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EDITORIAL

Editorial

Dear Readers

It is with great pleasure that we present the September issue of *Science Education International*, featuring eleven articles from researchers across Asia, Africa, and Europe that collectively advance our understanding of science teaching and learning across diverse educational contexts. This issue reflects the richness and complexity of contemporary science education research, ranging from pedagogical strategies and technological innovations to conceptual development, inclusivity, and teacher education. Each contribution offers important insights for researchers, practitioners, and policymakers working to improve science education worldwide.

The first article addresses the principle of "Science for All" by exploring science teachers' experiences in inclusive classrooms. The findings indicate that while teachers attempt to adapt lessons for students with disabilities, such efforts are often constrained by limited resources, insufficient training, and inadequate institutional support. Although individualized strategies and varied media enhance participation, assessment practices remain underdeveloped. This study calls for systemic support and policy alignment to ensure that inclusive science education moves from theory to meaningful practice.

The second article examines the influence of knowledge gained in biology education on university students' daily habits. Findings indicate that biology education fosters health-promoting behaviors, such as disease prevention and improved nutrition, demonstrating the broader societal impact of science education beyond cognitive gains. This research reinforces the importance of connecting curriculum content to real-world contexts and promoting behavioral change as an educational outcome.

The third article explores middle school students' informal reasoning patterns and socioscientific reasoning when engaging with local and global socioscientific issues. Students displayed more sophisticated reasoning when addressing local issues, suggesting that relevance, prior experience, and emotional connection influence the quality of their reasoning. The study advocates for the inclusion of locally grounded socioscientific issues in curricula to foster deeper engagement and balanced reasoning skills.

The fourth article investigates teaching strategies, opportunities, and challenges in promoting students' conceptual understanding of redox reactions. Teachers employ a range of pedagogical approaches, from passive to active strategies, yet persistent misconceptions remain – particularly in shifting between macroscopic, sub-microscopic, and symbolic representations. The study highlights the critical need for professional development focused on pedagogical content knowledge, especially in areas where conceptual complexity and representational fluency are essential for student understanding.

The fifth article investigates how middle school students perceive scientists from an emotional perspective. By analyzing students' drawings and explanations, the study reveals predominantly positive attitudes toward scientists, suggesting that emotional perceptions play a significant role in shaping students' engagement with science. Such findings underscore the importance of addressing affective dimensions in science education and promoting more diverse and relatable representations of scientists to inspire future generations.

The sixth article examines the perspectives of students and teachers on computer-assisted formative feedback in physics education. Through a comprehensive needs analysis, the study identifies the potential of digital feedback systems to enhance conceptual understanding and motivation. However, it also exposes differences in perceptions between students and teachers regarding feedback design and accessibility. This work underscores the importance of aligning pedagogical goals with technological tools and tailoring feedback mechanisms to meet diverse learner needs, thereby improving the effectiveness of digital interventions in science instruction.

The seventh article explores pre-service teachers' conceptions of the nature of science (NOS) and their attitudes toward NOS instruction. Although participants express positive views about the importance of NOS, many still hold misconceptions, such as beliefs in a single scientific method or the absolute objectivity of science. The study proposes a revised course structure aimed at addressing these misconceptions and better preparing future teachers to integrate NOS instruction effectively in primary classrooms.

The eighth article investigates the effects of augmented reality (AR) on student learning in natural science education in Vietnam. The study finds significant improvements in conceptual understanding, engagement, and motivation among students participating in AR-enhanced lessons. It also identifies key design principles – such as signaling, segmenting, and guided interaction – that support effective AR implementation. These results provide valuable guidance for integrating emerging technologies into science education to enhance learning outcomes.

The ninth article explores the impact of hands-on experiments on the development of scientific process skills among middle school students in Indonesia. The study demonstrates that engaging students in hands-on, inquiry-based activities outside the classroom can effectively strengthen their observation, experimentation, and data interpretation skills. However, the findings also reveal that procedural competencies do

not necessarily translate into improved science literacy, highlighting the need for instructional approaches that integrate both conceptual understanding and practical application. The motivational benefits observed during these activities further emphasize the value of student-centered, experiential learning environments.

The tenth article examines the difficulties pre-service teachers encounter when designing experiments for complex or counterintuitive everyday problems. The results show that challenges in hypothesis formulation and variable manipulation stem not only from procedural shortcomings but also from conceptual and metacognitive limitations. This research highlights the need for targeted interventions in teacher education programs to develop higher-order experimental design skills and better prepare future teachers for classroom practice.

The eleventh article presents a model for facilitating sensemaking moments in science classrooms, based on case studies of proficient teachers. The proposed model identifies key instructional steps – such as generating thought-provoking questions, supporting hypotheses, encouraging reflection, and fostering reconciliation of ideas – that enable deeper student engagement in scientific reasoning. By emphasizing the role of teacher facilitation and the dynamics of classroom interaction, this study provides a valuable framework for designing more effective science lessons that nurture critical thinking and collaborative inquiry.

Collectively, the articles in this issue reflect the vibrant diversity of contemporary science education research and practice. They address fundamental questions about how students learn, how teachers teach, and how science education can become more inclusive, engaging, and impactful. As science educators continue to navigate the challenges of preparing learners for an increasingly complex and interconnected world, the insights offered in this issue will serve as valuable resources for advancing both theory and practice.

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