

## Editorial

Welcome to the fourth issue of Volume 33 of the *Science Education International* journal. This issue brings together 12 articles from Turkey, Ethiopia, United States of America, South Africa, Mexico, and Nigeria ranging from primary school to in-service teacher professional development. Mutlu Uygur investigated the effects of a STEM-based course design on Turkish Grade 4 students' attitudes toward STEM and a science course. Hayal Kocabaş compared the analytical thinking skills of eighth grade Turkish students who received emergency distance and face-to-face education in a science course and to get student ideas concerning emergency distance education. Metin Kaya reports on the relationship among socioeconomic status, attitude toward science, school climate, and academic achievement comparatively in terms of Turkish, the United Kingdom, and Singaporean 14-year-old students. Ferhat Karakaya, Selçuk Arık, and Mehmet Yılmaz examined the motivation of Turkish secondary school students toward context-based biology in terms of gender, school type, biology laboratory experience, and grade level. Tadesse Hagos and Dereje Andargie evaluated the impact of technology-integrated formative assessment strategies on Ethiopian students' retention of conceptual and procedural knowledge in chemical equilibrium concepts. Portia York, Shaoan Zhang, Mei Yang, and Venkatesan Muthukumar examined how crochet that was embedded in a STEM summer camp impacted American female high school students' sense of belonging, creativity, well-being, and STEAM learning. Lawrence Mata compared the performance of White and Hispanic students from California, Texas, and Arizona on the Advanced Placement (AP) Biology examination from 2016 through 2019. Anthony Peña looked at how student perceptions from students pushed out of education who are re-engaged through an alternative education impact their STEM aspirations. Adolfo E. Obaya-Valdivia, Carlos Montaña-Osorio, and Yolanda M. Vargas-Rodríguez determined the effectiveness of discussion sessions as a teaching strategy in a case of Basic Physical Chemistry with Mexican university students. Bulent Cavaş and Simge Koç investigated Turkish science lesson teachers' knowledge level regarding laboratory safety and increase science teachers' knowledge level regarding laboratory safety by professional development seminars.

In the first article, Mutlu Uygur investigated the effects of a STEM-based course design on Turkish Grade 4 students' attitudes toward STEM and a science course. Uygur argues how and why teachers are a basic part of the STEM education system but also how and why well-designed STEM experiences can provide learning affordances that enable the engagement of a more diverse range of students. Uygur's study was a quasi-experimental research design with 64 Grade 4 students (aged 11–12 years old) in an area of Turkey with a large Syrian

refugee population. This study in parallel with the conclusions reached in many studies in the literature concluded that the STEM method used in science classes increased these students' attitude levels toward STEM. Uygur's study ends with several recommendations based this study.

Hayal Kocabaş compared the analytical thinking skills of eighth grade Turkish students who received emergency distance and face-to-face education in a science course and to get student ideas concerning emergency distance education in the second article. Kocabaş highlights that emergency distance education is the education process that is carried out separately from the school environment instead of formal education in times of crisis to provide temporary access to learning and learning support. Kocabaş' study used the convergent parallel mixed method design with 39 eighth grade students (aged 13–14). Kocabaş determined that the cognitive achievement of the students who received face-to-face education based on context-based learning approach and analytical thinking in energy transformations and environmental science unit was better than the student group who studied this unit through emergency distance education. The students themselves noted that the teaching process was noisy, more boring, more difficult to understand, and less efficient as well as they could not do the experiments. Kocabaş ends the article with possible solutions that may overcome the students' perceived barriers to learning by distance.

Metin Kaya in the third article reports on the relationship among socioeconomic status (SES), attitude toward science, school climate, and academic achievement comparatively in terms of Turkish, the United Kingdom, and Singaporean 14-year-old students. Kaya's study adopted a correlational survey design using data from TIMSS 2019. This study used three separate data sets. The first data set represented Turkish sample, the second the United Kingdom sample, and the third Singapore. The analyses of the data sets were performed independently. The findings regarding the data sets were then compared. Kaya reported that an auto-correlation problem among the variables in Singapore sample data meant that the variables were inadequate in accounting for the change in academic achievement in science for Singapore. Comparisons between Turkey and the United Kingdom are made. Kaya concludes with recommendations.

The fourth is from Ferhat Karakaya, Selçuk Arık, and Mehmet Yılmaz examined the motivation of Turkish secondary school students toward context-based biology in terms of gender, school type, biology laboratory experience, and grade level. Karakaya *et al.* argue there is a need to examine the affective dimensions of students' interests, motivations, and attitudes toward context-based biology. Their study used a survey model

with 545 students ranging from the 9<sup>th</sup> grade to 12<sup>th</sup> grade across both public and private schools to include both male and female students. According to their results, gender was a factor in the context-based biology motivations of secondary school students. Similarly, Karakaya reports how the participating students from the state schools' motivation scale and the sub-factors were determined to be significantly different in favor of the students studying at the state schools. They go on to comment on how laboratory experience positively affects secondary school students' context-based biology motivations as well as how senior students were more positive in self-reporting. Karakaya *et al.* conclude noting how their study supports the use and inclusion of laboratory learning opportunities for students.

Tadesse Hagos and Dereje Andargie evaluated the impact of technology-integrated formative assessment strategies on Ethiopian students' retention of conceptual and procedural knowledge in chemical equilibrium concepts in the fifth article. Hagos and Andargie highlight not only can technology help teachers gather resources by providing online databases that link curriculum and national standards but also able to address students' misconceptions using technology integrated formative assessment. Hagos and Andargie argue efforts to implement formative assessment in many countries, including Ethiopia, are hindered by several challenges that contribute to ineffective practices. Their study was a quasi-experimental research design which included three groups of year 11 students: Two experimental and one comparison totaling 132 students. One group received technology integrated formative assessment, one formative assessment and one conventional methods of teaching and learning. Hagos and Andargie concluded that a technology-integrated formative assessment strategy was effective in improving secondary school students' conceptual and procedural test scores.

Portia York, Shaoan Zhang, Mei Yang, and Venkatesan Muthukumar in the sixth article examined how crochet that was embedded in a STEM summer camp impacted American female high school students' sense of belonging, creativity, well-being, and STEAM learning. The crochet craft has been around for centuries and boasts many benefits. Of interest to the researchers was the impact that practicing crochet had on secondary school girls' emotional and artistic expression, and creativity; particularly those who were immersed in a STEM camp. The studied program involved a 5-week summer camp for girls in Grades 6–11 to learn Robotics and Arduino programming and integration of these tools to conduct projects in ubiquitous intelligent systems. York *et al.*'s study used a qualitative case study design with 37 participants. York *et al.* highlighted how crochet, together with other learning activities, allowed these students to socialize, learn about STEM and STEAM, and have fun. York *et al.* end with lesson learnt.

The seventh is from Lawrence Mata compared the performance of White and Hispanic students from California, Texas, and Arizona on the Advanced Placement (AP) Biology examination

from 2016 through 2019. Mata highlights how the AP program has grown over the past 60 years into most U.S. public and private high schools to provide educational opportunity and upward mobility for disadvantaged students. Then, it goes on to note student participation in rigorous AP classes in high school is important for increasing college readiness and success for students. However, Mata asks that the questions are there any academic benefits to high school students and if so, what are these specific benefits and how large of an impact do they provide for high school students. This study used archival data from the administration of AP examinations for White and Hispanic students living in California, Texas, and Arizona between 2016 and 2019 were obtained for this investigation. Mata concluded that there was a statistically significant difference between the AP Biology examination performance of White and Hispanic students from these three states. Mata concludes, however, that the cause or causes for this disparity requires additional analysis into how each of the three states in this study developed and implemented their AP Biology programs of study.

Anthony Peña looked at how student perceptions from students pushed out of education who were then re-engaged through an alternative education impacted their STEM aspirations in the eighth article. A young person is understood to have been “pushed out” of a high school when their education was discontinued before completing a high school diploma. For youth who have been “pushed out,” alternative education programs can be essential to their return to education. Peña's study looked at how the student perception of teachers, critical science education, the student sense of agency to create knowledge, the student engagement in science class, and the relevance of science to the student impacted their STEM aspirations. Peña's study was a survey study of 100 alternative education participants over the age of 18. Peña's study found that this alternative education program's science classes supported students' future STEM aspirations. Peña's study concludes with three implications as a result of this study.

Adolfo E. Obaya-Valdivia, Carlos Montaña-Osorio, and Yolanda M. Vargas-Rodríguez in the ninth article determined the effectiveness of discussion sessions as a teaching strategy in a case of Basic Physical Chemistry with Mexican university students. Obaya-Valdivia *et al.* noted that some chemistry students have problems with chemical concepts and misconceptions and some of these are in fundamental areas of chemistry. They sought to investigate these preconceived ideas and explanations of 46 university students. In this study, both groups attended the same theory classes with the difference between the experimental section and the control was the 2 h of additional discussions. Obaya-Valdivia *et al.* reported that the students in the experimental group performed significantly better than the students in the control group. Obaya-Valdivia *et al.* argued that this study supports arguments about the effectiveness of the explanation and integration of ideas which help students to avoid conceptual errors and reduce the failure rate.

Motlhale Judicial Sebatana and Washington Takawira Dudu present a model for designing Blended Problem-Based Learning activities and an evaluation schedule for assessing those activities for self-directedness in educational practices in the 11<sup>th</sup> article. Blended Problem-Based Learning involves a teaching and learning pedagogy that combines blended learning and Problem-Based Learning strategies. Such a blended learning strategy refers to the incorporation of technology to enhance face-to-face teaching and learning in a classroom. Sebatana and Dudu highlight that in South Africa, Physical Sciences as a secondary school subject are generally perceived as difficult by both students and teachers. Sebatana and Dudu's study was an explanatory mixed-methods research design with 40 teachers. They concluded to enhance self-directedness in implementing Blended Problem-Based Learning in a professional development intervention, Physical Sciences teachers must be exposed to the full potential of interactive simulations, generation of Blended Problem-Based Learning activities, and management skills to implement Blended Problem-Based Learning in teaching and learning.

The final article is from Bulent Cavaş and Simge Koç who investigated Turkish science lesson teachers' knowledge

level regarding laboratory safety and increase science teachers' knowledge level regarding laboratory safety by professional development seminars. The Cavaş and Koç argue that the laboratory method is a teaching method that allows permanent learning and students to work individually or in groups as theory is supplemented by a large component of laboratories. The Cavaş and Koç go on to note the need for science teachers to become more knowledgeable and competent about laboratory safety issues and their own responsibilities to plan experimental research and work safely in the laboratory. This study was a single group pre- and post-test design with 33 teachers participating in a professional development course. The Cavaş and Koç reported that the professional development seminars increased the laboratory safety knowledge level of science teachers and improved their laboratory safety knowledge levels. The authors conclude with recommendations based on this study.

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