

Editorial

Dear Readers,

The September 2026 issue of Science Education International presents 11 original research articles authored by scholars from 11 countries, including Germany, Slovenia and Italy, Finland and South Africa, Brazil, Chile and Argentina, Morocco, the Republic of Korea, the United States and Ireland, Croatia, and China. This issue reflects the journal's commitment to advancing high-quality science education on a global scale by addressing themes such as inquiry-based learning, student well-being, Science, Technology, Engineering, and Mathematics (STEM) career aspirations, digital transformation, conceptual understanding, and sustainability.

The issue opens with a study from Germany by Karsten Damerau, Kimberly Mary Hansen, and Christine Börtitz, who investigate physiological stress among lower secondary school students during inquiry-based and non-inquiry-based situations in science classes. Using heart rate variability data from 86 valid datasets, the study examines whether inquiry-based activities are associated with elevated physiological stress and whether students' individual dispositions influence their responses. Although no significantly higher stress level was observed during inquiry-based situations overall, the researchers identified three distinct types of students with different physiological stress responses. These findings highlight the importance of considering individual differences when designing supportive and personalized learning environments in science education.

The second article, by Lara Colja and Marjanca Kos, explores the use of live animals in science education across Slovenian-language primary schools in Slovenia and Italy. Based on responses from 208 primary school teachers, the study reveals that most teachers rarely or never include live animals in their lessons, despite recognizing their potential to increase motivation, encourage active learning, and develop empathy and respect for living beings. Organizational constraints, hygiene and allergy concerns, and financial costs were identified as important barriers. The authors also highlight teachers' limited methodological knowledge and emphasize the need for professional training and appropriate systemic support for the responsible inclusion of animals in science education.

The third article turns to students' future aspirations in STEM. From Finland and South Africa, Elisa Vilhunen and Jari Lavonen explore the factors influencing upper secondary school students' STEM career aspirations through semi-structured interviews with 10 high-achieving, STEM-oriented students. Drawing on social cognitive career theory, the findings are organized around self-efficacy beliefs, interests and values, outcome expectations, and environmental supports

and barriers. The study also identifies both positive and negative conceptions of STEM-related careers and emphasizes the importance of strengthening students' interest and self-efficacy, providing realistic information about STEM career pathways, and supporting more informed understandings of STEM-related work.

The fourth contribution explores an unconventional medium for communicating scientific ideas. From Brazil, Aleilson da Silva Rodrigues and Wilmo Ernesto Francisco Junior examine the representation and communication of science-related ideas in six internationally popular anime productions. Using Fleck's epistemology as a theoretical framework, the researchers analyzed the first 50 episodes of each production, or all available episodes for two shorter series, identifying and coding scenes containing scientific terms, expressions, or representations. Of the 396 science-related scenes identified, 377 were considered scientifically accurate. The findings suggest that anime can provide opportunities for communicating scientific ideas and facilitating interaction among specialized, school, and popular audiences, opening further possibilities for discussing science communication beyond conventional educational contexts.

The fifth article focuses on the rapidly developing intersection of artificial intelligence (AI) and physics education. From Chile and Argentina, Chia Shih Su, Chuan Chih Hsu, Kua I Su, and Chia Li Su present an exploratory systematic review of AI applications in physics education and their relationship to Sustainable Development Goal 4. Following the PRISMA 2020 guidelines, the researchers screened 105 records and included 12 empirical studies published between 2013 and 2025. The review identifies four major pedagogical roles for AI – as tutor, evaluator, assistant, and analyst – and reports potential benefits related to conceptual understanding, formative feedback, personalization, and self-regulated learning. At the same time, technical reliability, teacher preparation, acceptance, transparency, bias, equity, and data protection remain important challenges. The authors appropriately characterize their findings as an exploratory evidence map rather than consolidated empirical evidence.

The sixth contribution addresses conceptual understanding in chemistry education. From Morocco, Meryem Janati Idrissi, Omar Aarab, Lahbib Abbas, El Houssine Mabrouk, Ahmed Sali, and Nabil Amri investigate misconceptions in atomistics among upper secondary school students and examine their associations with learning practices. The 32-item assessment demonstrated satisfactory internal consistency, strong item discrimination, and an appropriate range of item difficulty. Students' performance differed significantly according to grade level, academic track, digital tool use, tutoring type, and

self-assessment. Exploratory factor analysis further indicated three dimensions involving structural representations and quantitative chemistry, ionic classification and nomenclature, and fundamental atomic concepts. The findings underline the value of diagnostic assessment for identifying and addressing students' difficulties with atomistic concepts.

The seventh article examines the effects of AI chatbot-supported instruction on students' experiences and attitudes in science learning. From the Republic of Korea, Heungjin Eom and Dongkuk Lee investigate an AI chatbot-integrated instructional program with embedded scaffolding in a high school Earth science unit on stellar types and evolution. Involving 138 eleventh-grade students, the study employed a quasi-experimental one-group pre-test-post-test design. The findings indicate significant improvements in students' science-positive experiences, including affective experiences, science self-concept, motivation, science career aspirations, and attitudes toward science. Students' attitudes toward AI also improved across cognitive, affective, and behavioral dimensions. Qualitative findings suggest that immediate feedback and hints provided by the chatbot reduced perceived cognitive burden and supported more active engagement in self-directed problem solving and collaborative inquiry.

The eighth contribution shifts the focus from technology to educators' systems thinking and sustainability. With researchers from the United States and Ireland, Jessica A. Cordaro, Cliona Murphy, and Jeremy Solin investigate systems thinking competence among STEM educators in Pennsylvania and examine its relationship with the integration of sustainability into teaching. Using a mixed-methods approach, the study finds that high school educators tend to demonstrate higher levels of systems thinking competence, place greater importance on education for sustainability, and incorporate sustainability topics more frequently than elementary educators. A positive correlation was also identified between educators' systems thinking competence and their perceived importance of education for sustainability. These findings highlight the potential value of strengthening systems thinking among educators, particularly those working with younger learners.

The ninth contribution examines peer interaction and meaning-making in asynchronous physics learning environments. From the United States, Rex N. Taibu and Lloyd M. Mataka analyze 64 peer responses produced by 18 students across four mechanics discussion modules in an introductory physics course redesigned around process-based tasks. Through qualitative content analysis, the study identifies a range of discursive moves, including probing reasoning, interpreting representations, negotiating conceptual understanding, co-constructing explanations, and extending ideas. Conceptual negotiation and probing reasoning were particularly prominent, while surface-level responses were relatively limited. The findings illustrate how structured, process-oriented tasks can create opportunities for students to make their thinking visible and engage with peers around reasoning, representations, and conceptual ideas.

The tenth article returns to primary science education by examining how young learners perceive animals. From Croatia, Alena Letina and Nika Hajduković investigate the perceptions of 189 students from Grades 1 to 4 and identify patterns that may contribute to misconceptions relevant to early science teaching. The findings show a strong relationship between the appeal of animals' appearance and students' levels of fear, indicating that students' perceptions are shaped not only by biological characteristics but also by affective, esthetic, and experiential factors. Misconceptions included the overgeneralization of traits, the influence of fictional representations, and insufficient attention to ecological functions, particularly in relation to animals such as spiders, snakes, bats, and earthworms. The study highlights the importance of helping young learners move beyond appearance-based perceptions toward a more scientifically grounded understanding of animals and their ecological roles.

The issue concludes with a contribution from China by Enhai Liu, Xin Huang, Xia Xu, Xianghe Liu, and Mingguo Peng, who present a case-based teaching model integrating project practice and problem chains within a curriculum framework. Guided by outcome-based education, the model uses practical cases, task-driven scenarios, and interconnected questions to encourage students' problem-solving, reflective learning, and innovative thinking. The reported results indicate increases in students' academic performance and course-objective achievement, as well as positive outcomes in practice- and innovation-related activities. The study also reports an increase in annual industry employment rates and continued growth in employers' satisfaction with graduates. Overall, the findings illustrate how case-based and project-oriented approaches can be used to connect curriculum learning with practical problem-solving and innovation.

Overall, the 11 articles in this September 2026 issue demonstrate the breadth and dynamism of contemporary science education research. From students' physiological responses to inquiry-based learning and their developing STEM aspirations to AI, sustainability, science communication, conceptual understanding, and innovative approaches to teaching and learning, the contributions address both established challenges and emerging directions in the field. Together, these studies provide valuable theoretical insights and practical implications for researchers, educators, teacher educators, and other stakeholders working to strengthen science education in diverse educational contexts. We hope that this issue will stimulate further research, dialogue, and collaboration within the international science education community, reinforcing Science Education International's commitment to advancing high-quality science education on a global scale.

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