

Boğaziçi University
SCED Graduate Student Research Symposium

Date: May 13, 2022

15.00- 17.00

ABSTRACT BOOK

The Department of Mathematics and Science Education (SCED) are pleased to announce Boğaziçi University SCED Graduate Student Research Symposium. Our goal is to showcase the quality and diversity of graduate-level research at our department. Our graduate students will present their posters during the Symposium.

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Examining elementary students' learning progression for scientific argumentation

Beyza Nur Çelik

Scientific argumentation is considered to be a significant aspect of scientific literacy for individuals to use evidence for supporting their claims through reasoning in learning science. Learning progressions are empirically grounded hypotheses of learners' gradual progresses in understanding of a concept from naïve ideas to more complicated or performing practices from lower to higher level (Duschl, Maeng, & Sezen, 2011). This study is about students' argumentation competencies on a learning progression as evidence-based hypotheses. The purpose of this study is to explore and map students' increasingly sophisticated progressions in making argumentation as a core practice in scientific contexts. Potential participants are 4th, 5th and 6th grade students studying at a private school in İstanbul and the members of each group are estimated to be 35 and making 105 participants in total. This cross-sectional study will adopt grounded theory research, and qualitative data will be collected from open-ended questions taken place in the argumentative tasks as well as individual follow-up semi-structured interviews. Student responses will be analyzed through constant-comparative method and will be categorized according to hypothetical learning progression for argumentation in science proposed by Osborne and his colleagues (2016). The findings of this study are expected to contribute to the literature, as there has not been any research done with younger sample groups targeted in the current study. The current data will validate and extend the hypothetical progression along the trajectories of the argumentation competency.

6th grade students' understanding of nature of science and their metacognitive awareness

Dilara Gören, Ebru Kaya

This study investigates the relationship between middle school students' understanding of Nature of Science (NOS) with theoretical framework of the *"Reconceptualized Family Resemblance Approach to Nature of Science (RFN)"* and their metacognitive awareness. In NOS learning process students' metacognitive processes and skills might be related with their NOS understanding. Totally 167 6th grade students completed "RFN Student Questionnaire" and "Metacognitive Awareness Inventory for Children". In addition, three students were interviewed. The data was analyzed through Pearson correlation and thematic analysis. The result of Pearson r correlation shows that there is a statistically significant positive relationship between 6th grade middle school students' RFN understanding and their metacognitive awareness. The interview findings show that students' responses to the RFN and metacognitive awareness-related questions were similar and compatible. The student who was metacognitively aware had a higher RFN understanding. This high-level student was using some metacognitive strategies such as evaluation, management of learning, awareness in his learning process and was able to explain many categories of science with diverse examples including epistemic-cognitive dimensions. The student with low metacognitive awareness were less likely to express use of strategies and possess naïve views on categories of science. Alignment in high- and low-level students' expressions and quantitative results point the possible relationship between NOS understanding and metacognitive awareness. This study adds to the growing body of research for inclusion of the use of metacognitive strategies in NOS teaching and learning.

Note: We would like to inform you that this abstract is submitted to 2022 IHPST Conference.

Using a STEM education approach with a computational tool: The impact on students' computational thinking skills and understanding of climate change

Dilara Kara

With the development of information and communication technologies in the 21st century, different thought systems have emerged to change our thinking to reform a sustainable society (Easterbrook, 2014). Interdisciplinary problem-solving techniques become a fundamental need for all disciplines to acquire new skills in addition to creativity and critical thinking. Since the importance of integrating interdisciplinary practices into lessons, computational thinking (CT) is fast becoming a key skill in STEM disciplines for detecting patterns and generating arguments in scientific investigations. In this study, the STEM integrated teaching approach will be applied to middle school students by using CT practices and tool. The purpose of this quasi-experimental study is to investigate whether teaching about climate change with a STEM approach by using a computational tool and practices provides a significant change in eight-grade students' CT skills and understanding of climate change. The effects of the CT approach as a thought system might help students to understand the relationship between concepts. Weintrop and colleagues' CT practices (2016) will be integrated into the STEM integrated teaching framework to focus on the development of CT skills of students in science classes. The participants of the study will be approximately 60 eighth-graders in a public school. The control group will participate in a traditional lesson about climate change. The experimental group will participate in an interactive lesson by applying CT steps throughout the lessons. Two different instruments will be applied as pre-and post-tests. Also, students' CT skills will be analyzed qualitatively with worksheets and individual interviews.

Keywords: *STEM education, computational thinking, computational tool, climate change, middle school students*

References

Easterbrook, S. (2014). From Computational Thinking to Systems Thinking. *2nd International Conference on ICT for Sustainability (ICT4S 2014)*, *Ict4s*.

Weintrop, D., Beheshti, E., Horn, M., Orton, K., Jona, K., Trouille, L., & Wilensky, U. (2016). Defining Computational Thinking for Mathematics and Science Classrooms. *Journal of Science Education and Technology*, *25*(1). https://doi.org/10.1007/s10956-015-9581-5

A causal-comparative study: Usage of gamification in 5th grade science lesson

Gizem Özyazıcı, Nazmiye Ertuğrul

Gamification is a technique that has recently been used in different sectors and has become widespread in the field of education. This study aimed to examine the differences in achievement levels in 5th grades by comparing whether they use gamification in science class or not. This study was designed as a quantitative, causal-comparative study. The achievement results of the 2 different groups in 5th grade were compared by using an achievement test as an instrument. 2 different groups were selected by considering their use of gamification techniques on Earth, Sun, and Moon topics by the researcher. The first group included students who learned with gamification and the second group included students who did not learn with gamification techniques. Participants were selected by convenience sampling. The data was gathered from google forms by integrating a reliable and valid achievement test. An independent t-test was used to compare the 2 groups' achievement results. The results show that there is a statistically significant difference between 2 groups and the group using gamification performed higher than the group that did not use gamification. These findings will be useful for researchers and educators who wish to increase students' achievement in science education.

Keywords: Gamification; game; academic achievement in science education; motivation.

Cognitive-epistemic categories of science in the Turkish science curriculum

Gözde Kurt, Ebru Kaya

Nature of Science (NOS) has been a significant research area in science education. Reconceptualized Family Resemblance Approach to NOS (RFN) is the recent approach explaining science from a holistic viewpoint. The RFN includes cognitive-epistemic and social-institutional categories of science. In this study, it was aimed to examine the Turkish science curriculum based on the cognitive-epistemic categories of the RFN, which are aims and values of science, methods and methodological rules, scientific practices, and scientific knowledge. This science curriculum is the current national curriculum that is used for primary and middle school science courses in Turkey. The whole document was analyzed with content analysis by detecting related codes about categories and frequency values of these codes were determined. The frequencies of codes were found as 41 for aims and values of science, 49 for methods and methodological rules, 371 for scientific practices, and 64 for scientific knowledge. On the other hand, the frequencies of codes in special sections including different grade levels are 12, 31, 334, and 48 respectively for categories. The most representative category is scientific practices while the least representative category is aims and values of science. Additionally, it was found that the total numbers of codes are 43, 47, 72, 80, 94, and 89 respectively from 3rd to 8th grade. This means that 7th grade level represents cognitive-epistemic categories more in the Turkish science curriculum.

Keywords: Cognitive-Epistemic Categories of Science, Science Curriculum, Content Analysis

Pre-service and in-service middle school science teachers' knowledge about climate change

Melike Hanedar

Climate change (CC) is a socio-scientific issue that has been debated for decades and presents critical challenges for humans today and in the future. Education plays a vital role in tackling this crisis by raising knowledgeable generations. Since CC relies heavily on science education, science teachers should be actively involved in CC education. In this regard, the importance of science teachers having a basic understanding of CC cannot be denied. The role of teachers is critical in helping future generations become conscious about CC. Considering science teachers, it is also important to examine pre-service teachers as they will be teachers of future generations. In this quantitative study, the pre-service and in-service middle school science teachers' knowledge about CC is investigated and compared. A total of 68 teachers (36 pre-service and 32 in-service) from İstanbul, Turkey participated in the study. Data was collected with the first polar of an instrument "The knowledge and confidence in one's knowledge about climate change". The statistical analysis results showed there is a significant difference between the knowledge levels of the two groups. This study has potential to provide information about future trends in CC education and the CC content in science courses, but further studies may examine the extent to which the content of currently implemented science teacher vocational education includes various such environmental challenges, and how pre-service teachers' knowledge of CC changes and affects their teaching when they become in-service.

The investigation of informal reasoning of pre-service science teachers in contexts of distal and proximal socio-scientific issues

Özlem Özdemir, Devrim Güven

Socio-scientific issues (SSI) are defined as science and technology based dilemmas that have impact in social context in many respects such as economy, politics, culture, environment, and ethics and so on. SSIs are argued to be significant context to improve scientific literacy through its facilitation of evidence based reasoning, argumentation and scientific epistemology. Since SSI in educational contexts assist students in dealing with challenges that they may confront in their daily life, decision making process in the contexts of SSI promotes democratic citizenship through science education. This study aims to investigate informal reasoning of pre-service science teachers and aspects of scientific epistemology utilized by them in the contexts of two SSIs; proximal (Use of Processed Foods in Turkey) and distal (Production and Use of GMO called Golden Rice in South Asia Region). Nineteen pre-service science teachers who were selected purposefully participated in this instrumental multi-case qualitative study. Participants, individually, are asked to respond to the same interview questions about two SSI scenarios prepared to be paralleled to each other in terms of general theme, balanced evidence and structure. Data was analyzed deductively by using the categories established by the (Zeidler & Sadler, 2005) to identify informal reasoning patterns of the participants. Results indicated that participants displayed more rationalistic thinking (evidence and logic-based) and decision making in the context of distal SSI - Golden Rice while displaying more emotive (care-based) informal reasoning in the context of proximal SSI - Processed Foods. The results of this study are thought to have implications for preparing effective SSI cases to be used in classroom instruction.

Keywords: socio-scientific issues, informal reasoning, science education

An analysis of 4th grade students' routine and non-routine problem-solving skills using cognitive diagnostic models

Züleyha Taştan, Serkan Arıkan

Assessment is an essential part of the education. Providing feedback to students helps to improve students' learning. Assessments also need to provide feedbacks to teachers, parents, administrations, and instructions. In this study, Cognitive Diagnostic Assessment (CDA) is used to give feedback to teachers and students. CDAs provide cognitive data about students' strengths and weaknesses in a particular ability. This study investigates routine and non-routine problem-solving attributes of grade 4 students with four operations (addition, subtraction, multiplication, and division) using CDA. The test used in the study is developed regarding 2021-2022 mathematics curriculum of grade 4. There are 20 items and 6 attributes in the test. A Q-matrix was constructed to link each item in the test to cognitive attributes. Each item was coded using binary system depending on whether the learner mastered (1) or non-mastered (0) on the attribute. Before administering the study, a group with 10 students were tested and interviewed to decide timing and clarity of the items. The CDA test administered to 438 students in 4th grade, from various public and private schools. The results of the study will be analyzed by using an R package of Cognitive Diagnostic Models. As a result of the analysis, each participant is given an attribute profile showing which skills they have mastered and which they have not. The analysis shows the percentage of participants who mastered a certain skill or attribute, as well as the percentage of participants in each latent class.