International Council of Association for Science Education

EDITORIAL

Editorial

This first issue of 2019 brings together authors from Argentina, Germany, Hungry, India, Namibia, Oman, and Turkey as they address issues concerning science education. This issue's nine papers explore a range of areas: Astronomy, Environmental Science and Literacy, Gamification, Gardening, Physics and Misconceptions, Science Laboratory adequacy, and Instructional Design to support visual impairment. The first two articles one by Esra Kızılay, Havva Yamak, and Nusret Kavak and the other by Volkan Hasan Kaya and Doris Elster were presented at the 2018 World STEM Education Conference held in Istanbul Aydin University Florya Campus, Istanbul, Turkey. The third article is by Hasan Özcan and Hakkı İlker Koştur investigating Turkish preservice teachers' misconceptions about Physics. The fourth article from Argentina's Diego Galperin and Andrés Raviolo presented the implementation process of a didactic proposal for the teaching of the lunar phases at the primary school level. Simson N. Shaakumeni and Benő Csapó in the fifth article validated a new questionnaire for assessing Namibian students' beliefs about the nature of science (BANOS). The sixth article from Oman investigated gardening in early childhood settings. Abdulla Ambusaidi, Rashid Al-Yahyai, Subhashni Taylor, and Neil Taylor highlighted how research projects have demonstrated significant benefits from incorporating teacher-student care of school gardens into school curricula. The seventh article is a study examining the effectiveness of instructional design to teach science concepts to visually impaired students, Turkey's Aydin Kızılaslan reports on seven students with various levels of visual impairment. The eight article is from Turkey's Murat Pektaş and İbrahim Kepceoğlu who investigated what prospective science education teachers think about the use of Gamification in education. The final article from India's Ram Babu Pareek explored the availability and adequacy of high school science laboratory facilities.

In the first article by Esra Kızılay, Havva Yamak, and Nusret Kavak investigated STEM fields that 2129 Turkish high school students from the three institutional types considered choosing for their university education. In Turkey, the employment in STEM fields and the number of students who prefer these fields are quite low. These results are similar for the students who are enrolled in the university as an analysis of new students to higher education shows that the number of students who are registered in the science, mathematics, statistics, information and communication technologies, and engineering departments is quite low. This study reported on the university departments that high school students considered choosing for their university education, identifying whether they belong to a STEM field, and revealing the relationships between students' preferences and gender, grade, and type of institution. Kızılay, Yamak, and Kavak reported that a significant relationship was found between grade, gender, type of institution, and considering STEM-related department for university among the students of high school.

The second article by Germany's Volkan Hasan Kaya and Doris Elster is based on a Delphi study on environmental literacy related to both teachers' professional development and environmental STEM literacy. Kaya and Elster argued that many countries continue to make reforms both in industry and education to address the needs of the world. In the area of science education, one of the reforms is to STEM education. Policymakers believe that STEM education is one of the concepts that are important for the industrial sector to improve the quality of the workforce. Teachers' professional experience, teaching skills, and disposition influence the training of qualified environmentally literate individuals. Educators should focus on teacher training and professional development so that teachers can comfortably teach and integrate environmental subjects in their classes. Institutions with responsibilities for teacher training and professional development should support the development of teachers' environmental content knowledge, pedagogical skills, interdisciplinary work, teaching approaches, effective assessment practices, and ability to use innovative technology. In this study, the Delphi study was carried out in three steps. First, the qualitative data were collected. After the analyses of the data, the quantitative form was developed for the second step of the Delphi study. After the analyses of the data collected in the second step, the final quantitative form (for the third step) was prepared. It is performed in three consecutive steps in Delphi study. The sample consisted of 45 experts who volunteered to participate in the study. The results show that teachers' professional development is a key factor that promotes the development of environmental STEM literate individuals. Thus, qualified environmental STEM literate individuals require qualified environmental STEM literate teachers. Kaya and Elster concluded that a new educational and environmental concept, $^{E+}$STEM-PCK, should be incorporated in teacher education.

Hasan Özcan and Hakkı İlker Koştur in the third article investigated the misconceptions in Turkish preservice teachers about physics. Since science contains a vast number of abstract concepts, science courses are prone to various misconceptions. The material development course in middle school (students in grades 5–8) science teaching programs was a unique opportunity to evaluate preservice science teachers' material designs. In this study, preservice science teachers' physics materials were critiqued, while the misconceptions in their designs concerning energy, light, sound, and electricity were discussed. To determine the misconceptions, Özcan and Koştur used the content analysis technique. Although the materials

investigated in this research were assignments of a university course, the topics and concepts in question were learned in middle school. Yet, when it came to designing a material about the topics, these participants had been learning for years, only 13 of 27 materials were adequate. Unexpectedly, a more serious finding in this research was the "unwillingness" of the participant preservice teachers. Although participants had enough knowledge about the scientific topics and enough time for the material design process, they did not pay enough attention and they did not show their best. In conclusion, the findings of this study revealed the need of a new term "unwillingness," which has not been defined in education studies before.

The fourth article from Argentina's Diego Galperin and Andrés Raviolo presented the implementation process of a didactic proposal for the teaching of the lunar phases at the primary school level, designed from a topocentric frame of reference. They highlight that the lunar phases are understood by a very small proportion of students of all ages. The poor results achieved in terms of comprehension of the lunar phases by students at all educational levels suggest that an alternative method is needed for the teaching of this phenomenon. In the current textbooks and curricular materials, the subjects of everyday astronomy such as day and night, seasons, and lunar phases are dealt with almost exclusively using the heliocentric reference frame. However, for a considerable proportion of students, the heliocentric frame is difficult to understand. In contrast, topocentric descriptions and explanations do not require this change of "perspective" on the part of the observer, since they are centered on a point on the Earth's surface. In this respect, the topocentric explanation of the lunar phases is scientifically satisfactory since the problem is purely kinematic: To understand the phenomenon, it is only necessary to know how the Moon changes its position each day with respect to the Sun. The study was carried out within the framework of qualitative research with a focus on the search for interpretations and assigning meaning in a particular context. The comparison between the initial explanations of most of the pupils with those given in the final task of the sequence of activities shows substantial changes in their descriptions and explanations of the phenomenon. Therefore, this alternative focus to traditional approaches, based on the use of the topocentric reference frame, represents a satisfactory didactic resource to improve teaching of the lunar phases to primary level children.

Simson N. Shaakumeni and Benő Csapó in the fifth article validated a new questionnaire for assessing Namibian students' BANOS. A new 28-item Likert scale questionnaire termed "BANOS" was developed. This questionnaire was new in the sense that although ideas for possible items were obtained from existing scales in literature, no similar questionnaire exists. The survey was administered to a sample of 860 (52% of male and 48% of female) secondary school students in Namibia. The sample was split randomly into two, 503 students' scores were used for exploratory factor analysis (EFA) by means of principal components and 357 students were used confirmatory factor analysis. The findings indicate that the eight dimensions model that had been suggested qualitatively could not be supported at EFA level. This could be attributed to the inherent similarity among the dimensions of the nature of science. However, the questionnaire had adequate construct validity and reliability though it had poor fit statistics values lower than the recommended thresholds, except for the χ^2/df and standardized root mean square residual (Hair et al., 2016). Shaakumeni and Csapó concluded that the questionnaire showed potential to be psychometrically valid.

The sixth article from Oman investigated gardening in early childhood settings. Abdulla Ambusaidi, Rashid Al-Yahyai, Subhashni Taylor, and Neil Taylor highlighted how research projects have demonstrated significant benefits from incorporating teacher-student care of school gardens into school curricula. Revenue from oil reserves has been a significant boon in the nation's capacity to modernize, including modernization and improvement of health systems. The World Health Organization ranked Oman's public health system eighth best in the world in 2000. Nevertheless, Oman has not escaped the trend of "lifestyle diseases" that often accompany modernization. Increased heart disease, high blood pressure, and diabetes have all become more prevalent, particularly in urban areas. Increased rates of obesity in children have caused many parents to call for a ban on the sale of "junk" food in school canteens. Various studies indicate that school garden programs have the potential to improve children's learning in traditional curriculum subjects. School vegetable gardens encourage children to eat more vegetables simply because they increase the children's experience to these foods as they plant, tend, harvest, and even cook them. Gardening activities can simultaneously build the life skills associated with gardening and cooking as well as ability to work cooperatively with others on real tasks. Gardening, furthermore, fosters students' understanding and appreciation of how the natural world works. Ambusaidi, Al-Yahyai, Taylor, and Taylor's results suggest that their gardening intervention had more of an impact on their female students than on male students in terms of overall attitude as well as attitudes within the three subscales. The qualitative findings were encouraging, as the responses to the gardening project from students, teachers, and parents were consistently positive. Overall, the findings of this study suggest that, for Grade 2 students in Oman, school gardens may be an effective resource.

The seventh article is a study examining the effectiveness of instructional design to teach science concepts to visually impaired students, Turkey's Aydin Kızılaslan reports on seven students with various levels of visual impairment. Science education has been identified by some special educators as one of the most useful and valuable content areas for students with disabilities. The development of many concepts, skills, and attitudes in science is associated with hands-on science activities. Students with disabilities need to have access to expanded core curriculum that enables them to participate in

hands-on science activities with their peers. Science education is less accessible to students with visual impairments because it includes many abstract concepts. The study was conducted through design-based research. This study concluded that the activities and materials that were prepared and designed according to student's priority could successfully take place, if an appropriate teaching method is adopted. As a result, teachers can make science lessons more accessible to students with visual impairments through collaboration and specific adaptations in both the science classroom and laboratory. Hence, curriculum reorganization, materials, the instructional procedures, and the awareness of science educators should be taken into consideration to meet the needs of students with impairments in science teaching.

Murat Pektaş and İbrahim Kepceoğlu highlight how rapid developments in technology are driving many societies toward an information-centered reality, and as a result, their educational policies are being reshaped. It is, therefore, necessary to develop individuals who think scientifically and is technologically literate. The quest for innovation and quality in education has led to the integration of new technological tools and practices, i.e., Gamification. Pektaş and Kepceoğlu investigated what 44 prospective science education teachers thought about the use of Gamification in education. They found that for these participating preservice teachers in comparison with traditional instruction methods commonly used today, the applications of Gamification allow students to have more fun in classrooms. However, the use of Gamification allowed teachers informative assessment on the students' learning. A benefit that was reported by Pektaş and Kepceoğlu was that participants felt the use of Gamification helped to prevent cheating. One negative aspect was that as results are near instantaneous, a student who consistently provides wrong answers is quickly demotivated. Pektaş and Kepceoğlu concluded that as these participants' opinions about Gamification-based evaluation were generally positive, it should be integrated into the curriculum of play as part of the educational process.

The final article for this issue from Ram Babu Pareek explores the availability and utilization of a science laboratory for the teaching and learning of science. Pareek argues that the quality of teaching and learning experience depends on the extent of the adequacy of laboratory facilities in secondary schools and the teachers' effectiveness in the use of laboratory facilities with the aim of facilitating and providing meaningful learning experiences in the learners. A laboratory activity is a way of allowing students to learn with understanding and at the same time engage in a process of constructing knowledge by doing science. Pareek surveyed principals, teachers, and students from 21 high schools about their perceptions relating to science laboratories in their school. Pareek's finding highlights that out of the 21 schools survey only one school actually had a dedicated science laboratory while seven schools had access to a space for science. As a result, teachers were faced with issues regarding inadequate equipment, assistance in using science apparatus, dedicated and sufficient time in teaching schedule, as well as support for students with special needs. Pareek concludes that government should take the lead in ensuring that schools are provisioned and supported adequately in science.

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