)	Country*
Teachers' roles and identities in student-centered classrooms (2018)	L. S. Keiler	U.S.A
A conceptual framework for integrated STEM education (2016)	T. R. Kelley et al.	U.S.A
Teachers' perception of STEM integration and education: a systematic literature review (2019)	K. C. Margot et al.	U.S.A
Multiple-true–false questions reveal more thoroughly the complexity of student thinking than multiple-choice questions: a Bayesian item response model comparison (2019)	C. E. Brassil et al.	U.S.A
Research and trends in STEM education: a systematic review of journal publications (2020)	Y. Li et al.	U.S.A
A study of the correlation between STEM career knowledge, mathematics self-efficacy, career interests, and career activities on the likelihood of pursuing a STEM career among middle school students (2018)	K. A. Blotnicky et al.	Canada
Problematizing teaching and learning mathematics as "given" in STEM education (2019)	Y. Li & A. H. Schoenfeld	U.S.A
Students' perceptions of STEM learning after participating in a summer informal learning experience (2018)	T. Roberts et al.	U.S.A
STEM education K-12: perspectives on integration (2016)	L. D. English	Australia
Making sense of "STEM education" in K-12 contexts (2018)	T. D. Holmlund et al.	U.S.A

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

two possible topic areas: (1) issues related to STEM teachers and (2) general conceptions and reviews about STEM education.

Across Tables 2 and 3, we can find that only the article by Li et al. (2020) appeared in both the top 10 most-cited list and the top 10 most-accessed list. Although this article is published as an editorial, it is a systematic review of journals' publication trends in STEM education research. This article's performance in access and citation metrics suggests a topic area that is likely sought after in the international research community of STEM education. Checking further about the topics covered by these 10 most-accessed articles, it is clear that the vast majority of these 10 most-accessed articles are about STEM, rather than an individual STEM discipline. The topic coverage is generally consistent with the top 10 most-cited list (Table 2). The result suggests that the journal has been valued for its leadership role in sharing STEM education research.

Different from what is noted about the top 10 most-cited list above, however, the majority of the most-accessed publications in 2020 (eight out of 10) were contributed by scholars in the United States. There are only two publications in the most-accessed article list contributed by scholars from two other countries (i.e., Australia and Canada). Based on the change in article authorship with the top 10 most-cited list (Table 2), it is reasonable to expect possible changes to the top 10 most-accessed list in the future.

Performance progress measured in terms of readership development

Table 4 shows the top five countries/regions that accessed the journal's publications by year. It shows the journal's international reach as well as some shifts in access by country over the years. Overall, the United States stays at the top with the most frequent access to the journal, followed by several countries in Asia, such as the Philippines, India, and Indonesia. There are some other countries that joined the top five list from time to time, including Australia, Brazil, and the UK. The international reach of the journal's readership presents a pattern that has relatively stabilized over the past several years.

If examining these accesses in terms of continents, Table 5 shows that Asia always stays at the top since 2017, followed typically by the Americas, Europe, Oceania, and Africa. It presents a consistent pattern over the past several years. The result suggests not only the journal's

Table 4 Top five countries that accessed the journal's publications by calendar year

Rank	2020	2019	2018	2017	2016	2015
1	U.S	U.S	India	U.S	U.S	U.S
2	Philippines	Philippines	U.S	Philippines	Indonesia	Indonesia
3	India	Indonesia	Brazil	Indonesia	Philippines	Turkey
4	U.K	India	Philippines	India	India	U.K
5	Indonesia	Australia	Indonesia	Australia	Thailand	Hong Kong

Source: Google analytics

Table 5 Rank of five continents that accessed the journal's publications by calendar year

Rank	2020	2019	2018	2017	2016	2015
1	Asia	Asia	Asia	Asia	Americas	Americas
2	Americas	Americas	Americas	Americas	Asia	Asia
3	Europe	Europe	Europe	Europe	Europe	Europe
4	Oceania	Oceania	Oceania	Africa	Oceania	Oceania
5	Africa	Africa	Africa	Oceania	Africa	Africa

Source: Google analytics

international reach, but also possible variations in the extent of STEM education research activities across different continents.

Building upon the journal's 7 years of development to elevate and expand the sharing of STEM education research around the world

The seventh PC year presents another year of stellar performance for the *IJ-STEM*. The journal's on-going strong growth over the years reflects the rapid development in STEM education research, as well as a recognition of the journal's emerging leadership in promoting STEM education research internationally. At the same time, we know that these journal performance measures (e.g., the number of publications, accesses, and citations) can change (up and down) from time to time after reaching a certain level. Thus, it would be more important to think about what the journal may do to promote STEM education research than to pay close attention to specific measures in the future. Here I would like to share two aspects, by building upon the journal's leadership, to elevate and expand the sharing of STEM education research around the world.

The first aspect is about possible ways of elevating the sharing of STEM education research. As discussed in previous editorials (Li, 2020; Li et al., 2020), the *IJ-STEM* has had great performance in attracting and publishing STEM education articles since the journal's inception in 2014. To further the identity formation of STEM education, it is important to promote scholarship development in identifying and studying some fundamental questions and issues in STEM education (Li, 2020). Related research efforts and discussions may be presented as research articles, research reviews, or commentaries. The *IJ-STEM* is well positioned to welcome, support, and promote the sharing of such scholarly work. Moreover, collective efforts are also welcomed for international researchers to work together on important topics to propose and publish special issues. The *IJ-STEM* published several special issues before, which can serve as possible examples for interested scholars about the format and structure.

The second aspect is about possible ways of expanding the sharing of STEM education research internationally. If looking at the *IJ-STEM* by itself, one way of expanding the sharing of STEM education research is to increase the number of article publications. As discussed above, the *IJ-STEM* is about ready in receiving and publishing more high-quality manuscripts as the next step. At the same time, it is important to realize that every journal has its own special features and limitations. International researchers are also encouraged to check some other viable journals and publication outlets. For example, Springer has another journal (*Journal for STEM Education Research (J-STEM)*, https://www.springer.com/journal/41979) with more emphasis on interdisciplinary research in STEM education (Li, 2018b). Differences between these two journals in STEM education were discussed in a previous editorial (Li, 2018a), mainly in (1) the modes of publication (Open Access vs. subscription-based) and (2) their content foci (multidisciplinary vs. interdisciplinary). Researchers may also think about book publications in STEM education. Springer has a book series specifically on STEM education (*Advances in STEM Education*, https://www.springer.com/series/13546). Interested researchers can learn more about the series from some recent book publications. For example, one recent published book (*Integrated Approaches to STEM Education*, Anderson & Li, 2020) has been well accessed with more than 25,000 chapter downloads in SpringerLink alone in less than 1 year. Interested researchers and readers can also find more information from a recent review of the book (see Wilson, 2021). In addition to Springer's publication portfolio in STEM education, a recent publication review revealed many other journals available that welcome manuscript contributions on STEM education (Li et al., 2020). International researchers are encouraged to explore different publication options and outlets to share scholarly work in STEM education. It is everyone's participation and contribution, together with a supportive publication environment with

diverse options, that we can expand the sharing of STEM education research internationally.

Last but not least, I want to take this opportunity again to thank all contributors, reviewers, the journal's editorial board members, staff members at SpringerOpen, and readers for the tremendous and on-going support for the journal over the past 7 years. The journal's accomplishment so far is not a small feat, and helps build a foundation for the journal's leadership in promoting STEM education research as the next step. To further international efforts of establishing STEM education as a distinct field, it is my hope that this journal, together with other journals and publication outlets, can provide a distinguished platform for all researchers to elevate and expand the sharing of STEM education research around the world.

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Declarations

Competing interests
Not applicable, as this is a single authored article.

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