frontiers | Frontiers in Education

TYPE Editorial
PUBLISHED 06 November 2023
DOI 10.3389/feduc.2023.1319874

OPEN ACCESS

EDITED AND REVIEWED BY
Lianghuo Fan,
East China Normal University, China

*CORRESPONDENCE
Lisbet Rønningsbakk
lisbet.ronningsbakk@uit.no

RECEIVED 11 October 2023
ACCEPTED 16 October 2023
PUBLISHED 06 November 2023

CITATION
Blackmore K and Rønningsbakk L (2023) Editorial: Women in STEM Education. *Front. Educ.* 8:1319874. doi: 10.3389/feduc.2023.1319874

Editorial: Women in STEM Education

Karen Blackmore[1] and Lisbet Rønningsbakk[2]*

[1]Department of Primary Education, Institute of Education, University of Worcester, Worcester, United Kingdom, [2]Department of Education, UiT The Arctic University of Norway, Tromsø, Norway

KEYWORDS

science technology engineering mathematics (STEM), pedagogy, inclusion, women, learning

Editorial on the Research Topic
Women in STEM Education

We are delighted to present this special edition of Women in STEM Education as a positive platform to examine insights from a range of fields including engineering, mathematics and information technology. The articles fall into two broad groups; those pertaining to the experiences and perspectives of women in STEM fields and those exploring enabling pedagogical approaches for all learners.

Learning experiences and perspectives of women in STEM fields

The first section presents papers which address perspectives of how women experience learning and education in STEM fields. The articles represent collaboration from a range of different countries and phases of education from young learners to adult students, with a strong emphasis on the importance of creating inclusive and positive STEM learning environments and communities, to meet the global needs of STEM competences.

Kim and Kim's study from South Korea documents the chilly climate perceived by female undergraduate engineering students. Using a concept-mapping method, they conceptualized and identified aspects that contribute to the chilly climate, such as inherent exclusion and alienation within the culture, lack of gender sensitivity, male-centered study situations, and indirect prejudice toward women. The paper highlights the expectations that female students experience a negative culture formed by social myths which arguably inhibits female participation in STEM.

Fernandez et al., have focused on differences in the time use in laboratory-based activities for university students. They used surveys where students reported the duration of undertaking activities and made observations of the actual time used. They found that female students spent less time in laboratories and interacting with the equipment, but took more time to observe and take notes than their male peers. However both groups were equally content with their time use. The authors suggest that females adopt roles in the laboratory which are formed by their expectations that they are less technically active and more observant than male students, a perspective that requires consideration by universities to ensure their obligations to an inclusive pedagogical stance.

Ladewig et al. questioning of gender stereotypes in the German Physics Olympiad, a science competition for German students, affords yet another lens through which to view gender differences. Using social threat theory to identify the reasons why women are under-represented and drop out earlier than men in the competition,

they assumed that negative stereotypes about women's abilities in physics and the predominant male environment worked as a threat to the female gender-identity. An intervention study in the form of two weekend assemblies for the participants, where they focused on belonging and values, however, showed no significant differences between genders. The researchers suggest that female students who have a genuine interest for physics are resilient toward the negative impacts from threats against their social and gender identities and conclude that genuine interest is a strong factor for female participation within the STEM fields.

Balasubramanian et al.'s case study shows how the retention of women in STEM careers in the US can be met by programmatic innovations. Various innovations were tried out over a period of 8 years, both curricular (colloquium, laboratory) and co-curricular (community building, junior review and conference participation). They concluded that a combination of several innovations resulted in an increased number of successful female major students, increasing degree completion by 200% (over 10 years) and resulting in an average graduation rate far above national standard. Another important outcome was that 80 % of the women physics majors maintained careers within the field greater than 5 years post-graduation.

Lane et al., were also concerned about the students' participation in STEM-subjects for future competence needs. Their study aimed to identify students' attitudes toward STEM education and careers for post-primary level and beyond, in an Irish context. Their survey study revealed that female students have more positive attitudes toward physics while male students are more positive about mathematics. The authors suggest this is an interesting aspect for discussing the role of STEM subjects within the post-primary curriculum.

Effective STEM pedagogies for all

The collaborative review paper by Zhu et al. illustrates the efficacy of providing learners with both integrated and informal opportunities to develop their spatial skills from kindergarten to adulthood. It makes the case that spatial skill development can enhance complex STEM problem-solving and *vice versa*. The authors also highlight how extra-curricular involvement is a positive predictor for girls' interest and confidence in mathematics, a vital enabler for further engagement in STEM careers. Despite an abundance of literature suggesting that boys outperform girls in spatial skills there appears to be no biological reason why this should be the case, rather it appears this factor may be due girls' perceptions of societal norms. This argument gains credence when it is considered that there is evidence that when girls are given constructive feedback on their spatial ability, they improve their performance. The timing and manner of feedback are important factors, with the suggestion that accurate peer feedback can also be facilitative.

Collaborative problem-solving facilitated by peer support, features extensively in our paper (Blackmore and Rønningsbakk) exploring children's perspectives on using mobile technology during science inquiry. The technology was seen to act as a conduit for sharing approaches and results of a range of STEM investigations. Children were exceptionally positive about developing both knowledge and skills by interactions with each other, supplemented by appropriate teacher feedback and guidance. This technology enhanced learning approach also conferred the advantage of capturing in-the-moment science phenomenon in primary classrooms, arguably a significant enabler for maintaining children's innate curiosity of the world around them.

Heim and Wang explored an alternative pedagogical perspective in their paper focusing on the affordances of cross-curricular learning to support computer science programming. They endeavored to examine linkages of children's perceptions of computational thinking during mathematics and food and health study. Whilst the majority of children were not able to make explicit links between unplugged programming and following recipes, there were indications that some children understood that food production involves a step-by-step set of instructions. This approach resonates with the recommendations made by Zhu et al. in terms of providing children with rich authentic experiences, that mirror STEM problem-solving and affording opportunities for learning to be transferred from one context to another.

The learning of student teachers is also an important element to be considered when exploring effective STEM pedagogies. In the paper by Leming and Johanson examining the perceptions of digital critical competence by student-teachers, they found a range of different perspectives including an awareness for the necessity of source criticism and links with a functioning democracy. This is heartening since these professionals will act as facilitators for 21st century skill acquisition. Such findings have implications for initial teacher educators since student teachers need to be given time and opportunity to develop a secure understanding of processes to identify authentic and rigorous learning resources.

In summary, we hope this special edition will provide insights into enabling STEM learning for all and inform practice in a range of contexts to support future collaboration and innovation.

Author contributions

KB: Writing—original draft, Writing—review & editing. LR: Writing—original draft, Writing—review & editing.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Acknowledgments

We would like to thank all the authors that contributed to the Special Edition of Women in STEM for their research insights and commitment to enhancing STEM learning. In addition, we are most grateful to the reviewers for their timely constructive feedback and support of the authors and editors. Lastly we would like to thank the chief editor for their exemplary commitment to this special edition.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note