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EDITORIAL

Editorial

The second issue of volume 34 this year brings together ten articles. The first article is from Turkey's Ufuk Uluçınar who scrutinized the effect of the problem-based learning approach on students' academic achievement in science lessons compared to the traditional instructional approach. Pongprapan Pongsophon from Thailand examined the factors that determined the science achievement of fourth-grade students on the Trends in International Mathematics and Science Study (TIMSS) 2019 in the USA in the second article. The third article from Ethopia's Kassahun Dejene Belayneh and Woldie Belachew assessed Grade 11 students' conceptual understanding of chemical kinetics and equilibrium using topic-specific pedagogical content knowledge (TSPCK)-based instruction in chemistry. Ryan Gallagher in the fourth article discusses several issues that arose from data collected from research on how the flipped classroom could benefit adolescents preparing for the Irish leaving certificate chemistry summative examination. Ghana's Joshua Kwabena Owiredu, Evans Asamoah, Richard Ankomah, and Diana Amoabea Aduamah conducted action research using a case-study paradigm which included that the simulation-role-play teaching strategy was used to teach pre-service teacher, the concept of "doping of pure semiconductors" into p-type and n-type semiconductors in the fifth article. The sixth article from Greece's Konstantinos G. Tsoumanis, Georgios Stylos, and Konstantinos T. Kotsis investigated and compared the scientific literacy level of Greek pre-service teachers and primary school students. The seventh article by Turkey's Kamil Arif Kırkıç and Elif Esra Arıkan determined the attitude of primary school teachers toward the STEM approach and to find their views on the STEM approach in the primary school curriculum. Lloyd M. Mataka, Jon C. Saderholm, and Tracy Hodge described the influence of a science education seminar (SES) on the learning assistants' (LAs) perceptions of their roles in the classroom in the eighth article. The ninth article from Nigeria's Ridwan E. Mohammed, Oluwasegun O. Odeniyi, Khadijat S. Ameen, and Aishat A. Yusuf assessed science teachers' use of analogies by identifying their common practices in secondary school classrooms in Ilorin, Nigeria. The final article by Collins Owusu-Fordjour, Charles Kwesi Koomson, Stephen Twumasi Annan, and Ruth Otison Asante determined how peer tutoring affected the anxiety of undergraduate students studying Integrated Science at the University of Education, Winneba (UEW) in Ghana's Central Region.

The first article is from Turkey's Ufuk Uluçınar who scrutinized the effect of the problem-based learning approach on students' academic achievement in science lessons compared to the traditional instructional approach. Unlike traditional instructional methods (i.e., chalk and talk, rote memorization), PBL uses problem-based instruction, self-regulated learning, and small-group learning to help students construct their topics. PBL transforms learning from memorizing abstract factual knowledge to developing knowledge that can be transferred to real-life situations, from passively acquiring knowledge to actively seeking knowledge, from a mere individual understanding of learning to building-shared knowledge in collaboration with others. This research has employed the meta-analysis method to reveal the effects of the problem-based learning approach on science academic achievement compared to the traditional instructional approach. The research results showed that the PBL method in science education had a high effect on academic achievement. Uluçınar's article ends with suggestions based on the results of this study.

Pongprapan Pongsophon from Thailand examined the factors that determined the science achievement of fourth-grade students on the TIMSS 2019 in the USA in the second article. Pongsophon notes that research studies indicated that student characteristics such as gender, age, motivation, attitudes toward courses, self-efficacy, students' efforts, being bullied at school have significant impacts on academic achievement. As such, there is a need to explore whether the impact of the student and school-related factors on student achievement. The implications of the findings are essential for educational policymakers to monitor the school activities and students' learning. Pongsophon reported that fourth-grade American students had a high sense of school belonging and never or almost never experienced bullying in school; perceived that their teachers delivered high instructional clarity in science lessons; and they liked learning science very much. Pongsophon ends with implications derived from this study.

The third article from Ethopia's Kassahun Dejene Belayneh and Woldie Belachew assessed Grade 11 students' conceptual understanding of chemical kinetics and equilibrium using TSPCK-based instruction in chemistry. Ethiopia has implemented the constructivism learning paradigm in education, teacher development, and policy formulation since 2003, however, teachers seem to still heavily depend on traditional pedagogies at all levels. TSPCK is the competence to transform knowledge of a topic for the purpose of teaching. TSPCK is the knowledge necessary for transforming content knowledge on a specific topic into teachable form using pedagogical reasoning. Belayneh and Belachew's study used mixed methods as the research method with 159 Grade 11 students. Belayneh and Belachew's concluded that TSPCK-based instruction such as curricular saliency; representation and conceptual teaching strategy were associated to the conceptual understanding of Grade 11 students. The study concludes with recommendations based on this study.

Ryan Gallagher in the fourth article discusses a number of issues that arose from data collected from research on how the flipped

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classroom could benefit adolescents preparing for the Irish leaving certificate chemistry summative examination. Due to the COVID-19 pandemic, one model of blended learning - the flipped classroom - has become considerably more popular in the Irish educational system. In the flipped classroom, the student studies new material outside the classroom not previously taught by the teacher. Gallagher reports on his Ph.D. study which found that, if certain guidelines were followed, the flipped classroom could lead to greater self-efficacy and self-confidence among students. The study involved converting the entire Leaving Certificate Chemistry syllabus into a series of approximately 60 video lessons and accompanying resources (assessment tasks, quizzes, model solutions, and revision notes), which were then uploaded onto a website. Gallagher concluded that the use of video lessons by themselves was ineffective for those students concerned about achieving high results in chemistry. A suite of comprehensive resources was required that catered for multimodal learning as well as all aspects of the Leaving Certificate Chemistry course. The article ends with recommendations.

Ghana's Joshua Kwabena Owiredu, Evans Asamoah, Richard Ankomah, and Diana Amoabea Aduamah conducted action research using a case-study paradigm which included that the simulation-role-play teaching strategy was used to teach pre-service teacher the concept of "doping of pure semiconductors" into p-type and n-type semiconductors in the fifth article. Owiredu et al. argue how challenges necessitate a teaching and learning approach in science that will facilitate the understanding of science concepts of prospective generalist student teachers and arouse interest in science concepts. Specifically, to this article, they note in Ghana, pre-service generalist teachers generally show a weakness in learning science concepts particularly basic electronics. Their study engaged 56 prospective generalists in active learning of doping of pure semiconductors through the simulation-role-play teaching approach of drama which makes teaching effective as well as promoting conceptual understanding was used. Owiredu et al. concluded that the introduction of simulation-role-play approach revealed a statistically significant increase in student teachers' performance in a basic electronics test. The article ends with noting areas of potential further research needed to build upon this study.

The sixth article from Greece's Konstantinos G. Tsoumanis, Georgios Stylos, and Konstantinos T. Kotsis investigated and compared the scientific literacy level of Greek pre-service teachers and primary school students. In Tsoumanis et al.'s study, a convenience sample was made and consisted of 787 people who were divided into two groups of interest: 465 students and 362 pre-service teachers. The study used the instrument SLA-D. The results of this study showed that the average student's score was very poor and the pre-service teachers' average score was also low. Tsoumanis et al. concluded that the participants need help to apply scientific decisions to everyday issues as both teachers and students may be more adept at memorizing scientific concepts than applying them. The article ends with recommendations based on this study.

The seventh article by Turkey's Kamil Arif Kırkıç and Elif Esra Arıkan determined the attitude of primary school teachers toward the STEM approach and to find their views on the STEM approach in the primary school curriculum. Kırkıç and Arıkan highlight how STEM is a teaching approach that not only shapes these processes and integrates them into education but also examines them separately. Kırkıç and Arıkan note that determining the attitudes of primary teachers toward the STEM approach and views on the STEM approach and primary school curriculum may contribute to the literature that associates STEM applications with primary school mathematics and science lessons. Their research was carried out using a mixed-method approach carried out with a concurrent design with ten teachers. Kırkıç and Arıkan results indicated three themes: The STEM approach should be used to equip students with skills, and for students' career planning, there should be STEM-integrated courses and the infrastructure of STEM education should be prepared in schools to apply for STEM-integrated courses, and the STEM approach needed in teacher education. Kırkıç and Arıkan conclude highlighting areas of needed research to build on this study.

Lloyd M. Mataka, Jon C. Saderholm, and Tracy Hodge described the influence of a SES on the LAs perceptions of their roles in the classroom in the eighth article. Mataka et al. argue active learning techniques that require students to engage with the material for effective learning. They then note that teaching students actively have its challenges, especially when different groups are created during class discussions. Mataka et al.'s study highlights how one proposed teaching technique for active learning is the use of undergraduate peer mentors called LAs. In their study, they created a STEM education seminar (SES) to train LAs. The SES aimed at acquainting eleven LAs with effective methods of teaching for conceptual understanding and familiarizing them with effective assessment methods, which include self-assessment, instructor evaluation of student progress and learning, and assessment of course efficacy. Results from this study showed that attending the SES improved the LAs' sophistication in using active approaches to guide students. Mataka et al. concluded that a well-designed STEM education seminar can improve LAs' perceptions about helping students.

The ninth article from Nigeria's Ridwan E. Mohammed, Oluwasegun O. Odeniyi, Khadijat S. Ameen, and Aishat A. Yusuf assessed science teachers' use of analogies by identifying their common practices in secondary school classrooms in Ilorin, Nigeria. Mohammed et al. highlight how science concepts are generally abstract requiring teachers to constantly seek more effective and efficient ways of teaching them. They go on to argue for teachers and educators, teaching activities must result in a relatively permanent change in learners' behavior, i.e., learning. Then note how analogy is one of the most important instructional tools that

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can be used to address students' misconceptions. Mohammed et al.'s study used a quantitative descriptive research design that obtains a sample of 80 science teachers from 34 senior secondary schools across the three sub-regions in Ilorin. They reported that even though more than 80% of these science teachers used analogies to teach difficult science concepts, just under 50% encouraged their students to use analogies. Mohammed et al. conclude with recommendations based on this study.

The final article by Collins Owusu-Fordjour, Charles Kwesi Koomson, Stephen Twumasi Annan, and Ruth Otison Asante determined how peer tutoring affected the anxiety of undergraduate students studying Integrated Science at the University of Education, Winneba (UEW) in Ghana's Central Region. Owusu-Fordjour et al. highlight that there is research on the connection between stress and academic performance has attracted a lot of interest, but it is crucial to focus on how stress affects anxiety, depression, and panic attacks as well as how these elements relate to academic performance. Owusu-Fordjour et al. argue that chatting to peers helps students organize their thoughts and recalls ideas they might have forgotten on their own. Their study used a mixed-method approach. They concluded that peer tutoring significantly reduced the students' anxiety and recommended that peer tutoring should be employed as an efficient strategy in conjunction with microteaching to help students.

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