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EDITORIAL

Editorial

In this third issue of Science Education International, nine articles have been brought together. The first three were written with master's degree level students. In the first article, Judith Jenkins worked with Bradley T. Shoopman on the misconception of students in the United States of America's Kentucky understanding molecular orbital diagrams. The second article sees Mustafa Hamalosmanoğlu working with Serdar Varinlioğlu to reveal the effects of scientific argumentation-oriented teaching activities on the environmental attitudes and knowledge of 7th-grade Turkish students. In the third article, Sevgi Aydin-Günbatar with Nesibe Kalender examined how learners' problem-solving approaches and success changed from high school to graduate school. The remaining six articles come from Greece, Japan and Singapore, United States of America, Turkey, Ethiopia, and Pakistan.

The fourth article by Greece's George Papageoriou, Vasilios Amariotakis, and Vasiliki Spiliotopoulou reports on developing a taxonomy for visual representations (VRs) characteristics of submicroscopic particles in chemistry textbooks. The fifth article by Shuichi Yamashita, Jennifer Yeo, Kei Nakanishi, Kentaro Kojima, Risa Igarashi, Asami Terasawa, Janessa Chang, Jeshrei Toh, Aaron Pang, Sapto Ashardianto, and Jun Nomurareports on a Japanese initiative in Singapore to develop and evaluate of a Global Positioning Satellite (GPS) Science lesson based on a STEM model. In the sixth article by Laila J. Richman, Sarah Haines, and Shannon Fello, they examined the design, implementation, and initial outcomes of a collaborative professional development (PD) program intended to prepare middle and high school educators to implement effectively the Next Generation Science Standards (NGSS) in classrooms with diverse learners in Maryland in the United States of America. The seventh article by Turkey's Mutlu Uygur investigated the effects of using digitally supported concept maps on the academic success of students in science classes in primary education and their opinions toward the advantages of digitally supported concept maps. The eighth article by Ethiopia's Bekele Gashe Dega reports on university-level science students' prevalence of Random and Null-modal Responses about Electromagnetism concepts. The final article by Pakistan's Azhar M. Qureshi and A. Kadir Demir from the United States of America is a comparative review of the literature on Pakistani science teachers' PD.

In the first article, Judith L. Jenkins and Bradley T. Shoopman note that a misconception is an idea, notion, or thought that does not mirror reality nor is it grounded in scientific reasoning. They further argue that it is important to identify, examine, and strategically address misconceptions held by students so that they progress from descriptions and definitions to richly interconnected, functional understanding. In chemistry, educators often use models due to the abstract nature of this discipline. Unfortunately, nonscientific mental models can arise when students struggle to connect a representation to the corresponding chemical phenomenon, or when they do not understand the limitations of a particular model. Their study was an exploratory study examining the misconception of students understanding molecular orbital diagrams. The misconceptions identified in this study will inform future strategies for teaching chemistry's molecular orbital theory. Before targeted interventions, students used familiar concepts to explain the less familiar. After interventions, the majority of students adopted chemically reasonable strategies, though some used memorized formulaic approaches (bond order) incorrectly, evidence of persisting confusion. Their work contributes to our awareness of misconceptions that persist through college chemistry. Ultimately, deep student learning requires continued vigilant attention to student misconceptions and informed strategic interventions.

The second article sees Mustafa Hamalosmanoğlu working with Serdar Varinlioğlu to reveal the effects of scientific argumentation-oriented teaching activities on the environmental attitudes and knowledge of seventh-grade Turkish students. The scientific argumentation method plays an important role in the structuring of the information by students through interaction. There are techniques that facilitate the implementation of argument in science classes. These techniques are the templates that the teacher can use as instructional materials for providing the students the opportunity to discuss their thoughts. The targeted population for this research study was all 7th-grade students in the Melikgazi district of the Kayseri province in Turkey. The study group consisted of 57 students from the approximately 1000 students from the target population. Their study reported that the effect of scientific argumentation-oriented teaching activities on the environmental knowledge of 7th-grade students was higher than the activities suggested by the Ministry of Education's science and technology curriculum. They noted that in their study, scientific argumentation did not cause a significant change on the attitude toward the science and the attitudes toward the chemistry. Consecutive implementation of scientific argumentation activities in the classroom may be a reason for the lack of change or even the decrease on the environmental attitude. They propose that scientific argumentation techniques should be combined with activities such as trips to allow students to make more observations on the environmental issues.

Sevgi Aydin-Günbatar with Nesibe Kalender examined how learners' problem-solving approaches and success changed from high school to graduate school in these issues in the third article. Their study investigated to what extent do chemistry

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experiences as a student support these participants' problem-solving approaches. Their problem-solving ability and the use of problem-solving approaches are ignored or assumed to be developed through gaining more knowledge. Algorithmic questions and problems require different approaches to solve them, which shed lights on implications for future research and goals of education. Questions asked in the examinations and solved in teaching generally have one correct answer. To be successful in the examination, students need to remember the algorithm and the method needed to solve it. On the contrary, teaching problem solving is useful regarding increasing motivation and retention, providing independence to the learner, and developing reflection skills. The data were collected through think-aloud protocol through which the participants were asked to verbalize their thoughts and actions while doing something. All participants were requested to take notes for calculations or reaction. The results revealed that participants engaged in more unsupportive approaches than supportive ones while solving problems. They concluded that receiving more and deeper knowledge about a topic, as well as more experience does not result in successful problem solving or the use of supportive strategies. Their results revealed that learners needed to observe how experts solve problems with missing data and parts, need to learn problem-solving strategies, and practice them in problem-solving process.

The fourth article by Greece's George Papageoriou, Vasilios Amariotakis, and Vasiliki Spiliotopoulou reports on developing a taxonomy for VRs characteristics of submicroscopic particles in chemistry textbooks. Textbooks are one of the most important instructional tools, playing a major role in the teaching and learning procedure. Due to their importance, school textbook analysis is critical for science education, as it could provide us with valuable information for the construction of students' knowledge and the whole teaching and learning process. VRs are, in fact, external representations, which lead students to construct corresponding internal representations. This means that any deficiency in their characteristics as illustrations can cause problems in their interpretation by the students or even the teachers, leading them to relevant misconceptions. The main objective of the present paper concerns the development of such a taxonomic system in a cohesive way, to help science teachers and curricula designers to realize the pluralism of these characteristics and their relations between and within resulting categories. The sample comprises a total number of 221 VRs of submicroscopic particles depicted in nine chemistry textbooks that have been used over the past three decades in Greek secondary education. Taking into account the important role of VRs in the effectiveness of textbooks and those textbooks are associated with the curriculum, the present taxonomy can help in future appropriate design and use of VRs of submicroscopic particles, contributing to a better science curriculum positively affecting the science teaching and learning process.

The fifth article by Shuichi Yamashita, Jennifer Yeo, Kei Nakanishi, Kentaro Kojima, Risa Igarashi, Asami Terasawa, Janessa Chang, Jeshrei Toh, Aaron Pang, Sapto Ashardianto, and Jun Nomura reports on a Japanese initiative in Singapore to develop and evaluate of a GPS Science lesson based on a STEM model. Since 2012, Chiba University has been funded by the Japanese government to promote global talent. As part of this funding, Chiba University's Department of Education designed and developed the Twin College Envoys program. Their paper reports on the third year of implementation in Singapore schools. The program was developed using the STEM model for Singaporean students by four Japanese students. Their Singaporean counterparts for the local teacher training institute revised the program. The project focused on GPS. To help students understand these mechanisms, the researchers created a model to demonstrate how GPS operates. By the end of the project, students could explain how GPS worked and list the benefits of GPS surveying. The teaching materials and hands-on activities were well received by the students and our Singapore counterparts.

In the sixth article by Laila J. Richman, Sarah Haines, and Shannon Fello, they examined the design, implementation, and initial outcomes of a collaborative PD program intended to prepare middle and high school educators to implement effectively the NGSS in classrooms with diverse learners in Maryland in the United States of America. The Science and Engineering Practices of the NGSS give students opportunities to develop the abilities necessary to do scientific inquiry and to understand the nature of scientific inquiry. The project provides 91 h of PD activities that focus on increasing the teachers' content and pedagogical knowledge related to effectively implementing the NGSS, with specific emphasis on the Science and Engineering Principles and Crosscutting Concepts. Twenty-two teachers from 14 different schools participated in the project. They taught a range of grade levels with 1 teaching in 5th grade, 15 teaching from 6th to 8th grades, and 6 teaching from 9th to 12th grades. One area that was consistently identified by teachers as critical to the effective implementation of the NGSS was the ability to collaborate and plan with others. Findings suggest that this PD program was successful and can serve as a model for providing teachers with the required content, and pedagogical knowledge as well as the opportunity and skills to engage is such critical collaborations.

The seventh article by Turkey's Mutlu Uygur investigated the effects of using digitally supported concept maps on the academic success of students in science classes in primary education and their opinions toward the advantages of digitally supported concept maps. Several educational tools help the cognitive activities in the learning process. These tools are called teaching materials. Good materials enrich the education process, make the learning easier by embodying the information and motivating the student, help the acquisition of knowledge, help engage the student's attention, encourage their willingness to learn, contribute to the conceptualization of

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thinking, and make the learning environment natural. Concept maps are teaching–learning methods that show how people acquire and make the information meaningful, support the student's mental organization of the information, and help the researching of conceptual interchange or two-dimensional tools that can be used in any part of teaching. The aim of the research was to detect whether there was a significant difference in the academic success of students. One group was taught using traditional methods, the control group, and the other was taught using the application of digitally supported concept maps, the experimental group. Forty-four students participated. These students were in the 7th grade in a state school in Mersin, Turkey in 2017. A significant difference has not been found between pre-test success grades of the experimental group and pre-test success grades of the control group. A significant difference was found between the post-test success grades in the control group and their pre-test success grades. This study supports research literature that has used concept map in science classes and digitally supported concept maps, which highlighted increases in the academic success of participating students.

The eighth article by Ethiopia's Bekele Gashe Dega reports on university-level science students' prevalence of Random and Null-modal Responses about Electromagnetism concepts. Research in physics education is primarily to improve students' understanding of physics concepts (McDermott, 2001). However, students often come to these science classes with only a limited or an inappropriate understanding of science concepts. Students' misconceptions in electromagnetism concepts have similar trends across undergraduate and upper high school students in different countries. An assessment is needed to provide information about students' understanding of relevant prior knowledge and misconceptions within the domain-specific knowledge. Such an assessment can provide information about their cognitive strengths and weaknesses. The quantitative research method was used to collect and analyze data collected from 117 undergraduate physics students in a university in Ethiopia. The results of this study show that these participating students have difficulty in understanding the basic concepts of electromagnetism and reveal that they lacked a coherent, in-depth understanding of the concepts. These results show that the previous students' learning had no significant impact on their conceptual development of electromagnetism concepts. Misconceptions are very stable and cannot be removed by traditional teacher-centered learning or by the transmission model of learning because conceptual change is a complex process that needs insight and intervention. Concepts learning cannot be effectively done through transmission model of learning between students and the teacher. Thus, schools and universities are advised to apply concept-learning strategies.

The final article Azhar M. Qureshi and A. Kadir Demir is a comparative review of the literature on Pakistani science teachers' PD. Their literature review was compiled from 200 peer-reviewed research articles, with more than 75% belonging to the Western context. They highlight that it has been generally known, on the international level, that PD for science teachers is very critical for the success of science education. Pakistan, like many other countries of the world, has been criticized for its unproductive PD policies and practices for teachers due to low student achievement in science subjects. Five common features of effective PD learning and experiences have been identified through research studies, which include focus on content, active learning, coherence, sufficient duration for practice, and reflection on PD experiences. The current practices of science teachers' PD in Pakistan are provided through a single workshop or at best, a series of sessions. Teachers in public sectors utilize the traditional Cascade model to instigate PD learning. Most of the PD programs put emphasize on the effectiveness of teachers by stimulating stress on the technical aspects of their profession. Science teachers in Pakistan stated that it is essential to have social and professional support systems for effective practices. However, teachers are unaware of the role of the professional learning community and were found to be reluctant in accepting feedback from their colleagues. A significant finding from the review of the Pakistani literature was that there is a shortage of published empirical research studies on the science teachers' learning and experiences, especially with teachers working in public schools.

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