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EDITORIAL

Editorial

The fourth issue of Science Education International is a double issue bringing together 15 articles. These articles range from South America, North America, and Europe to Asia covering topics ranging from STEM to special education involving participants from primary, high school, or university. In the first article, Yeşim Taktat Ateş, Hüseyin Ateş, Neslihan Özbek, and Özlem Afacan investigated Turkish special education teachers' self-efficacy belief levels toward science. The second article by Aslıhan Hafızoğlu and Sündüs Yerdeleninvestigated the mediating role of the 7th grade students' motivation toward learning science in the relationship between their science learning environment perceptions and science achievement. Helen Semilarski, Regina Soobard, and Miia Rannikmäe in the third article sought to develop models describing student's gains in perceived self-efficacy and importance of work and life skills as well as indicating the relationship with both disciplinary and interdisciplinary core ideas in science education. Sri Lanka's Kumudu Seneviratne, Junainah Abd Hamid, Ali Khatibi, Ferdous Azam, and Sepali Sudasinghe examined how professional development (PD) designs affect in-service teachers' efficacy beliefs to teach inquiry science in the fourth article. The Philippine's Danilo V. Rogayan Jr. and Lea F. Dollete developed a workbook in physical science for SHS based on the students' least learned concepts in a government-owned university in the fifth article. The sixth article by Özlem Eryilmaz Muştu and Ahmet İlhan Şen examined the impacts of teaching modern physics topics according to textbooks that are prepared based on two different physics curricula implemented in Turkey on students' success, problem-solving skills, and attitudes. Turkey's Nilüfer Didiş Körhasan and Derya Kaltakçı Gürel examined student teachers' physics knowledge in terms of their everyday explanations and physical reasoning pertaining to everyday concepts in the seventh article. Brazil's Geilsa Costa Santos Baptista and Geane Machado Araujo sought to identify the influence of practical experiences involving ethnobiology applied to science teaching on intercultural dialogue into their initial training in the eighth article. Article nine, Turkey's Gizem Türköz and Nurhan Öztürk examined the quality of the written argument of pre-service science teachers on certain socioscientific issues (SSIs) and their opinions about the process of something. The tenth article is from Ghana's Rebecca Esi Quansah, Nelly Adjoa Sakyi-Hagan, and Charles Essiam, which investigated challenges affecting the teaching and learning of Integrated Science in rural junior high schools. The eleventh article from Germany's Claas Wegner, Rachel LeeAnn Bruneman, and Antonia Steffen determined to what extent graduate students possess the chemistry skills essential for teaching the state-mandated biology curriculum. Rosa Aghekyan from the USA in the twelfth article describes the development and validation of an instrument called Science Identities, Expectations of Success in Science, Values of Science, and Environmental Attitudes (SIEVEA). Xiaoge Chen and Ingo Eilks from Germany in the thirteenth article study analyzed representations of practical work in the 10th grade chemistry textbooks and associated experimental workbooks from different Chinese communities. Lloyd M. Mataka, Jon C. Saderholm, and Tracy Hodge from the USA explored the epistemological beliefs of the science faculty at a small liberal arts college in the Southern United States and investigated the effect of a faculty learning community (FLC) PD in the fourteenth article. Finally, the fifteenth article by Patrick L. Brown and James P. Concannon from the USA investigated the 8th grade science students (13–14 years old) in advanced and traditional ability classrooms perceptions of their vocabulary knowledge, learning, and content achievement.

In the first article, Yeşim Taktat Ateş, Hüseyin Ateş, Neslihan Özbek, and Özlem Afacan investigated Turkish special education teachers' self-efficacy belief levels toward science. All individuals to maintain their lives independently and productively need to acquire the skills required for daily life. It is important that individuals with special needs should be completely independent to participate in social roles. Special education teachers should contribute to the development of students' knowledge, skills, attitudes, motivation, and academic achievement at all stages of the teaching process as well as in all courses. The main data of their study were collected through a survey by 115 special education teachers in Kırşehir in Turkey. According to the results, the average of special education teachers in terms of self-efficacy beliefs toward science courses was 3.33 of 5. When the results were examined in terms of items, 74% of special education teachers reported that they would generally welcome student's questions while teaching science course. However, Ateş, Ateş, Özbek, and Afacan reported many of their participating teachers think that students' success in science course was directly related to their effectiveness in science teaching. In addition, most of their teachers thought that the shortcomings of a student could be solved with good science teaching. The authors note that this study is limited in number and further study with a wider population is warranted.

The second article by Aslıhan Hafızoğlu and Sündüs Yerdelen investigated the mediating role of Turkish 7th grade students' motivation toward learning science in the relationship between their science learning environment perceptions and science achievement. Hafızoğlu and Yerdelen argued it is vital to examine the psychosocial features of the learning environment and their relation to motivation toward learning and achievement. Their study used survey method and

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data were collected using self-report questionnaires and a multiple-choice achievement test. Middle schools located at the city center of the Kars Province of Turkey were included in the study. Thirteen of the 16 schools were willing to participate. Therefore, data were collected from all of the 7th grade students (n = 922) from 11 public and two private schools. The results of the study showed that students who perceived their learning environment positively also had a generally high level of science motivation. Based on the present study, both science motivation and science achievements were significantly predicted by students' science learning environments. The findings showed that improving student's perceptions of science learning environments may enhance students' motivation and thereby science achievement. It is possible that educational strategies and objectives created to progress students' cognitive outcomes should focus on students' learning environment perceptions.

Helen Semilarski, Regina Soobard, and Miia Rannikmäe in the third article sought to develop models describing Estonian students' gains in perceived self-efficacy and importance of work and life skills as well as indicating the relationship with both disciplinary and interdisciplinary core ideas in science education. The focus of this study was to develop models about students' perceived self-efficacy and its importance toward work and life skills and core ideas among Grades 8 and 11 students. Data collection was undertaken from five different Estonian schools (both rural and city). These results showed that students evaluated the mean perceived importance toward disciplinary and interdisciplinary core ideas lower than average (M = 2.50). This is of concern because, based on students' opinions, they do not value these disciplinary and interdisciplinary core ideas. Findings indicated that while students' mean perceived self-efficacy for different ideas was greater than the average and thus, in general, they considered their self-efficacy in these disciplinary and interdisciplinary ideas high, they did not consider these ideas to be important. This was seen as very problematic because an appreciation of these disciplinary and interdisciplinary ideas could help to solve various problems or to explain phenomena. This suggested that there was a need for teachers to rethink about how these disciplinary and interdisciplinary ideas were presented. Semilarski, Soobard, and Rannikmäe ended with eight recommendations.

Sri Lanka's Kumudu Seneviratne, Junainah Abd Hamid, Ali Khatibi, Ferdous Azam, and Sepali Sudasinghe examined how PD designs affect in-service teachers' efficacy beliefs to teach inquiry science in the fourth article. Learning and teaching science as inquiry requires not only grasping scientific information but also developing fundamental understandings and abilities to conduct scientific inquiry. Their paper is an exploratory and illuminating study into what level in-service science teachers perceive self-efficacy beliefs for inquiry-based science teaching, in general, and particularly focusing on student engagement, and how PD designs affect their efficacy beliefs to teach inquiry science in the classroom. A stratified random sample of 350 science teachers participated in this study. The in-service science teachers comprised 61 males (17.4%) and 289 females (82.6%) from state schools in the Colombo and Homagama education zones of the Colombo district in Sri Lanka. The majority (more than 50%) of science teachers noted quite a high belief that they could perform the instructional strategies of responding, assessing, and providing an alternative explanation for both students who were confused as well as those very capable in scientific inquiry in teaching scientific inquiry. This study provides valuable insights into the science teachers' efficacy beliefs in engaging students in scientific inquiry and how other efficacy beliefs perceived support from PD programs and school characteristics related to these beliefs.

The Philippine's Danilo V. Rogayan Jr. and Lea F. Dollete developed a workbook in physical science for SHS based on the students' least learned concepts in a government-owned university in the fifth article. Teachers find it difficult to teach some science concepts and principles due to the scarcity of relevant, responsive, and research-based learning materials. Science cannot be meaningful to students without worthwhile practical experiences in the school laboratory. This descriptive developmental educational research focused on the development of an instructional material in the form of an alternative workbook to facilitate learning of the least learned and least practiced concepts and skills of students in the senior high school. The first group of participants was 50 randomly sampled undergraduate teacher education students from a government-run university in Central Luzon, Philippines. The second group of participants was the four expert validators. The third group of participants was 24 students who evaluated the effectiveness of the activities in the workbook using the student's evaluation checklist. The developed workbook was found to be very much acceptable as validated by the experts. The developed workbook can serve as a prototype in developing workbooks for other core courses in senior high school.

The sixth article by Özlem Eryılmaz Muştu and Ahmet İlhan Şen examined the impacts of teaching modern physics topics according to textbooks that are prepared based on two different physics curricula implemented in Turkey on students' success, problem-solving skills, and attitudes. In modern physics classes, fundamental theories and interpretations of quantum physics are usually discussed. While modern physics topics are being taught, it is important to ensure meaningful learning by concretizing concepts. This means bringing the visibility to the forefront and identifying the conceptual and mathematical difficulties that students encounter. The study, in which the effectiveness of modern physics teaching based on two different teaching programs and textbooks prepared according to these teaching programs was investigated and evaluated, was conducted in a causal comparison research model. The sample for the study consisted of a total of 80 students studying at the 11th and 12th grades of two different high schools in Aksaray Province of Turkey. When the results were analyzed as to

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students' modern physics achievements and attitudes toward physics course, no significant differences were found. When the results were analyzed in terms of students' problem-solving skills, significant differences were found between students' problem- solving skills at the end of the courses conducted in the 2011 curriculum in comparison to the previous curriculum. It was determined that the problem-solving skills of the students who were taught with 2011 curriculum and textbook were higher in comparison to the 2005 curriculum.

Turkey's Nilüfer Didiş Körhasan and Derya Kaltakçı Gürel examined student teachers' physics knowledge in terms of their everyday explanations and physical reasoning pertaining to everyday concepts in the seventh article. A significant amount of research on students' understanding of physics concepts over the past 30 years has revealed student's difficulties in learning physics and reflected their poorly organized physics knowledge, as well as their misconceptions in different physics concepts such as force and motion. Körhasan and Gürelexamined physics knowledge together with sources of the knowledge of student teachers who will teach primary and elementary level science in elementary schools (students aged 10–14), in eight different daily life contexts. The results about student teachers' reasoning and use of physics concepts indicated that correct use of physics concepts to explain phenomena facilitated correct reasoning; however, limited use resulted in wrong explanations. However, their explanations and reasoning regarding everyday phenomena may or may not be scientifically compatible with expert opinions. Physics educators should design their physics courses by considering student's epistemologies to remove the hidden barrier between everyday and formal concepts because traditional physics courses may not change student's epistemologies.

Brazil's Geilsa Costa Santos Baptista and Geane Machado Araujo sought to identify the influence of practical experiences involving ethnobiology applied to science teaching on intercultural dialogue into their initial training in the eighth article. Baptista and Araujoargued that it is necessary in the context of school education, for teachers to develop the competencies and skills that will enable them to teach Western science without, however, losing sight of the consideration and respect of their students' cultural diversity. Baptista and Araujo understand that bringing science closer to students requires going beyond the classroom and the science epistemology to include other knowledge systems, in which these individuals are embedded. This requires contact with these subjects' cultural realities. This study was based on qualitative approach and case study. The research sample involved 18 biology teaching undergraduate students (BTU students), both male and female, between 17 and 29 years of age. The results indicate that ethnobiology contributed to the education of these undergraduate students in the following aspects: Perception of existence of a diversity of cultural knowledge in the school environment; respect for the heterogeneity of students' knowledge and the importance of relating it to scientific knowledge; reduce the gap between students' realities and scientific learning; and increase in teacher knowledge. The results should be considered not only in the Brazilian educational context but also in other countries where classrooms are characterized by students of different cultural backgrounds.

In article nine, Turkey's Gizem Türköz and Nurhan Öztürk examined the quality of the written argument of pre-service science teachers on certain SSI and their opinions about the process of something. The issues which provide dynamics between science and society which have different perspectives for the individual generally include those ethical, moral, and legal dilemmas considered to be non-consensus are called SSI. It has been emphasized in many studies that SSI is an important context for individuals to make informed decisions by taking into consideration social, political, and scientific dimensions of social problems and developing their skills of discussion, reasoning, and decision-making. This research aimed to identify pre-service science teacher's views about SSI and their views about the implementation process. In the research process, written arguments of pre-service science teachers, their journals, focus group interviews, and field notes were used as data sources. Twenty-six (18 females and 8 males) pre-service science teachers studying at a state university were selected as participants. Fourteen (seven females and seven males) pre-service science teachers were selected for the purpose of general evaluation in the implementation process. For the purpose of the study, the pre-service science teachers' argument qualities related to the SSI on sugar intake during pregnancy, raw/processed milk, and nuclear power plant were determined based on the argument evaluation rubric, which was divided into levels ranging from 1 to 5. Türköz and Öztürk ended with five recommendations.

The tenth article is from Ghana's Rebecca Esi Quansah, Nelly Adjoa Sakyi-Hagan, and Charles Essiam, which investigated challenges affecting the teaching and learning of Integrated Science in rural junior high schools. The government of Ghana has made teaching and learning of Integrated Science in basic education across the country from primary year 4 (students aged 9 years old) to junior high school year 3 (students aged 14 years old). Integrated Science comprises physics, chemistry, biology, and agricultural science. The study specifically assessed the limitations of teachers' use of the English language as the medium of instruction and the availability of instructional materials used in the teaching and learning of Integrated Science in rural JHSs in the Effutu Municipality. The head teachers of the selected six rural schools and the Integrated Science teachers were then approached for inclusion in this study. Simple random sampling technique was employed to select 30 final year pupils, five from each sampled school. The final year pupils were chosen because they would have had more exposure to the use of English language as the medium of instruction and the use of instructional materials in relation to the teaching and learning of Integrated Science. Effective teaching and learning of Integrated Science requires adequate resources; however, Quansah, Sakyi-Hagan, and

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Essiam highlighted that due to the inadequacy of the apparatus, Integrated Science lessons were mostly in the lecture format with limited demonstrations. The medium of instruction for teaching Integrated Science in JHS is the English language; unfortunately, Quansah, Sakyi-Hagan, and Essiam reported that pupils are not able to express themselves and exchange ideas in science classes, it makes the teaching and learning of Integrated Science more challenging and unattractive. Quansah, Sakyi-Hagan, and Essiam concluded their paper with five recommendations.

The eleventh article from Germany's Claas Wegner, Rachel LeeAnn Bruneman, and Antonia Steffen determined to what extent graduate students possess the chemistry skills essential for teaching the state-mandated biology curriculum. Wenger, Bruneman, and Steffen highlighted how the previous research acknowledged the prominence of chemistry throughout the biology curriculum and recognized that it is crucial for biology instructors to maintain an adequate understanding of chemistry. However, biology education students at several universities in Germany are not obligated to attend chemistry seminars or lectures before fulfilling graduation requirements. In the conducted study, it was assumed that the graduate students without chemistry as their second elected subject would resemble the performances of the 1st year biology students, due to the lack of furthered education in the subject of chemistry. A total of 55 graduate students pursuing a master's degree in biology education, took part. Biology education students with chemistry as their second elected subject scored 47.83% higher on the knowledge test than the students with other second elected subjects. Wenger, Bruneman, and Steffen concluded that biology is best taught by a teacher, who possesses an understanding of fundamental chemistry.

Rosa Aghekyan from the USA in the twelfth article describes the development and validation of an instrument called SIEVEA. Motivation and interest are some of the key factors in initiating and sustaining students' interest in science learning. Understanding high school students' (students aged 14–17) science identities and their motivation in science can aid in explaining phenomena such as disliking science or not doing well in science. The SIEVEA Instrument measures high school students' science identities, motivation in science, and environmental attitudes so that science instruction can be reshaped based on students' perceptions and responses regarding their science learning. The survey was web based. A total of 1660 high school students from 11 school districts in New Jersey, Pennsylvania, and Connecticut (Grades 9–12) completed the SIEVEA. The results of this study illustrated the usefulness of SIEVEA as a simple and expedient instrument for measuring important constructs related to science learning and environmental attitudes. Aghekyan concludes how understanding the factors that contribute to students' motivation of science learning will help science education researchers and educators to improve science education.

Xiaoge Chen and Ingo Eilks from Germany in the thirteenth article study analyzed representations of practical work in the 10th grade chemistry textbooks and associated experimental workbooks from different Chinese communities. Most educational standards and traditions in science education state the importance of practical work for the teaching and learning of science. Chen and Eilk sused the term practical work in a broader sense, to it refer to any kind of teacher or student interaction either with equipment or materials to produce or observe phenomena, from which students achieve a better understanding of the natural world. Although there is a growing body of literature emphasizing the important role of textbooks in science teaching and various facets of learning were analyzed with reference to textbooks, not much is known about how practical work is presented in secondary chemistry textbooks, especially in the context of secondary chemistry education in Chinese communities. The sample consists of seven sets of the 10th grade (students aged about 15 years old) secondary chemistry textbooks and the accompanying experimental workbooks from Mainland China, Taiwan, and the Chinese sector in Malaysia. All of the textbooks were examined page by page. Each representation of practical work was carefully collected and listed. This led to an overall total sample of 508 representations from the seven selected sets of textbooks and experimental workbooks. This study is limited to chemistry education in three Chinese communities and only looks at one certain grade level. It also only deals with one aspect of textbooks and cannot say how these textbooks were being used, either as stand-alone tools or in combination with other resources.

Lloyd M. Mataka, Jon C. Saderholm, and Tracy Hodge from the USA explored the epistemological beliefs of the science faculty at a small liberal arts college in the Southern United States and investigated the effect of an FLC PD in the fourteenth article. In this study, we used the teacher beliefs interview to investigate the epistemological beliefs of faculty at a small, liberal arts college in the Southern United States. Mataka, Saderholm, and Hodge also compared the faculty epistemological beliefs to their classroom practices using the reformed teacher observation protocol. Mataka, Saderholm, and Hodge applied a quasi-experimental post-test only methodology for this study. The methodology comprised a mixed methods study that reported the same interview data both quantitatively and qualitatively. The participants were a combination of tenured and pre-tenured faculty who teach courses in the disciplines of biology, chemistry, physics, mathematics, and computer science. Results from this study have shown that there is still a long way to go to change faculty epistemological beliefs about teaching. This study encourages college to create intentional activities to boost faculty epistemological beliefs about teaching to, as these results suggest, improve teaching practice.

Finally, the fifteenth article by Patrick L. Brown and James P. Concannon from the USA investigated the 8th grade science students (13–14 years old) in advanced and traditional ability classrooms perceptions of their vocabulary knowledge,

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learning, and content achievement. Recent reforms in science education call for providing experiences for students that are cognitively appropriate and mirror the work of scientists. In the USA, the Common Core State Standards highlights that instruction, regardless of academic discipline, should promote students gathering, comprehending, assessing, and synthesizing the information presented in technical texts required for college and career readiness. The purpose of their study was to compare middle school science student's perceptions of vocabulary knowledge, learning, and content achievement in advanced and traditional classes. Ninety-two students (n = 92) age 13 and 14 participated in the study that represents two separate data sets: Advanced class (n = 41) and traditional class classes (n = 51). The comparison analysis showed there was a statistically significant difference between advanced and traditional class perceptions of vocabulary knowledge. The lack of statistically significant differences between advanced and traditional groups on the content test shows that amalgamation of metacognitive awareness and effective literacy strategies (both vocabulary strategies and close reading) leads to a robust experience for all students that enhanced science learning. This research is one of the first studies to provide a more nuanced view of vocabulary learning in science using critical ideas about learning and cognition. The benefit of promoting metacognitive awareness and literacy practices in science education is that they provide students with engaging strategies to learn content and empower them with greater science literacy.

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