

## Editorial

The fourth issue of Science Education International for 2020 brings together 12 papers from North America, Europe, Asia, and South-East Asia. In the first article, Münevver Subaşı aimed to investigate the relationships among mastery goal orientations (approach and avoidance), adaptive coping strategy (positive coping), and motivational beliefs (self-efficacy and task value) among Turkish middle school students in science. When the related literature is examined, a correlation between the mastery goal orientations and positive coping strategies; mastery goal orientations and task value and self-efficacy can be observed. A total of 249 volunteer middle school students (109 girls and 130 boys) from four public schools in one of the largest cities in eastern part of Turkey participated in the study. The mean age of participants was 12.62. According to the results obtained from the research, individuals with mastery goal orientation used positive coping strategies more often. Individuals with high levels of motivational beliefs (task value – self-efficacy) used mastery goal orientation more often. It was revealed that individuals with high levels of self-efficacy use mastery goal orientation more often. In summary, Subaşı concluded students who strive to increase their abilities and master their skills feel more confident about themselves.

Pelin Mete study aimed to determine the understanding level of Turkish 11<sup>th</sup> grade high school students on “gases” in terms of chemical variables and any alternative frameworks on the subject of gases. Mete argued that science education aims to enable students to acquire the skills of problem-solving and scientific thinking using scientific concepts and definitions and to educate them as science-literate. Mete went on to note that students sometimes perceive and explain basic concepts or events differently from scientists. The fact that students think that their knowledge is scientifically true leads them to develop alternative concepts. Mete’s data were collected through a paper-pencil test and a group discussion with 11<sup>th</sup> grade science students about their understanding levels of gases and their alternative frameworks. The data obtained from the study were analyzed using content analysis and descriptive statistics. According to the findings obtained from the study, Mete observed that the students answered the question where the effect of temperature, pressure, and state change on the intermolecular distance in gases was examined at the level of sound understanding. These statements might be due to their inability to reason that the most irregular state of the matter is gas and the distance between particles is the most. In addition, the students attempted to explain the increase or decrease of intermolecular distance by intermolecular bonds. By explaining the distribution properties of gases, they could not clearly describe the relationship between concepts. Mete concluded that the alternative conceptions of

students should be taken into consideration while designing teaching and this teaching should be aimed at overcoming such misunderstandings.

Hasan Özcan, Gülcan Çetin, and H. İlker Koştur investigated the effectiveness of simulation-based instruction on Turkish students’ greenhouse effect achievement. They argue that global warming has become one of the most important climatic problems across the world. They go on to report that there have been numerous studies and research carried out to slow down and stop global warming. In 2018, the Turkish science education curriculum was updated to include “global warming” and “greenhouse effect” concepts. In compliance with science literacy aims, teaching should not be only to provide information on global warming and the greenhouse effect but also implicitly teach the science process skills, develop affective aspects, and discuss science-technology-society-environment concepts, as a whole. Their study was a pre-test-post-test with control group design quasi-experimental study. Their study was carried out on 45 6<sup>th</sup>-grade students, studying in the elementary school in a city located at the Central Anatolia Region of Turkey during the 2017–2018 school years. The data were collected with the “Greenhouse Gas Test” developed by the researchers. Pen-resource accessible greenhouse effect PhET simulation was used for this process. With this simulation, the students were given the opportunity to research how the climate was affected by the greenhouse gases, thus observing the greenhouse gas levels within the atmosphere during the ice age, present time, and the future, along with the temperature changes in the world. It was confirmed that the PhET simulation had a statistically positive contribution in learning the concept greenhouse effect. The researchers ended with recommendations based on this study.

Chatree Faikhamta explored Thai pre-service teachers’ views of the “nature of STEM” (NOSTEM) from both individual and integrative perspectives. Faikhamta noted that to learn any discipline, it is necessary for students to understand its nature, including the impact of their epistemological beliefs and why they are learning what they learn. The integration of all four STEM disciplines, in both the classroom and real life, is the primary current trend in education that works to make learning more meaningful for students. Teachers’ understanding the NOSTEM is one of key goals in STEM education. The sample for Faikhamta’s study comprised 428 Thai pre-service science teachers enrolled in 5-year teacher-education programs across the country. Faikhamta’s study developed and administered a NOSTEM questionnaire, consisting of 16 items. It was found that the participating pre-service science teachers held intermediate views regarding what science is as well as mathematics. Very few of these pre-service teachers thought of

technology as a process for doing something or solving practical problems. In terms of engineering processes, while they had a sound understanding that engineering designs aim to meet human needs, they failed to understand that design is an iterative process. This research indicated that pre-service science teachers' views on STEM integration were consistent with the view that science and math are connected by technology and/or engineering. Faikhanta noted it would be useful to follow-up on how the pre-service teachers integrated their understandings of the NOSTEM into their classroom practices.

Jeerawan Ketsing, Noriyuki Inoue, and Sandy Buczynski examined the quality of reflection on inquiry teaching by two Thai pre-service science teachers as they participated in a mini-Community of Practice (mCoP) with their cooperating teachers and university advisor. Their study sought to investigate what does it takes to help pre-service teachers move on from focusing on the technical aspects of teaching in their reflective practices. Their study was conducted using interpretive methodology as they aimed to understand the way, in which the two pre-service teachers constructed meanings of their inquiry teaching experiences through reflections while working with experts. Based on the findings, the mCoP helped the two pre-service teachers to move from descriptive level of reflection to critique level after going through four cycles of teaching and reflection. Their study concluded with three recommendations based on this research.

Mahsa Kazempour and Aidin Amirshokoochi's study explored the dynamics of inquiry-based learning experiences of two teams of American elementary preservice teachers in an introductory science content course. They explored their participants' actions and interactions during two inquiry sessions using observation data and field notes to collect detailed descriptions and reflective notes. Kazempour and Amirshokoochi discuss their findings pertaining to each team by first sharing an excerpt of their participants' dialog, then an analysis of the individual member's roles, and overall group interaction patterns. The researchers reported even though no formal roles and responsibilities were assigned to team members, an informal contractual power was witnessed whereby different team members assumed different roles throughout the activities. They concluded collaboration and communication, vital components of learning about and through inquiry, are critical for stimulating reflection, which is critical in shaping changes in preservice teachers' attitude, beliefs, and confidence levels. Therefore, it is critical to focus research on understanding the dynamics of inquiry-based learning experiences and identifying the social context and interactive patterns that preservice teachers engage in. Kazempour and Amirshokoochi research highlighted the challenges with equitable interactions where some members were less active than others and the level of discourse was, therefore, not as productive as possible.

Lampe Damjana and Francka Lovšin Kozina sought to determine whether the learning results of Slovenian pupils

after the introduction of a didactic game with nutrition cards were better than the learning results of pupils who acquired knowledge through a traditional (i.e., teacher-lead) presentation. Improved nutrition knowledge may help young people make healthier food choices. Along with parents, the educational system can help young people develop proper and balanced eating. Damjana and Kozina highlighted that games have an educational value because they follow the natural principle of learning. This study describes a micro didactic experiment in which 56 Slovenian Grade 6 (students aged 11–12) voluntarily agreed to be involved. The implementation of the activity with the nutritional cards was carried out in a lesson on milk and dairy products. The learning performance of both groups was compared based on the average of points achieved in the knowledge test. The results showed that learning with nutritional cards allowed the experimental group of pupils to achieve better learning results when compared to the pupils experiencing traditional teaching group. Damjana and Kozina noted that further research was necessary to investigate if their findings reflect the wider population and if a wider range of topics result in similar findings.

Neslihan Ültay, Eser Ültay, and Hatice Yılmaz aimed of this study were to determine the relationship between Turkish preschool teachers' attitudes toward science teaching and self-efficacy beliefs and to examine them in terms of gender and professional experience. The method of this study was case study. Case studies aim to investigate the characteristics of a group in depth. This research was conducted in the years 2018–2019. It included 113 female and eight male preschool teachers who worked in either a state or private school in one city in Turkey. In the light of the findings obtained from the study, it was seen that preschool teachers' attitudes toward science teaching and science self-efficacy beliefs did not differ according to gender and professional experience. Ültay, Ültay, and Yılmaz argued that faculties of education should rearrange their curricula in a way that improves teachers' attitudes and self-efficacy beliefs.

Özlem Koray and Sercan Çetinkılıç investigated the effect of critical reading practices in science courses on academic achievement, science performance level, and problem-solving skills on 102 Turkish seventh-grade students. Koray and Çetinkılıç argue that being a critical reader requires making reliable observations, making inferences, and establishing rational hypotheses. Four activities covering the objectives of the Turkish curriculum and critical reading on the 7<sup>th</sup>-grade Human and Environment unit were developed by the researchers. The experimental group was taught according to the Critical Reading Practices Course Plan, the control group was taught according to the annual plan of the Turkish Board of Education and Discipline. The results show that the experimental group, in which critical reading practices were used, had higher academic achievement than the control group in which curriculum-appropriate teaching was followed. Koray and Çetinkılıç concluded with recommendations based on their research.

Victor Antwi, Fortune Addo-Wuwer, and Nelly Sakyi-Hagan explored the teaching and learning of Newton's third law of motion, using daily life or real-life activities in an interactive engagement manner to help 20 Ghanaian 1<sup>st</sup>-year university students' conceptual understanding. Antwi, Addo-Wuwer, and Sakyi-Hagan highlight that the traditional approach in teaching students Newton's third law of motion does not help improve students' conceptual understanding and performance. Their study investigated the impact an interactive engagement approach using a pre-test/post-test approach. Interactive engagement teaching enables students to relate Newton's third law to real world experience through a microcomputer-based laboratory. They reported significant results due to the introduction of the real-life activities and examples in an interactive engagement manner in the teaching process. Antwi, Addo-Wuwer, and Sakyi-Hagan conclude with recommendations because of their study.

Gargalakos Michail and Sotiriou Sofoklis present a very timely study in the use of technology to address the shortage of personnel and adequately equipped laboratories as serious obstacles for the teaching process, similar to those experienced by many during COVID-19. They investigated the impact of a large-scale implementation of the Go-Lab integrated environment in a laboratory course of Greek tertiary education. Michail and Sofoklis report on how the Virtual Instrument Systems in Reality (VISIR) lab provided an environment in which students could construct and test different circuits with a degree of freedom normally associated with a traditional, hands-on electronics laboratory.

The implementation took place for 5 weeks in the Hellenic Army Academy with 200 participants. Michail and Sofoklis discussed how the VISIR was able to support learning. They concluded noting the advantages of VISIR holds and how this tool overcame pandemic issues with ongoing student learning.

The final article of this issue is from the United States' John Gilbert and James Concannon who examined the differences between sequences of secondary science courses on achievement on science high stakes exams. Their study sought to investigate first what is currently known about the impact of science course sequence on student achievement and what effects, if any, are there on student achievement when changing science course sequence. Gilbert and Concannon utilized a purposive quantitative research design. Their study included 45 secondary school principals from 45 separate secondary schools. Each principal responded to the science course sequence questionnaire indicating the secondary school's respective science course sequence and indicated if they have switched their science course sequence between the years of 2012 and 2017. They concluded there was no statistical significance between science course sequences. They concluded their paper with recommendations based on this study.

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