

Editorial

The second issue of 2022 brings together articles on students' critical thinking, impacts of teaching methods on students, the disadvantages faced by some students, and issues related to chemistry, biology, physics, and digital technology. This issue offers four articles from Turkey, two from Ghana and two from Brazil (one of which was in collaboration with a Columbian colleague), one each from Nigeria in collaboration with South Africa, Sweden, Germany, United States of America, and Ethiopia.

İrfan Topsakal, Sema Altun Yalçın, and Zehra Çakır explored the effect of problem-based STEM activities on Turkish middle school students' perceptions related to problem-solving skills and their critical thinking tendencies in the first article. Topsakal et al. study was a mixed-method research design with 81 students aged 13 years old. Topsakal et al. argued how and why developing the cognitive thinking and skills of the students encountering real-life problems is crucial in problem-based STEM education. Nine different activities were offered over 9 weeks. Before each STEM application, a problem situation was given to the experimental group of students to solve, the students were asked to work in groups and create unique products. In control groups, the normal education was given without grouping. Topsakal et al. reported there was a statistically significant difference between students' perceptions related to their problem-solving skills and their critical thinking tendencies. They concluded that STEM applications have a positive effect on students. They go further to highlight that STEM applications develop cooperation and group work and recommend the integration of problem-based STEM practices into pre-school education.

In the second article, Turkey's Uluhan Kurt sought to determine the relationship between students' metacognitive learning, critical thinking, scientific process skills and academic achievements after the "Cell and Divisions" and "Force and Energy" units have been processed according to different teaching methods. Kurt highlights how a person's thinking skill is the basic skill that enables the individual to take responsibility in the learning process and increases the retention level of the learned information. Kurt goes on to report how Turkish teaching methods have been developed based on the constructivist approach and are now used in educational activities. Kurt's study was a quasi-experimental design with 185 seventh grade students studying in two secondary schools over 10 weeks. Students were grouped into five groups: Multiple intelligence (MIG), peer instruction (PIG), problem-based learning (PBLG), combined methods (CMG), and comparison (CG). Kurt reported a moderately significant relationship was determined between the metacognitions and academic achievements of MIG and CMG students. A highly

significant relationship was found between the scores of only CMG students from different groups in terms of scientific process skill and metacognition. Kurt then explores how there is a relationship between metacognition and scientific process skill.

Nigeria's Oloyede Solomon Oyelekan and South Africa's Johnson Enero Upahi report on how disadvantaged pupils' ability to learn in school is impeded by their family, social, or economic situations in the third article. Oyelekan and Upahi argue that education is the right of every human being and as such society must therefore be structured in a such way that ensures its access. They, unfortunately, note how some have their access to education impeded and this limits their potentials for successful living and having a fulfilled life. Oyelekan and Upahi review the circumstances around Nigeria's nomadic and Almajiri children. After describing the living conditions of both nomadic and Almajiri children, Oyelekan and Upahi conclude their article with ten challenges facing science education of these two groups then offer recommendations, so these groups of disadvantaged children are not further denied basic education.

The next four articles deal with issues related to chemistry. Articles four, five, and six are about high school chemistry and the seventh concerns pre-service teachers. Francis Adjei, Ruby Hanson, Arkoful Sam, and Samuel Sedegah investigated the use of collaborative instructional approaches on Form two Nigerian science students' performance in redox reactions. Adjei et al. highlight that for both students and teachers of chemistry consider the concept or redox reactions difficult. Their study was a quasi-experimental design with 106 high school students. Data were collected from observation, interview, questionnaires, and performance tests. The control group received the conventional teaching instruction which involved lessons using lecture/discussion methods to teach redox reaction. The experimental group was taught using collaborative learning model. Adjei et al. reported that a majority of the students agreed that the conditions in school inhibited the smooth study of chemistry, as 63 students admitted to being discouraged from studying the subject due to the influence from peers. There was a positive significance difference in the performance between students exposed to the collaborative learning approach and those exposed to the traditional learning approach. Adjei et al. concluded in a collaborative classroom, there is healthy competition which brings about higher academic achievements.

The fifth article from Lawrence Edward Mata determined if and to what extent there were differences in chemistry end-of-course (EOC) exam scores between high school chemistry students taught using Process Oriented Guided

Inquiry (POGIL) pedagogy and non-POGIL pedagogy in the state of Utah. Mata argues that the United States has fallen behind European and Asian countries in terms of science and mathematics. Therefore, his causal-comparative study investigated The performance of 11th grade high school students (aged 16–18) taught using student-centered POGIL instructional strategies ($n = 158$) and students taught using teacher-centered traditional instructional strategies ($n = 158$). Mata's study employed the Student Assessment of Growth and Excellence (SAGE) chemistry test administered at the end of the school year to all high school chemistry students, to measure student academic achievement and concept mastery. Mata reported that the POGIL students' mean value was 23.66 points higher than the non-POGIL group suggesting POGIL students developed higher cognitive development and a more complex understanding. Mata concluded that further research in needed in this area.

The sixth article concerns high school chemistry but has a focus on second language learners. Sweden's Lizette Widing, Pernilla Nilsson, and Pernilla Granklint Enochson investigated how chemistry discussions mediated by representations, contribute to second language students' development in the language of chemistry. Widing et al. highlight how if students do not have the necessary skills in the language of teaching, they often have problems understanding the science content, showing lower success in learning than students taught in their first language. Widing et al. note modeling-based teaching (MBT) aims to contribute to students' active involvement in their learning process and enable students to discuss chemistry in the process of creating, questioning, and evaluating representations. Participants were aged between 17 and 20 of which 16 were second language learners and 14 first language learners. Widing et al. reported that their results demonstrate that created representations were used as tools for both thinking with a concept or phenomena but also to express experience. They concluded there is a need to conduct more studies on other types of student active approaches, besides modeling-based ones, in the multilingual context.

The seventh article from Turkey's Bahar Candaş, Zeynep Kiryak and Haluk Özmen investigate the effect of the analytical chemistry laboratory course, designed, and conducted according to the flipped learning approach (FL) on prospective science teachers' meaningful understanding and interpretation of knowledge in the context of the environment. Candas et al.'s study was action research with 73 prospective science teachers (PST) in their second year of study. These participants were divided into four groups, attended two hours per week of laboratory classes for 13 weeks. They then worked in groups of 3–4 people during the teaching process which included discussion, problem solving, and conducting experiments. Before implementation, there were deficiencies in these PSTs' conceptual understanding of environment and environmental problems and in relating them to chemical knowledge. Candas et al. reported these PSTs replaced their superficial information on environment, soil, and water pollution in their pre-test

with the ideas requiring higher-level and deeper information after implementation. Candas et al. concluded despite minor increase in these PSTs' conceptual understanding it did result in them developing more positive thoughts about the laboratory course and contributed to their learning.

Articles eight and nine concern issues in Biology. The eight articles are from Brazil and Columbia's Angélica Lúcia Figueiredo Rodrigues, Gabriel Melo-Santos, Geilsa Costa Santos Baptista, Jairo Robles-Piñeros, and Maria Luisa da Silva. Rodrigues et al. to identify the knowledge, feelings, and life experiences that students of public schools in the Amazon have toward aquatic mammals. Their study is an ethnozoological research as it seeks to explore the interactions established between human beings, their cultures, and those animals that are endemic to the country. Their study was a qualitative-quantitative study with 241 students from rural to urban areas. Students were asked about specimens belonging to the orders Cetartiodactyla (Cetacea) and Sirenia with appearance records in Amazonian rivers and estuaries. Rodrigues et al. report on students' responses in terms of biological, morphological, behavioral, ecological, threats, and taxonomical aspects. Rodrigues et al. conclude that to demonstrate that in order to raise students' ethnozoological knowledge about a species or group of animals it is essential to identify which intervention strategies can be adopted in the promotion of scientific education aiming at the conservation of endangered species.

The ninth article from Malte Michelsen, Jorge Groß, Jürgen Paul, and Denis Messig reports on German high school and university students' conceptions. Their article, part of a larger study, focuses on working with students' conceptions, specifically the diagnosis of conceptions cultivated by learners. All of their participants had been exposed to the topic of plant nutrition on several occasions during their studies; however, to identify conceptions on an individual level, the assignments should offer a variety of possibilities for editing. Michelsen et al.'s study assignments required the participants to explain plant nutrition by complementing a corresponding graphic with suitable drawings, arrows, and keywords. Michlesen et al.'s study shows several aspects of how assignments can be constructed and improved to diagnose students' conceptions about plant nutrition.

The tenth and eleventh article use physics as they explore issues with high school students in Brazil and Ethiopia. In the tenth article, Brazil's Guilherme Paulino do Santos-Silva and Neilo Marcos Trindade present a review of how radiation and radioactivity themes have been discussed at the high school level in several locations around the world. Silva and Trindade highlight how both radiation and radioactivity are controversial topics and that they both carry with them an emotional burden that must be taken into account in the teaching of physics. One issue was how European newspapers presented the radiological risk after the Fukushima accident; similarly, another issue was the nuclear incident occurred in Goiania where a sample of

Cesium-137 chloride was found by scavengers in the rubble. Silva and Trindade report on how radiation and radioactivity are addressed in various locations around the world. One conclusion drawn from their review is how radiation is seen by society, especially by those who do not belong to the scientific community, noting the main source of information ends up being the media. Silva and Trindade finish their review highlighting how their literature review can be used not only to present the current scenario of discussion about radiation and radioactivity in the classroom but can also be used by educators in their own plans of action as a teacher, giving direction to their research to promote the discussion on these topics.

Ewonetu Bantie Belay, Mekbib Alemu, and Mesfin Tadesse from Ethiopia investigated the effect of dialogic practical work on 91–11th grade students' attitudes towards physics in the eleventh article. Belay et al. highlight that the Ethiopian government has an ambition to spur economic structural transformation and sustain accelerated growth and sees science education as a means to achieve this. Unfortunately, Ethiopia like many countries notes it has a lack of quality science education. As a result, Belay et al.'s study examined how implementing dialogic practical work in secondary school physics laboratories affected grade 11 students' attitudes towards physics. Belay et al.'s study specifies that students' attitudes toward physics are theoretically conceptualized as the feelings and values held by students toward physics in terms of four dimensions: enthusiasm toward physics, physics learning, practical work, physics teacher, and future vocation. Their study used the dialogic practical work (DPW) framework. Their study reported that students who conducted dialogic practical work showed more positive improvements in attitudes toward physics as compared to the traditional practical work. Belay et al. conclude that while this was a small study, it should be the basis of further work in this area, especially in Ethiopia.

The final two articles concern issues with pre-service teachers. Ghana's Isaac Asare and Joseph Parker examined the perception of 120 students in six Ghanaian Southern Colleges of Education in Ghana on the use of web-based technology software for teaching and learning of biology. Asare and

Parker note that Ghana like many other countries has joined the race for technology advancement in order not to be left out of globalization and development. Specifically for this study, Asare and Parker report that despite biology tutors' acceptance and usage of technology in their instructions, trainee students' interest and performance in biology lessons in Southern Colleges of Education in Ghana has not improved. Their study was quantitative action research. Asare and Parker reported on what students felt their instructors did in class as well as that the use of web-based instruction; improved students understanding in biology concepts, stimulates students' interest and thinking, and did not waste instructional time. As result of this study Asare and Parker make recommendations.

The final article from Turkey's Derya Orhan Göksün and Gülden Gürsoy evaluated the digital stories prepared by preservice teachers in the frame of their planning, content, mechanics, story structure, and use of technology dimensions. Göksün and Gürsoy argue how storytelling has been accepted as a universal teaching method. Göksün and Gürsoy note that the processes involved in creating a digital story helps to improve students' skills in research, writing, organization, technology use, presentation, interviewing, communication and cooperation, problem solving, and also evaluation. Göksün and Gürsoy's study aimed to determine the stages of digital storytelling where problems were experienced and the measures necessary to help eliminate such issues. Their study was a survey research design with 50 preservice teachers tasked with preparing a digital story within the framework of the environmental pollution unit of their science course. Göksün and Gürsoy's finding suggests that these preservice teachers had sufficient content knowledge; they needed additional support in Planning, Mechanics, Story Structure, and Use of Technology. Göksün and Gürsoy end their article with suggestions based on their study.

Steven S. Sexton*

College of Education, University of Otago, Dunedin, New Zealand

*Corresponding Author:
steven.sexton@otago.ac.nz