

## Editorial

In this fourth issue of 2018, 10 articles have been brought together. The first five focus on Chemistry. Mexico's Irma Rojas-Oviedo, Arcelia Meléndez-Ocampo, and Nancy Herrera-García address the question "Is Chemistry as hard for women as for men?" Then, both Trinidad's Nicole Sookoo-Singh and Laila N. Boisselle and the Philippines' Joje Mar P. Sanchez investigated Year 10 students'. Sookoo-Singh and Boisselle sought to improve students' motivation and possible subsequent academic achievement in chemistry while Joje Mar P. Sanchez reports on students' translational skills between the macroscopic, submicroscopic, and symbolic levels of the chemistry triangle. The fourth chemistry related article is from Nigeria's David Agwu Udu who assessed the efficacies of Cooperative Learning Instructional Approach (CLIA), Learning Activity Package (LAP), and Lecture Method (LM) on enhancing senior secondary students' academic retention in chemistry. The fifth and final chemistry article is from Pakistan's Saadia Yousouf Qureshi who collected the perceptions of 32 students studying Chemistry in a Master of Science Education on two different assessments formats: Multiple Choice Questions and Constructed Response Tests.

Articles six and seven concern Turkish middle school students. Özge Ceylan and Elif Atabek Yiğit analyzed the effect of concept cartoon usage on year 7 students' cognitive structure developments and science achievements. Ayhan Aksakalli used the qualitative method of case study with the purpose of investigating the effects of science teaching based on critical pedagogy principles on year 8 classroom climates. Article eight from the United States of America's Sara Hagenah, Carolyn Colley, and Jessica Thompson investigated how talk, tasks, and tools work to funnel or focus year 9 students in science. The ninth article from Turkey's Elvan Sahin and Murat Berat Ucar reports on preservice teachers' beliefs regarding science and pseudoscience. The final article has Serhat Irez, Cigdem Han-Tosunoglu, Nihal Dogan, Gultekin Cakmakci, Yalcin Yalaki, and Eda Erdas-Kartal's assessing a group of 15 Turkish science teachers' competencies in identifying aspects of the nature of science (NOS) in various educational critical scenarios (ECS) featuring different socioscientific issues (SSI).

First, Mexico's Irma Rojas-Oviedo, Arcelia Meléndez-Ocampo, and Nancy Herrera-García address the question "Is Chemistry as hard for women as for men?" To do this, they present a case study of the Bachelor of Biological Pharmaceutical Chemistry at the Autonomous Metropolitan University, Xochimilco Campus in Mexico City. They sought to investigate if university level organic chemistry and physical chemistry are actually harder for one gender over the other. To address this question, they collected the final scores of two modules of study over a 15-year period between 1995 and 2010. This analysis was undertaken to identify whether teaching with a

gender perspective, an emphasis on reasoning and construction of knowledge, using molecular models in taught sessions, and applying open-book exams had an effect on the scores of students. Particularly, on whether there exists an interaction effect between students' scores and gender. They found that the content of the module was not the variable which determined a student's passing score. Their results suggest that the gender equity participation in the sessions, the use of molecular models to promote spatial skills, and open-book exams could help female students to learn chemistry and physical chemistry with better or similar outcomes to their male counterparts.

Second, Nicole Sookoo-Singh and Laila N. Boisselle sought to improve year 10 Trinidad students' motivation and possible subsequent academic achievement in chemistry. Specifically, they investigated a move from a teacher-centered, lecture-based model to an active, student-centered model of instruction known as a "flipped" classroom. Sookoo-Singh and Boisselle argue that students are motivated to learn when they find pedagogical activities purposeful, rewarding, useful, and significant enough to be encouraged to work for the benefits that may be derived from the educational objectives of these activities. The flipped classroom uses educational technology tools and active learning within a student-centered environment to positively influence the learning environment by moving instruction out of the classroom, thus allowing for the independent creation of work as opposed to traditional models of the lecture classroom. Sookoo-Singh and Boisselle administered a questionnaire before and after the intervention of a flipped classroom was used to teach a unit of work on chemical reactions. This study's flipped classroom model depended on students using the intervention at home. The ability to deliver classes asynchronously is very valuable as time constraints are a common issue among many teachers due to the sheer volume of the curriculum and the many cocurricular school activities carded during the academic year of the school in which the study was located. The flipped classroom model was found to impact positively and significantly on student motivation while having no significant effect on academic achievement. Students' perception of the flipped classroom was generally positive. Sookoo-Singh and Boisselle highlighted how the flipped classroom increased student motivation by focusing less on content allowing more time in the classroom for students to carry out activities and apply concepts, engaged students in active learning with material rather than passively listening to a lecture, and met students on their own technological level. Sookoo-Singh and Boisselle noted that while the flipped classroom model should be promoted in schools in Trinidad and Tobago; however, it should not be the only method of teaching utilized.

Third, Joje Mar P. Sanchez investigated the extent of the translational skills of students exposed to conventional lecture method (CLM) and the Integrated Macro-Micro-Symbolic Approach (IMMSA). Chemical understanding is often expressed and taught in three modes of representation, which are collectively included in a framework called Johnstone's Chemistry Triangle. Students often find the interplay of the levels both difficult to understand and use. Some of the problems arising from such interplay include the lack of macroscopic experience, misconceptions of the sub-microscopic nature of matter, and the inability to move in between levels. The ability to move from one level of the triangle to another is called the translational skill, an important skill in chemistry wherein one can fully grasp the true meaning of the concepts taught and learned. Sanchez's study utilized a qualitative research approach to determine the extent, ways, and patterns of the translational skills of 10<sup>th</sup>-grade students. These students were studying the concepts on Kinetic Molecular Theory of gases. Sanchez reported students from the CLM group only had one-way translations and no two-way ones, which indicated that pedagogy used did not take into account other modes of representation. Moreover, Sanchez noted that most of the students in IMMSA group had two-way translations which showed the advantageous use of the approach in chemistry.

Fourth, Nigeria's David Agwu Udu assessed the efficacies of CLIA, LAP, and LM on enhancing senior secondary students' academic retention in chemistry. Learning is the acquisition of new behaviors or the strengthening or weakening of old behaviors as a result of experience. Science teaching, specifically chemistry teaching in Nigeria, over the years has been approached mainly through traditional methods of delivery which do not allow the students the opportunity of experiencing other approaches to learning. CLIA is a student-centered, instructor-facilitated instructional approach in which small groups of students are responsible for their own learning and the learning of all group members. LAP is student-centered but unlike CLIA is an activity-based teaching strategy where the teacher acts as a facilitator of learning, guiding the students through series of activities and problems that may help them to achieve high academic retention. While empirical studies on CLIA and LAP have shown that both have been effective in enhancing students' academic retention in the science subjects better than the LM, these findings need to be further substantiated among Nigerian students. Udu's study employed a pre-test, post-test, non-equivalent, control group, and quasi-experimental design. His results identified that CLIA and LAP were significantly more effective than the LM and that the efficacies of the teaching methods were not influenced by the students' gender. His study lends empirical support to the fact that students' academic retention in chemistry could be greatly improved if they are exposed to innovative, student-centered, and activity-based instructional strategies.

Fifth, Saadia Y. Qureshi from Pakistan investigated how the washback of two different formats of assessment is perceived by 32 postgraduate students studying chemistry. Washback of

assessment is when the teaching and learning in the classroom are effected and driven by the assessment held at the end of term. Washback is a complex phenomenon that is an outcome of the interaction of a variety of intervening variables such as tests, test-related teaching, learning, and the perspectives of stakeholders. As such, Qureshi collected the perceptions of students in a Master of Science Education. Her study investigated the assessment formats of multiple choice questions (MCQs) and constructed response tests (CRTs). As much as possible, other factors such as teaching methodologies, environment of classroom, and context were kept as constant as possible during the semester. Student responses were collected qualitatively before the midterm assessment and again at the end of the semester. The majority of these participating students preferred MCQs format due to its objectivity in scoring, increased chances of securing higher scores, and a quicker response to answering the questions. Students performed well at the comprehension level for CRTs but low for MCQs. Qureshi concluded that the MCQs format is becoming the preferred choice of students as it avoids deep learning and organization of ideas and is perceived as an easier pathway to better marks. Qureshi highlighted that while the MCQ assessment produced effective comprehension of concepts at the same time, MCQs allowed the majority of students to avoid the mathematical aspects of the course content.

The sixth article from Turkey's Özge Ceylan and Elif Atabek Yiğit analyzed the effect of concept cartoon usage on year 7 students' cognitive structure development and science achievement in a Particle Structure of Matter Unit. Ceylan and Yiğit noted that students encounter many science-related concepts both in school and out-of-school settings, and sometimes they connect their misconceptions to the learning process. Concept cartoons are one technique that helps students to address wrong concepts. Ceylan and Yiğit's study used pre-tests for both the experimental and control groups before both groups were taught the science unit by the same teacher. For both groups, content was prepared according to the 5E model: Engage, explore, explain, elaborate, and evaluate. In the experimental group, concept cartoons were included as an addition to this content. After the 8-week course, an achievement test was administered. Each student was recorded and analyzed one-by-one for both the pre-test and post-test. The flow map technique was used to analyze each sound recording. Ceylan and Yiğit's finding indicates that the teaching with concept cartoons was effective in enhancing the success of teaching. According to their results, the level of knowledge belonging to the particulate nature of the matter unit was increased in the cognitive structures of the students in both groups. However, the number of sentences expressed in the experimental group was higher and more meaningful. Significantly, Ceylan and Yiğit's study reported how misconceptions of the experimental group were addressed while those of the control group were not.

Seventh, Turkey's Ayhan Aksakalli study used the qualitative method of case study with the purpose of investigating the effects of science teaching based on critical pedagogy principles

on a year 8 classroom climate. Aksakalli argues education is expected to provide the knowledge and skills that will allow individuals to adapt to the information society, the learning society, and changes, and transformations in economics and technology. In the process where education turns into a market, this marketization of education leaves schools in the hands of the markets and the resulting transformation of schools into businesses. Critical pedagogy aims to create a new interpretation of education by re-evaluating the existing definitions of education. Critical pedagogy problematizes education, politics, and educational practices; and the relationship between reproductions of power relations in daily life and in classrooms. The classroom climate may help students learn at a higher level; it may also act as a barrier that obstructs their learning process. The 20 8<sup>th</sup>-grade students were observed to observe the effects of science teaching based on critical pedagogy on the classroom climate. It was seen that over the 32 weeks of study, generally positive changes were made in the classroom climate. To make critical pedagogy applicable for classrooms, teachers need to adopt its language. Not only in-service teachers but also prospective teachers should look at education with a revolutionary approach that is seeing schools as freer public spaces and consider teachers as transformative intellectuals. A sharp turn of direction may be achieved in terms of the history of education with the help of critical pedagogy.

Eighth, Sara Hagenah, Carolyn Colley, and Jessica Thompson from The United States of America report on a study that highlight how talk, tasks, and tools within classroom activity work together to either funnel 9<sup>th</sup>-grade students toward reproducing normative scientific answers or focus students on deepening their understanding about unobservable causal mechanisms of phenomena, such as astronomy. Funneling privileges science knowledge over students' ideas. Talk, tasks, and tools are designed to reinforce reproducing facts and explanations by treating science as a static, final-form body of knowledge. Focusing patterns emphasize working on students' ideas as the goal. Student ideas are resources for collective reasoning and inquiry. Hagenah, Colley, and Thompson observed that when funneling occurred, it limited what students did, missing out on opportunities for potentially rigorous interactions, and resulting in low rigor, low responsiveness, and fact-driven classroom episodes. Hagenah, Colley, and Thompson report that focusing was associated with students' engagement in more rigorous interactions that were responsive to and explicitly worked with and on students' understanding. Students demonstrated active listening, adding onto and challenging one another's ideas, and pressing for how and why levels of explanations for real-world scientific phenomena. Hagenah, Colley, and Thompson concluded students should experience less memorization and learning about concepts disconnected from a phenomenon. To move away from these traditions, teachers can assess and reflect on how ideas are treated in their classrooms by looking at the patterns of talk, task, and tools. Consider focusing students on building and

revising their ideas in classroom activity instead of funneling them toward reproducing authoritative explanations.

Ninth, Elvan Sahin and Murat Berat Ucar researched Turkish pre-service science teachers' (PST) beliefs regarding science and pseudoscience. The demarcation between science and pseudoscience has become a significant issue as people now have easier access to information as compared to past decades. Moreover, it has been widely observed that individuals have the tendency to accept something declared as scientific or labeled as scientifically proven. Sahin and Ucar investigated ways to prepare scientifically literate teachers in having the required competencies to educate their pupils by addressing their beliefs in pseudoscience, science as a process of inquiry, and demarcating between science and pseudoscience. Unlike the science or erroneous science, non-science covers beliefs, ideology, philosophy, or the point of view of people. The most popular term for this is "pseudoscience." A 5-point Likert-type instrument, called the Science-Pseudoscience Distinction Scale, was used to determine PST beliefs regarding the demarcation between science and pseudoscience. Sahin and Ucar's participating PSTs were found not to be good at differentiating real science from pseudoscience. Sahin and Ucar reported gender was not a variable in PSTs beliefs related to the science, pseudoscience, and the demarcation between them. They concluded PSTs should be taught scientific processes besides subject matter knowledge and the NOS.

Finally, Turkey's Serhat Irez, Cigdem Han-Tosunoglu, Nihal Dogan, Gultekin Cakmakci, Yalcin Yalaki, and Eda Erdas-Kartal's study aimed to assess a group of 15 science teachers' competencies in identifying aspects of the NOS in various ECS featuring different SSI. SSI refers to social science-based problems that are both open-ended and ill-structured. These issues are controversial in nature and do not have the discrete right or wrong answers. As such, SSIs deal with content that is uncertain, evolving, and socially relevant. Specifically, in Turkey, the Turkish revised elementary science curriculum was introduced in 2018 and has emphasized the importance of utilizing SSI in science classrooms. Therefore, Irez, Han-Tosunoglu, Dogan, Cakmakci, Yalaki, and Erdas-Kartal investigated teachers' competence in identifying relevant NOS aspects in various SSI and their views about how to utilize these for NOS instruction. Three universities in Turkey and the Turkish Ministry of National Education collaborated in this project. The intervention process with the science teachers consisted of 10-month meetings with teachers, each lasting about 8 h, over two semesters. Data were collected through interviews and an open-ended questionnaire at the end of the professional development project. This study reported the participating science teachers who attended the professional development program on the teaching and learning NOS presented generally informed views about the NOS. They reported their participants were successful in identifying some of the embedded aspects of science in scenarios (namely, the tentative NOS, the empirical NOS, and

subjectivity in science); however, these participants did not present the same success on locating embedded discussions about the science-society relationship, and creativity and imagination in science. Irez, Han-Tosunoglu, Dogan, Cakmakci, Yalaki, and Erdas-Kartal's study indicates that in promoting learning about the NOS in school science, teachers do need effective contexts such as SSI and clear guidance and

support with regard to the ways in which these contexts could be utilized in an effective manner.

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