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Disciplinary and Interdisciplinary Science Education Research

EDITORIAL

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Editorial: Disciplinary and interdisciplinary science education research (DISER)

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Science education has been evolving for more than 100 years (DeBoer, 1991). Despite the fact that the first issue of the scholarly journal, *Science Education*, was published in November 1919, it was only toward the end of the last century when science education was firmly established as a distinct discipline of inquiry (Fensham, 2004). There is now a core body of knowledge as represented by handbooks (e.g., Lederman & Abell, 2014), a well-established set of journals (e.g., *Science Education*, *Journal of Research in Science Teaching*, and *International Journal of Science Education*), vibrant annual research conferences (e.g., annual NARST International Conference), and reputable doctoral education programs across the globe.

Despite the above noticeable achievements made by the science education community as a whole, there is still a long way to go for science education to reach a status similar to that of natural science disciplines (Lagemann, 2000; Lagemann & Shulman, 1999). Like any other disciplines, science education has been continuing evolving. Entering the twenty-first century, we have witnessed a few major developments in science education research and practice. Here we highlight the following three: (a) there is a growing emphasis on interdisciplinary science education inquiry, (b) there is a growing trend toward science education globalization, and (c) the emergence of Discipline-Based Education Research (DBER) in science.

The call for interdisciplinary science education research goes back to John Dewey almost 100 years ago. In his book, The *Sources of a Science of Education* (Dewey, 1929), Dewey identified isolation from other disciplines to be one of major challenges for education to become a science. Although much has improved for science education research to be interdisciplinary, scholars are still calling for enculturating doctoral students in the norm of interdisciplinarity (Eisenhart & DeHaan, 2005). The release of *Next Generation Science Standards* in the US (the lead states, 2013) with a particular emphasis on crosscutting concepts, science and engineering practices, and the three-dimensional integrated learning solidly places interdisciplinary science learning at the center of science education research and practice.

Scholars have clarified nature and characteristics of interdisciplinary inquiry. Petrie (1992) distinguishes disciplinarity, multidisciplinarity, transdisciplinarity, and interdisciplinarity. Disciplinarity consists of (a) a specialized knowledge; (b) unity of common set of concepts, specialized methods, and (c) an organized group of people who study the discipline, train other practitioners, and form the social mechanism for deciding among varying truth claims within the discipline. Multidisciplinarity refers to "the idea of a number of disciplines working together on a problem, an educational program, or a research study. The effect is additive rather than integrative" (p. 303). Transdisciplinarity is integration of knowledge into some meaningful way that is no longer possesses characteristics of individual disciplines. Based on the above, interdisciplinarity is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or field of research practice (National Academies Committee on Science, Engineering and Public Policy, COSEPUP, 2005). The COSEPUP report further identifies the following four drivers for interidsciplary inquiry: (a) the Inherent complexity of nature and society, (b) the drive to explore basic research problems at the interfaces of disciplines, (c) the need to solve societal problems, and (d) the stimulus of generative technologies. Thus, interdisciplinarity is problem and inquiry process-oriented; it draws from disciplinarity, transdisciplinarity and multidisciplinarity but does not replace any of them. This notion of interdisciplinarity, while still affirming disciplinarity, has been adopted by other science education scholars (e.g., Lederman & Niess, 1997; Shen, Sung, & Zhang, 2015).

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The second trend is science education globalization. In 2011, *Journal of Research in Science Teaching* published a special issue on science education globalization (Chiu & Duit, 2011). There are such ongoing international comparison studies as Trends in Math and Science Study (TIMSS) and Programme for international Student Study (PISA). There is also an emergence of science education as a discipline in non-English speaking and developing countries such as Germany and China. For example, there was a special issue in *International Journal of Science Education* in 2012 (Liu, Liang, & Liu, 2012) on science education research in China, a volume published by Springer on science education in China (Liang, Liu, & Fulmer, 2016, eds.), another volume on science education research and practice in Asia also published by Springer (Chiu, 2016), and the establishment of the journal *Asia-Pacific Science Education* in 2015. Science education research has traditionally been dominant by English speaking western countries (e.g., USA, UK, Canada and Australia) (Martin & Siry, 2011); however, over the past decade, publications by authors of non-English speaking and developing countries have been increasing. For example, among authors who published in three top-tier science education journals, i.e., *Science Educa*tion, *Journal of Research in Science Teaching*, and *International Journal of Science Education*, the top five countries (or regions) in 2013 were the US, UK, Taiwan, Canada and Sweden; in 2017, the top five countries (or regions) were the US, Germany, Sweden, Taiwan and UK, and in particular China became the 10th (Lin, Lin, Potvin, & Tsai, 2019). The rise in ranking in number of publications in top science education journals by Germany and China is particularly worth noticing because the two countries have a different research tradition of science education than that of US and UK. Jenkins (2001, 2004) defines two research traditions in science education: the empirical tradition and the pedagogical tradition. The empirical tradition is primarily concerned with development and testing of general science education theories, while the pedagogical tradition is primarily concerned with improvement of science curriculum and instruction in specific disciplines. The former is represented by primarily English-speaking countries such as the US, UK, Canada and Australis, and the latter is represented primarily by non-English speaking countries such as China, Germany, South Korea, and eastern European countries. The rapid development of science education in China and Germany indicates an increasing interaction between the empirical and pedagogical traditions, another sign for science education globalization.

The third trend is the emergence of the Discipline-Based Education Research (DBER) in science. While education research in such science disciplines as physics, chemistry, biology, geology, and engineering has been ongoing for many decades, discipline-based education research has almost exclusively focused on curriculum and instruction at the university level, and been largely separate from mainstream science education research. The release of the National Research Council committee report (NRC, 2012), *Discipline-based education research: Understanding and improving learning in undergraduate science and engineering* (NRC, 2012), the disciplinary status parallel to science education of discipline-based education research in science disciplines has been affirmed. The establishment of DBER has also created an opportunity for increased interaction not only between the two communities of science education and DBER, but also between the pedagogical tradition and empirical tradition in general.

The above trends in science education are creating a new demand for communicating science education research. There remains a divide in communicating science education research between discipline-based science education research (e.g., DBER) and science education research, between English-speaking and non-English speaking countries, in addition to the long-recognized divide between formal and informal science education and between science education research and science education practices. On top of the above divides is an ever increasing and prohibitive cost for institutions, particularly institutions in developing countries, to subscribe to science education journals. There is a need for a journal that not only bridges the above divides, but also is widely accessible world-wide. *Disciplinary and Interdisciplinary Science Education Research* (DISER) is such a journal; it intends to promote scholarship and best practices in education within and across science disciplines. DISER publishes original, empirical, conceptual and policy studies reflecting the latest development in science education from disciplinary and interdisciplinary perspectives. DISER is open-access, but authors do not pay an article-processing charge (APC), thanks to Beijing Normal University that covers APC for all accepted papers.

DISER's scope is broad in both methodology and content. It is interested in research at all levels, including early childhood, primary, secondary, tertiary, workplace, and informal learning as they relate to science education. It publishes research in biology education, chemistry education, geology education, physics education, science education, and engineering education. Research can take various methodological approaches, including qualitative research designs (e.g., ethnography, narrative, case studies, historical/philosophical approaches, etc.), quantitative research designs (e.g., experimental and quasi-experimental designs, survey research, correlation study, measurement study, statistical research, etc.), and mixed methods.

At present, DISER accepts submissions that are of three types: Research, Review, and Position. Research papers report empirical studies addressing significant questions in science education. Research questions are grounded in pertinent literature and theories; they are answered by data that are systematically collected and analyzed. Review papers are systematic and substantial syntheses of specific research areas, evaluations of progress in specified areas, and critical assessments with respect to issues. Position papers are essays written by prominent scholars or organizations to advance an argument, opinion, program, or action; they are usually invited, shorter than research and review papers, and focus on specific topics that are of central importance to the field and make specific recommendations to advance research and practice of the topic. Please refer to the journal website for article review criteria.

Unique features of DISER include: (a) publishing disciplinary (i.e., Chemistry, Physics, Biology and Natural Geography/Earth Science/geology) and interdisciplinary science education research and best practices; (b) facilitating dialogues between formal and informal science education; (c) promoting linkage between K-12 and post-secondary science education; and (d) being open access with no publication fees by authors.

We welcome you to become a member of the DISER community as an author and a reviewer!

Authors' contributions
XL and LW jointly conceptualized and wrote this editorial. Both authors read and approved the final manuscript.

Competing interests
The authors declare that they have no competing interests.

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