Science Education International
31(2), 127-129
https://doi.org/10.33828/sei.v31.i2.e

International Council of Association for Science Education

EDITORIAL

Editorial

The second issue of *Science Education International* 2020 is a special issue based on presentations from the 6th International Council of Associations for Science Education (ICASE) World Science and Technology Education Conference held in Pattaya, Thailand, from December 2, 2019, to December 6, 2019. The theme of this conference was *The Future of Science and Technology Education*. The ICASE was established in 1973 to extend and enhance the work of its member organizations, provide, and support activities and opportunities to enhance formal and non-formal science and technology education worldwide. The World Conferences are meant to further the vision and mission of ICASE. The first world conference was held in Penang, Malaysia, in 2003. This conference was followed by Perth, Australia, in 2007, then Tartu, Estonia, in 2010, Kuching, Malaysia, in 2013, and Antalya, Turkey, in 2016. The 2019 World Conference attracted participants from 22 countries from around the world. Participants were invited to submit research papers to *Science Education International* based on their presentation. This issue brings together twelve of the 72 presentations. These papers come from the United Arab Emirates, Malaysia, South Africa, New Zealand, Thailand, the Philippines, China, Estonia, and Nigeria.

The first paper is from the United Arab Emirates' Dr. Abdurrahman Ghaleb Almekhlafi from United Arab Emirates University. The second paper is from Tracy Mensan, Kamisah Osman, and Nazatul Aini Abdul Majid from the National University of Malaysia. Motshidisi Lekhu and Sheila Matoti of the Central University of Technology in Bloemfontein, South Africa, present the third paper. The fourth paper is from Samri Chongo, Kamisah Osman, and Nazrul Anuar Nayan from the National University of Malaysia (UKM) and also from the National University in Malaysia (UKM) is the fifth paper by Noraini Lapawi and Hazrati Husnin. New Zealand's Steven Sexton is the sixth article. The seventh paper brings together Eng Tek Ong, Xingkai Luo, Jing Yuan, and Janchai Yingprayoon from Malaysia, China, and Thailand. Karizza Jane B. Pejaner and Voltaire M. Mistades from the Philippines present the eight paper. The ninth paper is from China's Chaochao Jia, Tao Yang, Yu Qian, and Xinye Wu. The tenth paper comes from Estonia's Tapashi Binte Mahmud Chowdhury, Jack Holbrook, and Miia Rannikmäe. The eleventh paper is from China's Ma Juanjuanand Hu Shengli. The final paper of Volume 31, Issue 2 is from Nigeria's Regina Marita Onabid Samba, Emmanuel Edoja Achor, Asabe Edward Bash, and Stella O. Iortim.

In the first paper, Dr. Abdurrahman Ghaleb Almekhlafi reports on the design and creation of digital interactive content for teaching and learning. The Almekhlafi Digital Interactive Content (ADIC) model is a systematic guide that is able to be used to produce interactive digital content on any subject. While there are many models currently in used, these models have only focused on instructional design with respect to ubiquitous learning contexts and environments. None of them have focused on designing and creating interactive digital content. The ADIC model addresses this gap and provides guidelines for designers and curriculum developers to design interactive digital content for effective learning and teaching. The model is generic and sufficiently flexible to be adapted for designing and developing a variety of digital interactive content. Twenty-eight university faculty members were involved in the piloting of the model, and 81 university students were involved in the application and validation of the model. The university faculty members developed an interactive presentation following the ADIC model during a 3-day workshop, whereas the students developed two projects, each within 2 months, during the 2018 fall semester. The study results showed that the proposed ADIC model is an effective tool for designing and creating digital interactive content.

The second paper is from Tracy Mensan, Kamisah Osman, and Nazatul Aini Abdul Majid from the National University of Malaysia. Their paper describes the development and validation of unplugged activity of computational thinking (CT) in science module, which is specifically designed to integrate CT. CT is a collection of fundamental cognitive tools and practices originated in computing but addressed to all disciplines far beyond computer science (CS). It is useful in solving problems and design systems to assist in automating a wide range of intellectual processes. The development of CT in young learners is a foundation for learners to embrace a systematic problem-solving approach and foster higher-order thinking skills. In Malaysia, implementation of CT in primary schools has been rolled out as part of the new standards based primary curriculum which started in January 2017. A total of 58 science teachers and 76 students from primary schools in Sarawak participated in answering the analysis questionnaires. The mean age of the students was 11 years old. Tracy Mensan, Kamisah Osman, and Nazatul Aini Abdul Majid from highlight that textbooks are often the main resource for formal science education. However, textbooks do not integrate CT skills and are teacher centric. Their module was developed to cover these weaknesses to prepare the children with the 21st century fundamental CT skills in an active and collaborative environment.

Motshidisi Lekhu and Sheila Matoti of the Central University of Technology in Bloemfontein, South Africa, present the third paper. Motshidisi Lekhu and Sheila Matoti examined pre-service science teachers' self-efficacy beliefs and professional identity as influenced by their high school

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experiences. They note that teaching science requires an understanding of how to teach the content to be effective practitioners. However, the specific ways in which high school experiences might influence developing pedagogic competencies of trainee pre-service science teachers are not well known. South African pre-service science teachers take a minimum of two science subjects as major subjects from the 1st to 3rd year levels. These major subjects run concurrently with their subject specific methodology (didactics) courses in the 2nd and 3rd year levels, while in the 1st and 4th years, it is general subject methodology. This study focused on 85 pre-service science teachers' reflections of their secondary school science education prior learning experiences, and how these experiences were used as prior knowledge to improve and enhance their science teaching efficacy beliefs. Motshidisi Lekhu and Sheila Matoti report on how the five categories of teachers' approaches targeting learners' interest, teachers' affective domain, teachers' articulation of concepts, selection of topics, and teaching practices have both positive and negative impact on the pre-service teachers' professional identity and self-efficacy.

The fourth paper is from Samri Chongo, Kamisah Osman, and Nazrul Anuar Nayan from the National University of Malaysia (UKM). Their study aims to identify the level of students' CT skills by gender and their relationship to achievement in mathematics. Samri Chongo, Kamisah Osman, and Nazrul Anuar Nayan note that based on the results of the Program of International Student Assessment, Malaysian students are at a moderate level for solving problems. Therefore, CS subjects were introduced at the secondary level in 2017 to equip students with programming skills and algorithms. The population of the study was 128 students (aged 16 years old) from four secondary schools in one of the districts in Malaysia. The study utilized the CT skills test which was adapted from the United Kingdom's Bebras Computational Challenge. Their findings show that gender factors do not influence CT skills, whereas mathematic achievement is related to CT skills.

Also from the National University in Malaysia (UKM) is the fifth paper by Noraini Lapawi and Hazrati Husnin. Their study aimed to identify the effectiveness of a CT module on achievement in science subjects. Their study explored the use of *Scratch* to make the teaching and learning process more interesting while also enhancing the CT and integration of information and communication technology (ICT) in science subjects. The study included the conventional teaching and learning approach plus a transformed student-centered approach with the use of ICT. This study was a quasi-experimental field study with the random selection of groups from 67 students in their respective classes during the intervention. Noraini Lapawi and Hazrati Husnin concluded that the CT module is an effective step toward enhancing achievement in science and thus should be applied in science, technology, engineering, and mathematics (STEM) teaching and learning to solve complex problems.

New Zealand's Steven Sexton presents a study on how one school worked to implement a ministerial directive to include a new curriculum requirement into their teaching practice. In 2017, the Ministry of Education amended the national curriculum document to include digital technology as a compulsory curriculum area for years 1–10 (students aged 6–15). As a result, most primary school teachers (teachers of students in years 1–8, students aged 6–13) are now required to deliver a curriculum area for which they have had no training or professional development. Over the course of 2019, a school worked investigated how digital tools, toys, and technologies supported the implementation of this new curriculum area. This study offers insight into how primary teachers were able to work in authentic collaborative relationships to support each other in how to implement a new curriculum requirement that was not supported by any ministerial professional development.

The seventh paper brings together Eng Tek Ong, Xingkai Luo, Jing Yuan, and Janchai Yingprayoon from Malaysia, China, and Thailand. Their study aimed to determine the effectiveness of a professional development program on the use of STEM-based 5E inquiry learning model in enhancing the learning of STEM-based inquiry learning model using the context of electric circuit amongst 78 Chinese in- and pre-service science teachers. China's Ministry of Education issued a new guideline for science education in February 2017, requiring elementary schools to make science a compulsory subject. This study employed a triangulation mixed methods design which entails the collection of both quantitative and qualitative data concurrently or simultaneous during the study, and comparison of the results from both quantitative and qualitative analyses. This design involved a single group that was pre-test, exposed to a 6 h professional development program on STEM-based 5E inquiry learning model treatment, and post-test. The pre-test and post-test inventories are basically the same 9-item inventory that aims to gauge the participants' understanding on electric circuit. Despite the limitations in sampling and intervention duration, the professional development program on STEM-based 5E inquiry learning model has positively and significantly impacted on the pedagogical skills of the participants. The triangulation by the qualitative data gives further credence to the quantitative finding in that the pre- and in-service teachers reckoned that their knowledge of the science content used in the training was enhanced.

Karizza Jane B. Pejaner and Voltaire M. Mistades from the Philippines present the eighth paper. Pejaner and Mistades note that the knowledge and practice of science are deeply rooted in culture. Hence, how science is done inside the classroom depends on the culture in which it is practiced. It has been argued that inside the classroom, physics and other branches of science are still taught in such a way that culture is given less emphasis. They go on to highlight that teachers have reported that using culture in teaching is only applicable to other subjects not for the science. In the Philippines, frameworks were created not only to cater for the needs of indigenous students, which is mandated by the Philippine's constitution

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but also to empower their culture. This qualitative case study sought to determine the teaching practices of Grade 8 Physics teachers in teaching force, laws of motion, uniform circular motion, work, energy, and power concepts to *Obo Monuvu* students. In documenting the teaching practices of the physics teachers, two interview guides were used and an observation protocol. Teachers expressed a lot of challenges in teaching indigenous students. Pejaner and Mistades conclude their paper with recommendations.

The ninth paper is from China's Chaochao Jia, Tao Yang, Yu Qian, and Xinye Wu. Jia, Yang, Qian, and Wu explored the gender differences in science achievement, interest, and creativity from a national representative sample of Grade-4 and Grade-8 students in mainland China in 2017. Science Achievement was assessed by students' paper-pencil test. Six parallel tests were used to assess Grade 4 and 8 students' scientific literacy, including scientific understanding, scientific inquiry, and scientific thinking. Each Grade 4 parallel test contains 28 multiple-choice items and 6–7 construct response items, and Grade 8 parallel test contains 35 multiple-choice items and 5 construct response items. The science interest, habit, and creativity were assessed by students' questionnaires, among which science interests were measured separately in physics, biology, and geography subject, and habit and creativity were measured integrated. Jia, Yang, Qian, and Wu found that there was no gender difference in science achievement in either Grade 4 or Grade 8. However, the scientific interests vary in different grades and disciplines.

The tenth paper comes from Estonia's Tapashi Binte Mahmud Chowdhury, Jack Holbrook, and Miia Rannikmäe. Their paper reviews attributes of socioscientific issues (SSIs) which recognize that science education is more than promoting cognitive development within a science frame and sees science and society interactions providing a meaningful context for learning. Chowdhury, Holbrook, and Rannikmäe highlight that three major attributes associated with SSI have been identified indicating a contribution and barriers toward the preparation of a desired citizenry through science education: Socially embedded science contexts oriented to local, national, and global issues, perception of complexity in diverse values, ethics, and morals, and promoting student participation through an ill-structured cross-curriculum context. Their study provides a procedural link to utilize the aspects and dimensions of SSI to promote a desired citizenry and draws attention to the scope for research in overcoming the barriers of implementing SSI.

The eleventh paper is from China's Ma Juanjuanand Hu Shengli. Their study aimed to examine the understanding of year 9–12 Chinese school students about green chemistry-related concepts, to include raw materials, solvent, and atom economy. Ma Juanjuan and Hu Shengli highlight that green chemistry is not a new branch of science, but a new and responsible approach of thinking about science. This study developed a two-tier diagnostic instrument to assess 416 students' understanding of green chemistry concepts. Their results showed that students' understanding of green chemistry concepts improved significantly with their increasing grade; however, no significant differences were noted in the understanding of male and female students.

The final paper from Nigeria's Regina Marita Onabid Samba, Emmanuel Edoja Achor, Asabe Edward Bash, and Stella O. Iortim investigated the effects of graphic organizer (GO) and experiential learning (EL) with feedback on students' achievement and critical thinking. Nigeria places much emphasize on the teaching and learning of science and technology in schools. The objectives of teaching basic science and technology subject range from enabling their interest in science and technology to prepared them for further studies in science and technology. The study employed a quasi-experimental design. The 75 student participants were taught using GO learning technique or EL technique. Their results highlight that both experimental methods have great potentials in fostering the development of critical thinking as well as promoting meaningful learning in students. Samba, Achor, Bash, and Iortim end their paper with four recommendations.

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