International Council of Association for Science Education

EDITORIAL

Editorial

Dear Readers,

The December 2025 issue of *Science Education International* presents 13 original research articles authored by 41 researchers from eight countries, reflecting the international scope, methodological diversity, and thematic richness of contemporary science education research. The studies in this issue address key topics such as self-efficacy, creativity, digital technologies, STEM and STEAM education, lifelong learning, biotechnology, research skills, and career awareness across multiple educational levels.

The issue opens with a study from Spain that investigates creative self-efficacy in science among pre-service teachers. This article examines teachers' perceptions of their own creativity, their ability to recognize creative classroom activities, and their inquiry skills. The findings reveal a discrepancy between perceived and actual creative performance, underscoring the need to integrate creativity and inquiry more systematically into teacher education programs.

The second article, conducted in Estonia, explores students' self-efficacy in science education by examining the interrelationships among career preferences, science-related anxiety, perceived science competence, and transversal skills. Using a mixed-methods approach, the study identifies distinct student self-perception profiles and highlights the importance of addressing both emotional and cognitive dimensions to promote inclusive STEM engagement.

The third contribution comes from Turkey and examines the impact of robotic applications on science teachers' perceptions of 21st-century skills. Employing a mixed-methods design, the study demonstrates that robotics-based professional development significantly enhances teachers' perceptions of problem-solving, communication, and collaboration skills, while also strengthening connections between science learning and real-world applications.

The fourth article, originating from Moldova, focuses on the development of lifelong learning competencies in the science classroom. This theoretical and integrative study proposes an instructional framework that combines conceptual clarity, metacognitive guidance, transfer of learning, and the development of scientific identity through dialogue and collaborative practices.

The fifth article reports a qualitative case study from Thailand on engaging primary school students in STEM through virtual reality and hands-on activities. The findings indicate high levels of student engagement and interdisciplinary understanding, and introduce an eight-step learning cycle that contributes to inquiry-based and self-regulated learning models.

The sixth contribution, from Greece, presents the design and development of Scratch–Arduino educational tools for teaching electricity concepts at the middle-school level. By integrating visual programming with physical computing, the study illustrates how bidirectional interaction between digital simulations and real circuits can enhance conceptual understanding and student engagement.

The seventh article is an action research study from Turkey that examines how digital tools can enrich elementary science lessons, with a particular emphasis on student voices. The study highlights the motivational benefits of digital tools while also identifying challenges such as time constraints and technology-related distractions, offering practical strategies for effective classroom integration.

The eighth contribution comes from Indonesia and investigates the practicality and effectiveness of instruments for assessing project-based problem-solving skills in biotechnology. The results show that the developed instruments are highly practical and moderately effective in improving students' problem-solving skills, addressing a notable gap in biotechnology education assessment.

The ninth article, conducted in Kazakhstan, examines the enhancement of research skills in undergraduate chemistry education through an integrated project-based and inquiry-based learning approach. The study reports significant improvements across multiple dimensions of research competence, including experimental design, data analysis, scientific writing, and oral presentation skills.

The tenth contribution, also from Kazakhstan, evaluates science teacher candidates' knowledge and views on biotechnology. Using both quantitative and qualitative data, the study highlights ethical considerations, professional responsibility, and the importance of preparing well-qualified teachers for effective biotechnology education.

The eleventh article presents a systematic review from Indonesia focusing on computational thinking and deep learning in science education. By analyzing a large body of literature, the study identifies key challenges and enabling factors and proposes a comprehensive framework to guide the integration of computational thinking and programming into science classrooms.

The twelfth contribution, again from Indonesia, reports on the development of a STEAM workbook on simple machines and its effectiveness in improving middle school students' problem-solving skills. The findings demonstrate significant learning gains, supporting the value of STEAM-based instructional materials for fostering 21st-century competencies.

The issue concludes with a study from Turkey that examines the effect of job shadowing practices on science teachers' career perceptions. Conducted within the framework of the Erasmus+ acaSTEMy project, this mixed-methods research shows that authentic workplace experiences significantly enhance participants' professional identities, career awareness, and understanding of science-related careers beyond the school context.

Overall, the articles in this December 2025 issue collectively demonstrate how innovative pedagogical approaches, digital technologies, and authentic learning experiences can support the development of self-efficacy, creativity, research competence, and career awareness in science education. Together, they provide valuable theoretical insights and practical implications for researchers, educators, and policymakers, reinforcing *Science Education International*'s mission to advance high-quality science education on a global scale.

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