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EDITORIAL

Journal for STEM Education Research – Promoting the Development of Interdisciplinary Research in STEM Education

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Introduction

The *Journal for STEM Education Research* is a new interdisciplinary journal focusing on research in STEM (Science, Technology, Engineering, and Mathematics) education. It is established as a frontier and forward looking research journal to promote the development of interdisciplinary research in STEM education as a distinct field.

In this inaugural editorial, I intend to acquaint readers with the journal by providing background information about its establishment, the unique features that help distinguish it from other journals in STEM education, its topical foci, the types of articles that it publishes, and the general process of manuscript submission and review.

Why Establish the *Journal for STEM Education Research*?

The field of STEM education has experienced dramatic changes and development over the years in the United States. From a historical perspective, school education has long emphasized the importance of mathematics and science (but not engineering and technology) for students in the K-12 school setting. Attention has also been duly given to supporting and building on the inherent relationships between science and mathematics; we can trace efforts to integrate science and mathematics in school education back more than 100 years. The School Science and Mathematics Association, for example, was established in 1901 with one of its four goals stated as "advancing knowledge through research in science and mathematics education and their integration" (see https://ssma.org). Its official journal, *School Science and Mathematics*, was founded, also in 1901, to showcase "research on issues, concerns, and lessons within and between the disciplines of science and mathematics in the classroom" (see https://onlinelibrary.wiley.com/journal/19498594).

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However, recent developments in STEM education in the United States have pushed beyond the traditional focus on mathematics and science alone and emphasized the importance of further integrating mathematics and science education with engineering and technology. Started as SMET (by adding Engineering and Technology to the existing Science and Mathematics) in the 1990s, the U.S. National Science Foundation (NSF) formally expanded the focus to include engineering and technology. The term was changed to STEM by NSF in the early 2000s, and STEM education programs and related research have since experienced enormous development, with strong support at multiple levels (Li 2014). Recent STEM education development differs from traditional efforts in many ways including: (1) a broadened scope of students' academic learning, (2) the important and ever-increasing use of educational technology, (3) ever-increasing calls from academic fields and various employment sectors to increase STEM literacy of all students, especially women and minorities, and (4) an increasing call for integrated STEM education and the related need to examine and document how students learn in integrated modes (e.g., Honey et al. 2014; National Science Foundation 2010; NRC 2011a, b, 2013). Not surprisingly, advancing STEM education requires new and deeper scholarship, but the reality is that such research is still in its early stages.

Internationally, STEM is no longer just a buzzword. Although the term STEM was coined by NSF in the United States, STEM now represents an educational movement in many education systems around the world. This ever-expanding movement has inspired countless educators and policy makers, as well as the general public, to (re-)discover the value of integrated STEM education in their own education systems and sociocultural contexts. For example, in Australia, STEM education is now viewed as an important opportunity for reforming school education, including but not limited to mathematics and science education (Office of the Chief Scientist 2016). Australia has developed a *National STEM School Education Strategy*, 2016–2026 (National Council 2015), with goals of engaging all students and preparing them with strong foundational skills and capabilities in STEM. In China, STEM education has likewise become a movement, and it presents a broad spectrum of opportunities for Chinese educators to rethink what school education can and should offer students to better prepare them for the future, how students can and should be taught, and how student learning can and should be assessed. Efforts are being made in China to stimulate student inquiry, innovation, and critical thinking in and through STEM education and, indeed, educators see the potential (Center for STEM Education 2018; NIES 2017). Naturally, these and other global educational initiatives require research support. STEM education scholarship development, therefore, has rapidly become urgent within just a few years.

How Does the *Journal for STEM Education Research* Differ from Other Journals in STEM Education, Especially the *International Journal of STEM Education*?

The *Journal for STEM Education Research* is a new peer-reviewed research journal established to promote much-needed research in integrated STEM education worldwide. The journal is designed as a unique publication outlet that differs from existing journals in STEM education. Specifically, it differs from the *International Journal of*

STEM Education (IJ-STEM), also published by Springer, in two main aspects. These two aspects demonstrate how this new journal and the *IJ-STEM* are complementary to each other. First, *IJ-STEM*, like several other journals in the field, is an online open-access journal. Although authors who publish in *IJ-STEM* enjoy the broad access provided to their published articles, they also bear the burden of article processing charges (APCs). Paying APCs for publishing an article, which is not a traditional practice in education, can be a concern for many educators who have limited options for financial support. In contrast, the *Journal for STEM Education Research* is a subscription-based journal that publishes in both print and electronic formats. Because the journal is supported by subscription fees and so does not have APCs, it makes the journal more accessible to diverse contributors.

The second comparative aspect relates to the aim and scope of the *Journal for STEM Education Research*. Existing STEM education journals, including *IJ-STEM*, each have their own areas of focus. The *IJ-STEM* was established in 2014 as a platform to promote STEM education and research worldwide (see https://stemeducationjournal.springeropen.com) by serving as a *multidisciplinary* education journal that spans disciplinary boundaries. The *IJ-STEM* provided the multidisciplinary perspectives needed to complement the disciplinary-focused journals in subject content education at that time (Li 2014). The *IJ-STEM* continues to value original contributions by authors who view STEM education either as traditionally defined, individual-disciplinary-based education separately in S.T.E.M., or as an educational undertaking in inter-connected STEM fields. Although interdisciplinary research contributions are preferred, *IJ-STEM* remains a gathering place where disciplinary education scholars who have traditionally been separated can share both individual-disciplinary-based research and cross-disciplinary educational research.

As STEM education has been undergoing transformation from an individual-discipline-based education in S.T.E.M. to an integrated STEM education, issues and questions related to integrated STEM education have emerged, with their unique value and significance (e.g., Honey et al. 2014). The *Journal for STEM Education Research*, established as an *interdisciplinary* education research journal, is designed to promote research that helps identify and address sets of basic questions that can not only *reflect* but also *lead* the rapid development of integrated STEM education around the globe. It is this second aspect that aims to position this new journal as a pioneering research journal dedicated to developing interdisciplinary research in STEM education as a distinct field.

What Topics and Questions Does the *Journal for STEM Education Research* Aim to Focus on?

The *Journal for STEM Education Research* serves as a platform for sharing research in a broad spectrum of topics in STEM education across all levels from pre-college through continuing education, with a special interest in identifying and addressing questions fundamental to STEM education. We are interested in sharing research regarding, among other things, students' cognitive and non-cognitive development in and through STEM education, in formal or informal settings, at PreK-16 levels. Other examples of suitable research topics include factors closely associated with students'

learning and psychological development in integrated STEM education, such as curriculum models, innovative pedagogies, the design of and practices within technology-rich learning environments; the nature and development of teachers' expertise in STEM education, teacher education for effective instruction in STEM, and assessment in and of STEM education.

Although there are no methodological restrictions for publishing in the *Journal for STEM Education Research*, the journal aims to promote interdisciplinary, empirically grounded STEM education research through contributions that blend content expertise and educational endeavors. Contributions are encouraged from scholars within and across subject content fields (e.g., science, technology, engineering, and mathematics) and social science fields (e.g., education, psychology, and sociology). Given the short history of STEM education, the journal especially encourages scholarly contributions that help advance theoretical perspectives and research methodologies in STEM education.

What Types of Articles Does the *Journal for STEM Education Research* Plan to Publish?

The *Journal for STEM Education Research* publishes several types of articles including research articles, research reviews, research briefs, and selected book reviews. Further information about these types of articles appears in the Author Guidelines available on the journal's website (https://www.springer.com/41979).

The first volume consists of two issues that are now published together. In this inaugural double issue, readers can glimpse some of the range of topics and article types suitable for the journal.

In addition to this editorial, this inaugural issue contains one research review and seven research articles. The research review by Minichiello et al. provides a cross-disciplinary synthesis of the emerging literature related to applications of user experience (UX) product design frameworks in educational settings, and the methods used to design and implement such tools. The review is timely and has the potential to inform curricular innovation and promote institutional change within STEM education contexts. It further suggests the importance of developing UX-inspired tools and methodologies that are specifically tied to STEM education contexts. The seven research articles cover a broad array of topics in STEM education. The article by Schoenfeld and colleagues focuses on classroom observations, a critical topic for educators conducting classroom observation research and teacher professional development in STEM education. By comparing several observation tools and frameworks developed and used for mathematics classrooms, Schoenfeld and colleagues emphasize the importance of considering four desiderata when deciding how to choose and use specific tool and framework. Both the article by Ernest and Reinholz and that by Lichti and Roth are situated in the context of mathematics classrooms, albeit at different school levels. The questions that these two articles focus on (i.e., "off-topic talk in a classroom" in the former and "the impact of learning environments using computer-based simulations vs. real materials on fostering students' functional thinking" in the latter) present important and direct implications across and within STEM disciplines. The article by Ma et al. examines the role of mentors in facilitating STEM faculty

communities of practices to learn and adopt evidence-based instructional practices in a university setting. The article by Gardner et al. examines how the use of student response devices ("Clickers") varies among academic disciplines in a university setting, as well as considerations behind faculty's decision-making related to affordances and constraints provided by the devices. The other two articles relate to engineering. More specifically, the article by Barth-Cohen examines how fifth graders interpret and navigate multiple representations in computational thinking problem-solving processes in a robotics programming environment. The article by Strimel and colleagues explores students' engineering design cognition and the quality of their design work at both kindergarten and fourth grade levels.

What Is the journal's General Process of Manuscript Submission and Review?

The journal receives and reviews manuscripts through an online manuscript processing system. For inquiries about manuscript preparation and submission, please email the journal's editorial assistant, Ms. Jean Nicolle Pinpin, at JeanNicolle.Pinpin@springernature.com. Submitted manuscripts first receive processing by Springer's journal editorial office. Upon successfully passing initial screening by the journal's editorial office and the editor in charge, manuscripts undergo double-blind peer review by external experts. Potential contributors can obtain detailed instructions for manuscript preparation and online submission at https://www.springer.com/41979.

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