frontiers | Frontiers in Education

TYPE Editorial
PUBLISHED 03 August 2022
DOI 10.3389/feduc.2022.971287

OPEN ACCESS

EDITED AND REVIEWED BY
Eileen Scanlon,
The Open University, United Kingdom

*CORRESPONDENCE
Maria Meletiou-Mavrotheris
m.mavrotheris@euc.ac.cy

SPECIALTY SECTION
This article was submitted to Digital Learning Innovations, a section of the journal Frontiers in Education

RECEIVED 16 June 2022
ACCEPTED 22 July 2022
PUBLISHED 03 August 2022

CITATION
Meletiou-Mavrotheris M, Paparistodemou E, Dick L, Leavy A and Stylianou E (2022) Editorial: New and emerging technologies for STEAM teaching and learning.
Front. Educ. 7:971287.
doi: 10.3389/feduc.2022.971287

Editorial: New and emerging technologies for STEAM teaching and learning

Maria Meletiou-Mavrotheris*, Efi Paparistodemou, Lara Dick, Aisling Leavy and Elena Stylianou

Mary Immaculate College, University of Limerick, Limerick, Ireland

KEYWORDS

STEAM education, arts, emerging technologies, technology-enhanced learning, transdisciplinarity, STEM education

Editorial on the Research Topic
New and emerging technologies for STEAM teaching and learning

The advent of new and emerging technologies has led to the emergence of innovative approaches to teaching and learning aimed at cultivating the critical thinking needed for the rapidly changing and complex digital era. This trend has contributed to an integrated approach to teaching and learning known as STEAM. STEAM education arose out of STEM, an interdisciplinary approach that overcame the strict individual borders of Science, Technology, Engineering, and Mathematics by treating them as a whole. Arts were added to the original STEM framework (Yakman and Lee, 2012) to promote learning in more connected and holistic ways. Proponents of STEAM claim an integrated STEM and Arts curriculum is essential to foster creativity and innovation by allowing students to develop systematic thinking skills that combine the mind of a scientist or technologist with that of an artist or designer (Bazler and Van Sickle, 2017).

A trend in STEAM education is the integration of cutting-edge technologies. Although researchers and practitioners increasingly tap the potential of technology to enhance STEAM teaching and learning, empirical research investigating technologies' infiltration into STEAM education is limited (Ge et al., 2015). Responding to the need for more scholarly publications in the field, this Research Topic aimed to identify and publish best practices on the design, development, and educational use of new and emerging technologies in STEAM education. The four manuscripts introduced below successfully navigated the review process and were published.

Breien and Wasson focus on how narrative digital game-based learning (DGBL) can support the integrated and holistic education targeted by STEAM. The authors introduce eLuna, a multidisciplinary co-design framework that empowers STEAM educators to participate alongside game developers in the design and development of narrative DGBL. The eLuna framework comprises (1) a four-phase co-design method, and (2) a visual language to support the co-design and co-specification of the game. The use of the eLuna method

and visual language is illustrated through the description of the co-design, co-specification, and implementation into a prototype of a narrative DGBL named Idun's Apples. The authors share seven narrative DGBL (including Idun's Apples) co-designed using the eLuna framework, concluding that these can provide great opportunity and potential for promoting STEAM pedagogy, with positive effects on student engagement, motivation and learning.

Harron et al. outline the design and empirical development of a 3D Printing Ecosystem (3DPE) to overcome the issue of underutilization of 3DP and computer-aided design (CAD) observed on their campus. 3DPE is a coordinated system of hardware, software, and human collaborations intentionally designed to scale CAD and 3DP, as shared literacies, at an institutional level. Using a train-the-trainer model, the 3DPE supports STEAM education by training students and faculty in CAD and 3DP while also providing ongoing curricular support to infuse these skills into courses through project-based learning. The authors found this combination of support cannot be casual or unmanaged when scaling-up to meet institutional demands. In the article, they provide preliminary examples of how the 3DPE supports STEAM education by blending engineering with the arts, and offer advice for others seeking to replicate the model.

Kim and Kim exploit the affordances of Artificial Intelligence (AI) for enhancing STEM/STEAM teaching and learning. They report on how a group of STEM teachers perceived an AI-enhanced scaffolding system (AISS) that catered to the academic writing process. Results revealed most teachers positively experienced AI as a source of advanced scaffolding. Teachers agreed that AI-generated writing scaffolds can promote students' academic writing skills through the provision of accurate, individualized and optimally timed scaffolding that can guide learners' logical thinking and argumentation skills. At the same time, teachers identified potential issues of AI-supported learning, related to the transparency of decisions made by the AI system and the redefined role of the teacher, and made suggestions for further improvement of the AISS system. Teachers' experiences using AI and considerations of its implementation stemming from this study can be used as a foundation for developing guidelines for the effective and efficient integration of AI into STEM/STEAM school curricula and instructional settings.

Liston et al. report on STEAM-ED, a research design and developed project involving data science and an Internet of Things (IoT) based Environment Monitoring System for collaborative work between preservice teachers within a college of initial teacher education, and children and teachers in an elementary school (ages 4–12). The STEAM-ED team included artists, architects, scientists, engineers, STEAM education experts, preservice teachers, teachers, and children. Encompassing different stakeholders was important and placed transdisciplinarity at the core of the learning. The case study approach used during the study allowed the researchers to obtain valuable insights into the various stakeholders' perspectives, experiences, and perceptions on the role of innovative technology in STEAM education. The authors found that integrating new and emerging technologies with data science and IoT can break down boundaries between subjects and promote the delivery of a truly transdisciplinary model of STEAM education. The use of innovative data capturing technologies and the exploration of real-life data positively impacted the students' and teachers' STEAM knowledge and skills including their development of artistic concepts, engineering habits of mind, imagination, and creativity.

Each of these articles reported on original empirical studies that demonstrate validated practical experiences related to ICT-enhanced STEAM teaching and learning. While the authors split between interdisciplinary and transdisciplinary approaches to STEAM education, all papers highlighted various uses of emerging technologies within STEAM education with a focus on improving teaching and learning. All articles call for future work regarding additional training for teachers and various stakeholders as STEAM-ed works to develop STEAM competencies that foster creativity and innovation. This call highlights the continued need for empirical studies that carefully research best practices for professional development within STEAM-ed while simultaneously integrating emerging technologies and offering support for fostering a STEAM culture at the institutional level. This is a difficult task for researchers due to the vastly changing landscape of available technologies, but one we believe is imperative.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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

References

Bazler, J., and Van Sickle, M. L. (2017). *Cases on STEAM Education in Practice.* Hershey, PA: IGI Global. doi: 10.4018/978-1-5225-2334-5

Ge, X., Ifenthaler, D., and Spector, J. (2015). "Moving Forward with STEAM Education Research," in *Emerging Technologies for STEAM Education. Educational Communications and Technology: Issues and Innovations,* eds. X. Ge, D. Ifenthaler, J. Spector (Cham, Switzerland: Springer), 383–396. doi: 10.1007/978-3-319-02573-5_20

Yakman, G., and Lee, H. (2012). Exploring the exemplary STEAM education in the U.S. as a practical educational framework for Korea. *J. Korean Assoc. Sci. Educ.* 32, 1072–1086. doi: 10.14697/jkase.2012.32.6.1072