Editorial

In this third issue of 2018, six articles have been brought together. The first article by Angeloudi, Papageorgiou, and Markos explores primary Greek students' argumentation ability. Then, the second article by Suephatthima and Faikhamta reports on the development of argument skills of Year 12 Thai chemistry students. The third article by Vaino, Vaino, and Ottander investigates the relationship between 8th grade Estonian students' problem-solving processes while implementing a design-based science learning (DBSL) approach. The fourth article from New Zealand's Horsley and Moeed explores how schools address the motivational and learning needs of high-ability science students in Grade 6 through 12. The final two articles one by Dincer and Osmanoglu reports issue around prospective Turkish science teachers' unit conversion abilities while the final article by Didiş Körhasan, Eryılmaz, and Erkoç investigates the role of metacognition in the construction of mental models of Turkish physics students studying to become physicist or physics teachers.

Anastasia Angeloudi, George Papageorgiou, and Angelos Markos' study explored the possibilities to improve Greek primary students' argumentation ability concerning factors that affect dissolving, through the implementation of two versions of a teaching scheme, one with and one without particle theory. The study included two-fifth grade classes from Northern Greece. The teaching of particle theory leads to a conceptual understanding of dissolving, and thus, it could contribute to a student's argumentation ability. Taking into account its importance for science education, these researchers explored the effects of a teaching intervention using particle theory on students' argumentation ability about factors affecting the dissolving of a solid in a liquid solvent. Among these, factors were students' prior content knowledge and conceptual understanding of the arguments' subject matter. Data were collected through an open-ended written test and a semi-structured interview targeting four of the components of an argument: Claims, data, warrants, and rebuttals, for five factors affecting the dissolving of a solid substance in water: Temperature, stirring, amount of the substance, grain size, and nature of the substance itself. It seems that there was an overall significant improvement mainly concerning the structure of their arguments. Results showed an improvement concerning the structure of students' arguments, whereas improvements in content quality appeared mainly in some cases where particle theory was implemented. All students generally used more data, warrants, and rebuttals in their arguments across all the factors post-intervention. This advocates the aspect that any enrichment of students' prior knowledge influences their participation in relevant argumentation processes and brings to the foreground the relationship between learning gains and engagement in argumentation. The researchers highlight first, although there are significant indications for the improvement of students' argumentation ability for the factors affecting dissolving after a relevant teaching intervention, this is not something that is easy, and it requires particular circumstances. Second, any endeavor should be designed appropriately to cause a deeper understanding of the relevant topics and over a significant duration.

In the second article, Bureerat Suephatthima and Chatree Faikhamta investigated how to support the development of Year 12 Thai chemistry students' argumentation. The aim of the study was to develop the argument skills of students by focusing on the five components of claim, warrant, backing, counterargument, and rebuttal. The study investigated if teaching through socioscientific issues (SSIs) was an effective method for developing argument skills as SSIs are controversial social issues relating to science. SSIs have been utilized in science education to promote scientific literacy, as they emphasize the ability to apply scientific and moral reasoning to real-world situations since they are open ended and have multiple solutions. However, since SSIs are quite broad issues, controversial, and ill-structured, devising solutions are not easy; therefore, the learning environment and activities should be carefully designed to help students make their own claims, supported by warrants, and develop backings for those warrants. In this study, data were collected using teacher reflective journal, student journals, and the argument skill questionnaire over two cycles of SSI. For this study, Faikhamta designed rubric scores depending on the argument quality and argument variety. Regarding the five components of argument skills, these students had improved some characteristics that enhanced their argument skills. The data from students' reflective journals reveal that they improved in self-confidence, assertiveness, manner of speaking and listening, and class participation. Considering the argument components, students did well in constructing claims, warrants, and counterarguments (more than 95%), while not more than 60% could provide backings and rebuttals after each cycle. The study concluded when teaching argument skills, teachers should explicitly teach the components of an argument and make sure that the students understand their meanings and the relationships between them.

The third article by Katrin Vaino, Toomas Vaino, and Christine Ottander demonstrates how DBSL was used to support 8th grade Estonian students' learning. DBSL is a teaching approach that tries to incorporate science learning and the processes of engineering design. DBSL attempts to engage students in scientific reasoning through solving authentic design problems in situations that are quite similar to engineers' everyday work. A DBSL module was developed by Vaino, Vaino, and Ottander within which the students were expected to design an ice cream making device from simple and easily available materials. Vaino, Vaino, and Ottander highlight how this module was suitable in facilitating the development of higher-order thinking and collaboration in science classrooms. As part of their study, they report on how the design tasks supported students in finding unique pathways that did not necessarily result in a single "right" design solution as the design drives the science that needs to be learned. Students built their prototype and make ice cream, then students were required to evaluate their prototypes as a means to generate suggestions about how prototypes could be improved. Vaino, Vaino, and Ottander reported that there were three crucial aspects for the success of the design was the students' understanding of (1) the science phenomena, (2) the operational principle behind the ice cream making device, and (3) the design criteria. Vaino, Vaino, and Ottander concluded that at least one group's unrealistic design demonstrated the existence of a design-science gap although it was also seen how this gap was gradually narrowing through peer support, teacher guidance and some trial and error experiences, right up through the development of the final patent application. The researchers reported that throughout the whole module, the teacher needed to put effort into ensuring that students really understand the operational principle of the device and the scientific phenomena behind it as the students were able to learn from their practice.

The fourth article presents Joanne Horsley and Azra Moeed's exploratory case study aimed to gain an understanding of the phenomenon of science education for high-ability students. In their study, they investigated New Zealand Year 6 through 12 high-ability science students' perceptions of the programs and practices they perceived to have encouraged and informed their learning. Effective science education aims for all students to learn science content alongside developing an understanding of nature of science (NoS) with a focus on increasing the level of public scientific literacy as well as pre-professional education. High-ability science students, therefore, require not only high levels of content knowledge but also a strong understanding of the NoS. Specifically, they were interested in the alignment between what students were experiencing in terms of academic provision, what they perceived they were learning, and requirements of the curriculum. Students provided their views about possible barriers that prevented them from achieving to a high level. Horsley and Moeed grouped these as high-achieving student related, peer related, and teacher related. They reported that those students who identified that they had received either enrichment or acceleration were unable to describe enrichment activities but could identify where acceleration had occurred. In those instances, students referred to accessing content a year ahead of their peers. Finally, Horsley and Moeed noted that most high-ability students in this study enjoyed many aspects of their science classes, particularly those classes that involved practical work. Implications of this research identified that while enjoyment is a component of motivation, there are additional essential components of science education for high-ability learners that students did not identify. High-ability science students require strong intellectual challenge and a deep understanding of how scientific knowledge is created, validated, and disseminated. There was little evidence that students had the opportunity to be creative in designing investigations, gather reliable data, engage in critiquing the evidence, or in the design of their investigations.

The aim of the fifth article by Emrah Oguzhan Dincer and Aslihan Osmanoglu's was to examine prospective Turkish science teachers' knowledge of and difficulties with metric unit conversion. The participants of the study were 73 prospective science teachers. In this qualitative study, a measurement test with 14 questions was administered to the participants to examine their knowledge of and difficulties with unit conversion. The questions of the test were related to metric measurement units for length, area, volume, and mass as well as to the knowledge of approximate size of a body and some uses of metric units. For the first 11 questions, participants' answers were evaluated as right or wrong. To examine the reasons lying behind their difficulties, their explanations on the last three open-ended questions were analyzed. The findings indicated that prospective teachers' performance on unit conversion was not satisfying in general, and their major difficulties were mainly related to the conversion from gram into microgram, mg into g, ml into cm^3, dm^3 into mm^3, gigameter into nanometer, mm^2 into m^2, and determining the relation between centigram and dekagram. As this study's findings revealed, the ability to convert metric units also has an influence on participants' performance on science courses such as physics and chemistry. Thus, understanding teachers', prospective teachers', and/or students' understanding, misconceptions, and difficulties with unit conversion are vital to develop more effective teaching programs for student success.

The final article of this issue is by Nilüfer Didiş Körhasan, Ali Eryılmaz, and Şakir Erkoç reports on part of a multiphase study. Their article focused on the affective issues on cognition and examined the role of metacognition in the construction of mental models of 29 students taking a university physics course. In previous research, Didiş Körhasan, Eryılmaz, and Erkoç indicated that students had difficulty in organizing their knowledge of the quantum concepts to have a scientific understanding of quantization phenomena. Therefore, their examination of mental modeling is a good framework to understand better students' learning in terms of construction of coherent knowledge organizations. Quantization is a threshold concept for students' discriminating between classical and quantum perspectives, and making sense and constructing the knowledge of new phenomena that emerged with quantum theory. Because quantization is a reflection of the paradigm shift from the classical to quantum perspective, it is not a concept isolated to a specific topic, and it is an important phenomenon for understanding of many contexts. Didiş Körhasan, Eryılmaz, and Erkoç studied students' metacognitive behaviors because monitoring new information and comparing it with their previous learning may have a role in the construction of coherent knowledge structures of quantum phenomena. In their examination of students' metacognitive behaviors, they focused on whether they were aware or not of their cognitive process and knowledge, then identified the students who were satisfied or dissatisfied with their knowledge and, due to this, their use of some strategies to control their cognitive process and knowledge was examined. Didiş Körhasan, Eryılmaz, and Erkoç conclusions of this study highlight the importance of students' construction of physics knowledge by considering their metacognitive behaviors. In addition, regardless of whether students were satisfied or dissatisfied, the diversity of unscientific mental models decreased and the percentage of scientific models increased for the students who had their own strategies to learn quantization phenomena. Didiş Körhasan, Eryılmaz, and Erkoç explore the implications for metacognition having a role on conceptual learning.

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