

Editorial

In this June 2024 issue of the Science Education International, we are proud to present an array of scholarly articles that highlight the diverse and innovative approaches to science education from ten different countries: Türkiye, Greece, Estonia, Latvia, Philippines, USA, Thailand, United Arab Emirates, South Africa, and China. This collection underscores the global commitment to enhancing science education through varied methodologies, cultural contexts, and unique challenges. Some of these articles were presented at the 7th ICASE World Science and Technology Education Conference, held in Dubai between March 27 and 30, 2024, further enriching the discussions with insights shared among global experts.

The first article is from Türkiye. The article mentions that the rise in STEM education has led to more authors promoting Arduino in STEM. While research exists on Arduino and STEM separately, more studies on their relationship are needed. This study uses software tools (Vosviewer and Biblioshiny) and bibliometric methods, analyzing documents from Scopus (2013 to 2022). Performance analysis showed publication and citation trends, highlighting top contributors. Bibliographic mapping revealed conceptual, intellectual, and social structures. Results indicated prolific authors and institutes in Türkiye, with the most cited from the USA. Türkiye may soon lead due to high growth rates and younger documents. The study warns of potential monopolization and highlights the need for increased researcher mobility and collaboration. Overall, Arduino shows great promise in future STEM activities.

The second article is from Greece. The article surveys primary students in Greece on their views toward STEM education based on urban or rural settings and gender. The sample included 281 students from Attica and 69 from a Greek province. Data were collected through a close-ended digital questionnaire. Most students felt good at math and science but unlikely to pursue-related careers. They reported strong communication and cooperation skills. Rural students showed more confidence in improving their math and science skills, the usefulness of STEM knowledge, and awareness of environmental issues. Boys showed slightly more interest in STEM careers. The study suggests further research on geographical, gender, and socioeconomic disparities in STEM education.

The third article, a case study from Estonia, aimed to enhance pre-service science teachers' readiness for integration, inquiry-based learning (IBL), information and communications technology (ICT) use, and real-life applications in teacher training. It explored their perceptions of these methods and how their views evolved over time. A questionnaire was administered to 50 pre-service science teachers before and after their 2-year training, with data analyzed qualitatively

and quantitatively. Findings showed that teachers studying multiple science subjects valued integration, IBL, ICT use, and real-life examples more, with significant perception changes over time. Nearly half did not see IBL as crucial, and only a quarter recognized the importance of ICT.

The fourth article is from Latvia. The article addresses that teacher competence management and development are now school responsibilities, but school leaders often lack the tools and experience. Competence management in schools can involve identifying and implementing professional development (PD) tailored to teachers' needs. Unlike the "one-size-fits-all" approach, personalized PD can be more effective. This study focuses on identifying science teacher profiles to improve teaching that promotes student conceptual understanding (CU). Using a mixed-method approach, the performance of 26 urban science teachers was observed and analyzed. The study identified six distinct teacher profiles, demonstrating varied PD needs and offering a methodology for using lesson observation data to create teacher profiles in small samples.

The fifth article is the second article from Greece. The study examines 12th-grade students' understanding of "orbital" and "electron cloud" concepts in quantum contexts ($n = 1$ and $n = 2$) through verbal and pictorial representations. It involved 192 students from six urban schools in Northern Greece using a paper-and-pencil assessment. Results show students struggle more with verbal explanations than pictorial ones and exhibit inconsistencies between these representations. They understand the electron cloud better verbally, but the orbital better pictorially. Representations for $n = 2$ are more challenging than for $n = 1$. Students were categorized into four classes based on their profiles, with implications for science education discussed.

The sixth article is written by researchers from the Philippines and the USA. This meta-analysis study (2017–2021) assessed the impact of Socio-Scientific Issues (SSI)-based approaches on learners' CU, environmental attitudes, and pro-environmental behavior. Analyzing various SSI techniques, the findings revealed a strong positive influence on understanding complex environmental issues and promoting sustainable behavior. The study noted that SSI fosters critical thinking and engagement but also identified potential publication biases. It emphasized the need for context-specific strategies and interdisciplinary collaboration in climate change education. Overall, the SSI approach helps develop proactive, environmentally conscious citizens capable of addressing global issues.

The seventh article is from the USA. The study investigated the impact of an active project-based, aquaculture constructivist-

learning program on high school students' perceptions. It aimed to determine if the program influenced students' interest, engagement, and future educational and career aspirations in STEM fields, both inside and outside the classroom. The study also sought to understand students' knowledge about aquaculture and skill development post-program participation. Qualitative data were gathered through post-student focus groups, teacher journal reflections, and public newspaper articles from three rural high schools in Kentucky. Four main themes emerged as follows: (1) students demonstrated excitement and enthusiasm in the hands-on aquaculture program; (2) students exhibited attention to detail in aquaculture tasks, leading to increased responsibility; (3) students engaged collaboratively with their peers; and (4) there was a greater interest and confidence in STEM through practical application. The results indicated that the program engaged learners in real-world problem-solving and decision-making situations, fostering collaboration and enhancing skills such as responsibility and self-confidence in STEM.

The eighth article is from Thailand. This research assessed the ability of Thai grade 10 students to construct scientific explanations and explored differences based on learning achievement, attitude toward science, and school size. The study involved 231 students from Phetchaburi province, Thailand, with 77.5% demonstrating moderate ability levels. Significant differences were found in students' ability levels based on their learning achievement, attitude toward science, and school size. The study also revealed correlations between students' ability levels and their learning achievement, attitude toward science, and school size. Students with higher learning achievement, positive attitudes, and attendance at larger schools tended to have higher ability levels. However, there was no significant relationship between students' attitudes toward science and school size. These findings emphasize the importance of considering individual differences and backgrounds, particularly in terms of learning achievement, attitude toward science, and school size, when teaching science.

The ninth article is from United Arab Emirates (UAE). This mixed-approach study explores the effects of virtual science laboratories on students' motivation and attitude toward science. Conducted in an American curriculum private school in Dubai, the research surveyed 237 students from grades 7 to 11. Results show that virtual laboratories positively impact students' overall motivation, including intrinsic motivation, perceived usefulness, effort, perceived self-efficacy, and attitude toward science. Perceived self-efficacy and perceived usefulness significantly influence students' attitudes toward science, with perceived self-efficacy being a predictor of their effort.

The tenth article is from South Africa. This study examines the effectiveness of Khan Academy Videos (KAVs) in rural thermodynamics education. 88 students were divided into two groups: one taught traditionally (control group [CG]) and the other using KAVs (experimental group [EG]). Results show significant improvement in learning outcomes and engagement with KAVs, with EG scores increasing by 61% compared to 31% in the CG. Pre-tests and post-tests were used to measure academic performance, and a mixed-method approach analyzed results and feedback. The study highlights the positive impact of KAV integration on student performance, especially in resource-limited rural schools, suggesting its transformative potential in enhancing teaching quality.

The eleventh article is from China. The article analyzes 30 documents from Web of Science and CNKI databases to compare and understand the role of science teachers in China and overseas. The research highlights slow development in both Chinese and English publications, with most studies in theoretical exploration. The role of science teachers encompasses five main aspects: Role expectation, role orientation, role identification, role transformation, and role enactment. Combining the "should be" research from Chinese publications with the "real" research from English publications could lead to a more comprehensive understanding and positive interaction. This analysis provides a basis for future research on the role of science teachers.

As a final remark, the Science Education International stands as a vital platform for advancing science education globally. By disseminating innovative research, effective teaching practices, and transformative educational methodologies, the journal fosters a deeper understanding and appreciation of science among educators and students alike. Its contributions are instrumental in shaping future generations of scientists and informed citizens, ensuring that science education continues to evolve and thrive in an ever-changing world.

I warmly invite all science educators, researchers, and practitioners to contribute to the Science Education International. Your innovative research, insightful perspectives, and practical experiences are crucial in shaping the future of science education. By sharing your work, you will help advance the field, inspire fellow educators, and enrich the learning experiences of students worldwide. Join us in our mission to promote excellence and innovation in science education by submitting your manuscripts and becoming part of our vibrant, global community

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