1st International STEM Education Conference

Proceedings

June 13-14, 2019
İstanbul

Editor: Dr. Hasan Özcan

ISTANBUL AYVANSARAY UNIVERSITY
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Co-funded by the Erasmus+ Programme of the European Union

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PUSULA

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PUSULA 20 TEKNOLOJİ VE YAYINCILIK A.Ş

1st International STEM Education Conference Proceedings
ISBN: **978-605-2359-82-2**
Publisher Certificate: 29644

Release Date: December 2019

Editor:
Dr. Hasan Özcan
Aksaray University Faculty of Education
Department of Mathematics and Science Education 68100 - Aksaray / TURKEY
E-mail: hozcan@aksaray.edu.tr • Office: +90 382 288 33 64 • Fax: +90 382 288 33 33 • Web: http://hasanozcan.com.tr

Pusula 20 Teknoloji ve Yayıncılık A.Ş
Namık Kemal Mah. Köşk Sk. No. 25B Ümraniye/İstanbul
Tel. : +90 (216) 505 49 45 • Fax: +90 (216) 505 49 43 • E-mail: pusula@pusula.com
www.pusula.com • www.pusulakitaplik.com

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Conference Program

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Time	**Author(s)**	**Title**	**Room**
13:45 – 15:15	Cody Buye	Using Texas Instruments' technologies to engage in the International Baccalaureate® (IB) curriculum	E-202

Thursday, June 13, 2019 **Workshop - 2** **Chairs: Mustafa Hilmi Çolakoğlu & Kemal Togayev**			
Time	**Author(s)**	**Title**	**Room**
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Thursday, June 13, 2019 **Workshop - 3** **Chairs: Ismail Dönmez & Hande Tölüv**			
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Thursday, June 13, 2019 **Workshop - 4** **Chairs: Cody Buye & Tuba Kocabiyik**			
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1st Day

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STEM Show Time / Playground
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Time	Author(s)	Title	Location
1	Shakhmaran Seilov Askar Nauryzbaev Dias Abildinov Aishabibi Zhursinbek Akniet Nurzhaubaev	Desktop network simulator “IT-alem” – experience of using the simulator in the process of teaching ICT	Ground Floor & Garden
2	Arash Salimi Kia	Understanding Quantum Phenomena by Simple Quantum Eraser Experiment	
3	Toni Chehlarova Ivaylo Kortezov Albena Vassileva	Preparation of mathematics teachers for gifted students	
4	Nuray Özmen Seher İnce	Cooking STEAM	
5	George Gachev	Interactive algebra tutorial	
6	Toni Chehlarova	Diversity of PD courses and resources of IMI-BAS	
7	Albena Vassileva	“Students’ Institute of Mathematics and Informatics” and “Teachers Professional Development”	
8	Sona Hacılı Sevinc Nazarova Yegane Ramazanova	STEM Education in Azerbaijan	

2nd Day

Friday, June 14, 2019
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Chair: Joyce Peters-Dasdemir & Zulfu Genc

Time	Author(s)	Title	Room
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	Sümeyra Hallaç Feral Ogan-Bekiroğlu	Development of a Scale to Measure Attitude Towards STEAM Education	
	Merve Kostur Cigdem Haser	Pre-Service Mathematics Teachers' Rationales for Selecting Certain Technologies: Planning and Design	

Friday, June 14, 2019
Plenary Session – 5
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	Koray Kasapoglu Bulent Aydogdu Nil Duban	Comparing Metaphorical Perceptions of Elementary School Teachers and Science Teachers about the STEM Approach to Education	
	Hakkı Ilker Kostur Hasan Ozcan	STEAM-Boats: A Material Design Activity	
	Nazli Baris	Investigating Science and Maths Teachers' STEM Education Practices at Science and Art Centers	

2nd Day

Friday, June 14, 2019
Plenary Session – 6
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	Martin Lindner Lukas Hursie Jolina Ulbricht	Long-term effects of Science Summer Camps	

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	Seyda Bas Betul Iscan	ELT methods as a means for STEM education	
	Meryem Demir Guldal Funda Savaci Acikalın	Girls in STEM: A Perspective of female students at the vocational school of technical science in Turkey	

Friday, June 14, 2019
Plenary Session - 8
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	Hakkı Ilker Kostur Hasan Ozcan	Investigating Pre-Service Preschool Teachers' Opinions About Visiting Science Centers in Preschool Education	
	Kader Bilican	Early Childhood Teachers' Understanding of STEM Pedagogy	
	Orhan Curaoglu	Challenges of Using Block-Based Tools in Coding Education	

2nd Day

Friday, June 14, 2019 Workshop - 5 Chair: Cathy Baars & Arash Salimi Kia			
Time	**Author(s)**	**Title**	**Room**
13:30 – 15:00	Ian Galloway	Frictional Forces and Car Tyres: Clearing up Misconceptions (by using Texas Instruments' technologies)	E-202

Friday, June 14, 2019 Workshop - 6 Chair: Ridvan Elmas			
Time	**Author(s)**	**Title**	**Room**
13:30 – 15:00	Murat Akarsu Nilüfer Okur Akcay Mehmet Fatih Ocal, Seda Okumuş	A STEM Activity: Lighting Room Design with Mirrors	E-203

Friday, June 14, 2019 Workshop - 7 Chair: Metin Kapıdere & Süleyman Seren			
Time	**Author(s)**	**Title**	**Room**
13:30 – 15:00	Ahmad Housseini Samih Jaber Mahdi Mansour	Robotics for Mathematics Teacher	E-201

2nd Day

Friday, June 14, 2019 Workshop - 8 Chair: Hande Tölüv & Fatma Caner			
Time	**Author(s)**	**Title**	**Room**
15:30 – 17:00	Cody Buye	Using Texas Instruments' technologies to engage in the International Baccalaureate® (IB) curriculum	E-202
15:30 – 17:00	Arash Salimi Kia	Understanding Quantum Phenomena by Simple Quantum Eraser Experiment	E-301

Friday, June 14, 2019 Workshop - 9 Chair: Hakkı İlker Koştur & Tuğba Ecevit			
Time	**Author(s)**	**Title**	**Room**
15:30 – 17:00	Rawda Eideh	How to prepare a STEM activity? Ready to use tool for promoting thinking skills	E-203

Examination of Pre-Service Physics Teachers' STEM Lesson Plans During Their STEM Integration Attempts

Fatma CANER[1], Feral OGAN BEKİROGLU[2]

Abstract

Considering the goal of integration of physics with mathematics, technology and engineering in our updated physics curriculum, it is important for educators to investigate how physics teachers integrate STEM approach in their teaching practices. Therefore, this study aimed to examine teacher candidates' STEM lesson plans. The participants of the study were 10 sophomore pre-service physics teachers, who continued their education in a state university in Istanbul. Multiple case study design was carried out for this research. After one semester of integrated STEM education where the participants experienced various implementations, they were required to prepare STEM lesson plans individually. Document analysis was performed to analyse their plans. STEM lesson plan debugger was used to determine strengths of the participants' plans and their facets that needed to be developed. Results showed that the pre-service physics teachers focused only on physics learning objectives in STEM lesson plans and ignored the math learning objectives. The participants taught that by solving physics problems which were not related to engineering design process, integration of math process was already sorted out.

Keywords

STEM Education, STEM Lesson Plan, STEM Integration, Pre-Service Teachers

Introduction

Integrated education in learning environments begins with Dewey (1931) arguing that disciplines should not be disjoint, but should be integrated with real world practices. Dewey (1931) proposed laboratory schools to pave the way for STEM education. There are different definitions of STEM and it is accrued knowledge of science, technology, engineering and mathematics as separate but related fields. For example, Tsupros, Kohler and Hallinen (2009) define STEM as "an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons in contexts that make connections between school, community, work, and the global enterprise". Johnson, Peters-Burton and Moore (2015) describe STEM as "the teaching and learning of the content and practices of disciplinary

1 Marmara University, canerfatma@gmail.com
2 Marmara University, feralogan@yahoo.com

knowledge which include science and/or mathematics through the integration of the practices of engineering design of relevant technologies". According to Krajcik and Delen (2017), a richer, more productive manner of thinking is to recognise STEM as an integration of science, technology, engineering and mathematics to focus on solving pressing individual and societal problems. Breiner et al. (2012) shared that STEM is sometimes referred to as a pedagogical approach that emphasises inquiry and problem-based learning approaches. Kelley and Knowles (2016), on the other hand, claim that there is a need for a conceptual framework beyond a simple definition of STEM education. They explain STEM education as a process approach involving two or more STEM disciplines, including engineering and mathematical thinking, where the engineering design process is used to solve real-life problems with scientific inquiry.

Dare, Ring-Whalen and Roehrig (2019) point out that teachers have a limited understanding of what STEM is and what it means for their instruction. Çorlu, Capraro and Capraro (2014) recommend a teacher education model that integrate all STEM disciplines. Integrated STEM teacher education model is used in both pre-service and in-service teacher education (Akaygun & Aslan-Tutak, 2016; Çorlu, 2017). However, both of these studies did not describe how an integrated STEM teacher education model should be developed. Hence, more research needs to be done to look at teachers' understanding and implementation of STEM integration (Wang, 2011). The purpose of this study was to examine pre-service physics teachers' STEM lesson plans during their STEM integration attempts. To accomplish this, we addressed the following research question: *What are the challenges that pre-service physics teachers encounter during preparation of lesson plans in their STEM integration?*

Theoretical Framework

Moore et al. (2014)'s STEM integration framework includes six major principles for successful STEM education:

(1) a motivating and engaging context,

(2) the inclusion of mathematics and/or science content,

(3) student-centred pedagogies,

(4) an engineering design,

(5) an emphasis on teamwork and communication,

(6) learning from failure through redesign.

STEM integration is complex and challenging situation because it is a kind of curriculum integration (Wang, 2011). Research are often not clear about the key points that has been used to describe integration (Lederman & Niess, 1997), so we need to understand what challenges teachers face when preparing STEM lesson plan. One of the indicators of effective STEM integration is to prepare a STEM lesson plan (Jolly, 2016). Lesson plans are common pieces that teachers and pre-service teachers learn to develop in their preparation (Brown & Melear, 2006). Lesson plans are crucial data sources because they reflect teacher goals for their lessons. Lessons plans are valuable artefacts of teacher practices (Sias et. al, 2017).

Methodology

Multiple case study design was carried out for this research. Document analysis was used in the process of examining the teacher lesson plans. Bowen (2009) defines this research method as the systematic interpretation of research documents by researchers. This study included the attempt to prepare a lesson plan for STEM approach by 10 pre-service physics teachers who were in the second year of a Physics

Teaching Program. After participating in a STEM course for one semester, pre-service teachers were asked to create their own STEM lesson plans, based on their STEM approaches. STEM Lesson Plan Debugger developed by Jolly (2016) and revised by Ozel (2017) was used for analysing STEM Lesson plans. As shown in Table 1, it consisted of eight questions, possible answers given to the questions and their evidences.

Table 1. STEM Lesson Debugger

Questions	Answer	Evidence
1. Is the challenge interesting and relevant?	Yes Partially No	
2. Does the lesson help them make sense of the science and math they're learning?	Yes Partially No	
3. Does the lesson use an inquiry-based method of teaching and learning?	Yes Partially No	
4. Do your students feel safe about failing along the way?	Yes Partially No	
5. Do students know how to approach problem-solving?	Yes Partially No	
6. Are your students able to work successfully in teams?	Yes Partially No	
7. Do students have time to finish the lesson?	Yes Partially No	
8. Do students have opportunities to use and create technology?	Yes Partially No	

Results

Findings were reached by creating codes such as engagement of students, math and science objectives inclusion, inquiry-based teaching, ability to learn from failures, using problem solving strategies, collaboration and team work, prediction of the duration, and usage of technology. Codes were created by considering the evidence of the answers given to the questions in the STEM lesson plan debugger. Results showed that the pre-service physics teachers focused on just learning objectives of physics and ignore the maths learning objectives in their STEM lesson plans. The pre-service teachers thought that integration of math process was sorted out by solving physics problems, which were not related to engineering design process. The pre-service teachers focused only on one physics learning objective in their lesson plans. In addition, they had difficulty in implementing inquiry-based teaching since the questions they asked were usually comprehension questions. They were having trouble in asking upper-level questions. In general, the pre-service physics teachers were good at conducting the engineering design process, but they might bypass the redesign process. Also, they were not good at attracting students' attention and using technological tools. Their predicted lesson durations were shorter than the necessary. Finally, they did not have any problem with engagement of students into team work and presenting of the daily life problem.

Suggestions

As stated by Wang et al. (2011), professional development for pre-service teachers is needed if STEM integration is to be sustainable. When all implications are considered, some key points arise in preparing STEM lesson plans for pre-service teachers. They have to combine content with math and physics learning objectives tightly. They should bring out good questions such as what-if questions rather than asking comprehension questions into every session of their plans. Additionally, they should integrate mathematics to STEM courses in the engineering design process. For instance, graphics sketching, calculation and measurement can be used in the engineering design process. They should prepare handouts or STEM activity booklets together with materials for students. Especially, they should practice the STEM activity before class, measure how much time it takes and recognize the challenges of the STEM activity. As Moore et. al (2014) mentioned that 'ability to learn from the failures' is one of the key points of STEM integration, the necessary time should be devoted to redesign in the engineering design process by teachers. Since formative assessment can easily be incorporated into STEM lessons, pre-service teachers would use concept map, 3-2-1 Bridge, KLEW (Know-Learning-Evidence-Wonder) and rubrics. They would also use STEM lesson plan debugger because it is practical.

As Sias et. al (2017) suggest that more professional development and support might be needed to prepare teachers so that they would consider to integrate educational innovations into their lessons. This study provided a snapshot from pre-service physics teachers' lesson plans and suggests that more integrated STEM training courses would be included in teacher training programs.

References

Akaygun, S., & Aslan-Tutak, F. (2016). STEM images revealing stem conceptions of pre-service chemistry and mathematics teachers. International Journal of Education in Mathematics Science and Technology, 4(1), 56-71.

Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative research journal, 9(2), 27-40.

Breiner, J. M., Harkness, S. S., Johnson, C. C., & Koehler, C. M. (2012). What is STEM? A discussion about conceptions of STEM in education and partnerships. School Science and Mathematics, 112(1), 3-11.

Brown, S. L., & Melear, C. T. (2006). Investigation of secondary science teachers' beliefs and practices after authentic inquiry-based experiences. Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 43(9), 938-962.

Çorlu, M. S. (2017). STEM: Bütünleşik öğretmenlik çerçevesi. STEM kuram ve uygulamaları. İstanbul: Pusula Yayıncılık.

Corlu, M. S., Capraro, R. M., & Capraro, M. M. (2014). Introducing STEM education: Implications for educating our teachers in the age of innovation. Eğitim ve Bilim, 39(171), 74-85.

Dare, E.A., Ring-Whalen, E.,A., & Roehrig, G.,H. (2019) Creating a continuum of STEM models: Exploring how K-12 science teachers conceptualize STEM education, International Journal of Science Education, 41:12, 1701-1720.

Dewey, J. (1931). The way out of educational confusion. Cambridge: Harvard University Press.

Johnson, C. C., Peters-Burton, E. E., & Moore, T. J. (Eds.). (2015). STEM road map: A framework for integrated STEM education. Routledge.

Jolly, A. (2016). STEM by design: Strategies and activities for grades 4-8. Routledge.

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. International Journal of STEM Education, 3(1), 11.

Krajcik, J., & Delen, I. (2017). How to support learners in developing usable and lasting knowledge of
STEM. International Journal of Education in Mathematics Science and Technology, 5(1), 21-2.

Lederman, N. G., & Niess, M. L. (1997). Integrated, interdisciplinary, or thematic instruction? Is this a question or is it questionable semantics? School science and Mathematics, 97(2), 57.

Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., Glancy, A. W., & Roehrig, G. H. (2014). Implementation and integration of engineering in K-12 STEM education. In Engineering in pre-college settings: Synthesizing research, policy, and practices. Purdue University Press.

Sias, C. M., Nadelson, L. S., Juth, S. M., & Seifert, A. L. (2017). The best laid plans: Educational innovation in elementary teacher generated integrated STEM lesson plans. The Journal of Educational Research, 110(3), 227-238.

Tsupros, N., Kohler, R., & Hallinen, J. (2009). STEM education: A project to identify the missing components. Intermediate Unit, 1, 11-17.

Wang, H. H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). STEM integration: Teacher perceptions and practice. Journal of Pre-College Engineering Education Research (J-PEER), 1(2), 2.

Development of a Scale to Measure Attitude Towards STEAM Education

Sumeyra HALLAC[1], *Feral OGAN BEKIROGLU*[2]

Abstract

Being a trending branch of STEM education, STEAM has a unique approach to education by integrating art into other STEM subjects. Therefore, it requires its measurement tools. This study was based on merging two existing scales, one for measuring student attitudes toward STEM, other for measuring student attitudes toward Art to create a new tool for STEAM. The new scale included separate parts for Science, Technology, Engineering, Art, and Math; as well as a part for 21st Century Skills. "Scale for Student Attitudes toward STEAM" contained 58 Likert-scale items. The new scale was applied to 95 9th grade high school students in Istanbul, Turkey. Conducted validity and reliability tests ensured that this new scale was valid for measuring attitude toward STEAM.

Keywords

STEAM, attitude scale, validity, reliability

Introduction

A new era for education has arrived with STEM, making education more focussed on industrial developments and future careers. Contributed globally, STEM is evolving into many different forms according to the needs of various countries. STEAM has been a trending branch of STEM Education for a couple of years. While STEM has Science, Technology, Engineering, and Math, STEAM brings forth the Art subject as another part of this integration and giving a new meaning for the abbreviation. STEAM is defined as Science and Technology, interpreted through Engineering and Arts, all based in a language of Mathematics (Yakman, 2008).

Yakman (2008) claims that the art and the engineering contain all of the divisions that interact with the pure possibilities of the other fields to shape the direction of development. STEAM education

1 Marmara University, sumeyrahallac@gmail.com

2 Marmara University, fbekiroglu@marmara.edu.tr

integrates STEM with Art, using Art as a tool to enhance creativity, critical thinking, and entrepreneurship skills. STEAM prepares students for unknown future careers, provides 21st-century skills, and is a holistic education system which provides flexible and adaptive learning for individual students. We're in an ever-changing world, and we can't predict future careers mostly. But this doesn't mean we can't predict anything at all. We know what skills will be needed in those unknown career paths and how to choose career paths according to students' interests. Through Art and Engineering, STEAM includes a wide selection of possible careers and lets students experience them, therefore determine their latent skills and interests. With industry 4.0, current life problems and occupational needs have changed considerably. In addition to today's occupations and fixed program education, individuals can solve complex and dynamic problems, have 21st-century skills, know how to learn, always be open to development, and work in cooperation between countries. The study of Corlu and Callı (2017) shows that professionals who are constantly collaborating with their colleagues in different countries are successful. For this reason, 21st-century skills and competencies will be given within the framework of the STEAM training that can bring our country on par with developed countries.

Attitude is a positive, negative, or neutral feeling toward some object or behavior (Pryor, Pryor & Kang, 2014). In this research, "attitude" indicates whether the high school students agree or disagree if STEAM is meaningful in their lives, their curiosity towards STEAM and their thinking and feelings towards STEAM. Attitude is important because it is gained through learning, and it can lead an individual's behaviors and their process of decision, which might also cause bias (Ulgen, 1996).

While STEAM education is spreading among schools, it has become trivial to measure its effects. Attitude is one of these effects, and therefore, we required a tool for measurement. This scale was developed to measure student attitude toward STEAM and provide data about our studies on STEAM education.

Methodology

Two different scales were combined to create a STEAM attitude scale. The first part was the "Scale for Student Attitudes toward STEM", developed by Friday Innovation Institute of Education in 2012 and included 37 Likert-type items. This scale was adapted to Turkish by Ozcan and Koca in 2018; validity and reliability studies were conducted. The second part was the "Scale for Student Attitudes toward Art", developed by Dede in 2016 by reviewing the relevant literature and consulting expert opinions for attitude measurement. The STEM attitude scale, which was developed by Friday Institute (2012), was chosen because it was used in many literature studies related to STEM (Wiebe et al.,2013; Unfried, Faber & Wiebe, 2014; Holmquist, 2014; Unfried, Faber, Stanhope & Wiebe, 2015; Yelderen, Kahraman & Taş, 2016; Karakaya & Avgın, 2016; Leonard et al., 2016; Çevik,2017; Wiebe, Unfried, & Faber, 2018; Conrad, Polly, Binns, & Algozzine, 2018; and other studies). Dede's work (2016) was chosen for the art because the culture and values of our country were included. The scale comprised of 21 Likert-type items. The new combined "Scale for Student Attitudes toward STEAM" included 58 Likert type items.

The new scale was applied to 95 9th grade students in a High School in Istanbul. This was a boarding school; therefore there were many residing students from all over Turkey and had a variety of students' backgrounds. Out of these 95 students, 67.4% of them were female, and 32.6% were male. 84.2% of the students had a Certification of Appreciation in their school life, 10.5% had Certification of Acknowledgment, and 5.3% had no certificate of success.

24.2% of students had participated in a STEM or STEAM activity before the study, and the remaining 75.8% of students had never participated in any kind of STEM or STEAM activity beforehand.

Findings

Before performing the validity study, Kalmogorow Simirow test was conducted to determine if the test is parametric or non-parametric. The result was higher than .05, and one-way Anova test concluded that the scale was homogenous to gender. Therefore, parametrical tests were used.

To perform the Validity Study, Exploratory Factor analysis was conducted on items in the scale. According to the analysis, 13 factors were identified. Out of these 13 factors, 2 questions have been found as a factor of their own; therefore they were merged to closest factors, and the total number of factors is reduced to 11.

By this analysis, the measuring capability of this scale was found 75.11%. Cronbach's alpha coefficient value was calculated as .94 for the whole scale, meaning that it had high reliability. The result of the Kaiser-Meyer-Olkin test was determined as .75. The sample size was in medium-level Kais for factor analysis. Both validity and reliability tests were determined that this new scale is valid for measurement.

Discussion and Suggestions

While STEAM training becomes popular, the contribution of STEAM to the education needs to be measured. According to Erkus (2003); it is desirable in many areas to measure attitude and to know the degree of attitude. It is known that the attitude towards education is increasing academical success, so the results may support the continuous positive attitude of the students. The academical success of the students can be supported if the parts that cause positive attitude are identified and enhanced.

While this study is performed to a relatively diverse student group, it was still limited to a single high school. As Turkey has other types of high schools, it is suggested to extend the conduction of this scale to all types of high schools. Also, other grades can be included to increase the sample size. Findings of the validity and reliability of the scale can be used to determine students' attitudes towards specific features. If the scale is to be used in groups other than high school students, the validity and reliability tests should be reconducted with the obtained data. In this context, educators and policy-makers should work collaboratively to develop student attitudes and to enhance student knowledge and skills in these areas (Friday Institute for Innovation in Education, 2012).

References

Conrad, J., Polly, D., Binns, I., & Algozzine, B. (2018). Student perceptions of a summer robotics camp experience. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 91(3), 131-139.

Çevik, M. (2017). Content Analysis of Stem-Focused Education Research in Turkey. Journal of Turkish Science Education (TUSED), 14(2).

Çorlu, M. S., & Çallı, E. (2017). STEM Kuram ve Uygulamalarıyla Fen, Teknoloji, Mühendislik ve Matematik Eğitimi. Pusula Yayıncılık ve İletişim: İstanbul.

Dede, H. (2016). Öğrencilerin Sanata Karşi Bakiş Açilarini Ortaya Koymaya Yönelik Bir Tutum Ölçeği. İdil Sanat ve Dil Dergisi, 5(25), 1559-1576.

Erkuş, A. (2003). Psikometri üzerine yazılar. Ankara, Türk Psikologlar Derneği Yayınları.

Field, A. (2000). Discovering statistics using SPSS for Windows. Sage Publications. London, 2, 44-322.

Friday Institute for Educational Innovation (2012). Middle and High School STEM-Student Survey. Raleigh, NC: Author.

Holmquist, S. (2014). A multi-case study of student interactions with educational robots and impact on Science, Technology, Engineering, and Math (STEM) learning and attitudes.

Karakaya, F., & Avgın, S. S. (2016). Effect of demographic features to middle school students' attitude towards FeTeMM (STEM). Journal of Human Sciences, 13(3), 4188-4198.

Leonard, J., Buss, A., Gamboa, R., Mitchell, M., Fashola, O. S., Hubert, T., & Almughyirah, S. (2016). Using robotics and game design to enhance children's self-efficacy, STEM attitudes, and computational thinking skills. Journal of Science Education and Technology, 25(6), 860-876.

Özcan, H. & Koca, E. (2018). Turkish adaptation of the attitude towards STEM scale: A validity and reliability study. Hacettepe University Journal of Education. Advance online publication. doi: 10.16986/HUJE.2018045061.

Pryor, B. W., Pryor, C. R., & Kang, R. (2016). Teachers' thoughts on integrating STEM into social studies instruction: Beliefs, attitudes, and behavioral decisions. The Journal of Social Studies Research, 40(2), 123-136.

Unfried, A., Faber, M., & Wiebe, E. (2014). Gender and student attitudes toward science, technology, engineering, and mathematics. The Friday Institute for Educational Innovation at North Carolina State University, 51.

Unfried, A., Faber, M., Stanhope, D. S., & Wiebe, E. (2015). The development and validation of a measure of student attitudes toward science, technology, engineering, and math (S-STEM). Journal of Psychoeducational Assessment, 33(7), 622-639.

Ülgen, G. (1996). Eğitim psikolojisi. Ankara, Lazer Ofset.

Wiebe, E. N., Faber, M., Corn, J., Collins, T. L., Unfried, A., & Townsend, L. (2013, June). A large-scale survey of K-12 students about STEM: Implications for engineering curriculum development and outreach efforts (research to practice). In 2013 ASEE Annual Conference & Exposition (pp. 23-59).

Wiebe, E., Unfried, A., & Faber, M. (2018). The relationship of STEM attitudes and career interest. EURASIA Journal of Mathematics, Science and Technology Education, 14(10).

Yakman, G. (2008). STΣ@ M Education: an overview of creating a model of integrative education. Pupils Attitudes Towards Technology. 2008 Annual Proceedings. Netherland.

Yerdelen, S., Kahraman, N., & TAŞ, Y. (2016). Low Socioeconomic Status Students' STEM Career Interest in Relation to Gender, Grade Level, and STEM Attitude. Journal of Turkish Science Education (TUSED), 13..

Investigating Pre-Service Preschool Teachers' Opinions About Visiting Science Centers in Preschool Education

Hakkı Ilker KOSTUR[1], Hasan ÖZCAN[2]

Abstract

Science centers have played an essential role in building a bridge between science and society for decades. In Turkey, after the establishment of the first interactive science center in 1993, science centers have gained attention and increased in numbers with the help of funding and the popularity within the society. Currently, there is at least one science center in most of the cities in Turkey and they host thousands of visitors every day. Students constitute the majority of these visitors who come to science centers via school trips. Preschools in Turkey also visit science centers a few times every year. In this regard, opinions of preschool teachers are considered to be important as they graduate from a non-science discipline without taking any science courses since high school. To this end, this study aims to investigate pre-service preschool teachers' opinions about visiting science centers as a non-formal learning environment. The participants of the study consisted of 30 third grade pre-service preschool teachers who were registered to science education course in 2018-2019 fall semester at a private university in Ankara, Turkey. The data were collected through reflection papers. As a course requirement, the students were expected to visit a science center and write a reflection paper. The data were analyzed through content analysis to identify the emerging themes, categories, and codes. The results revealed three main categories: a) Things to do before, during, and after visiting science centers, b) Things that impress in science centers, c) Pedagogical aspects of school trips to science centers.

Keywords

Pre-school education, Non-formal learning environments, Reflection

Introduction

National Science Education Standards (NRC, 1996) define the classroom as a limited environment and suggests that "the school science program must extend beyond the walls", implying the importance of non-formal learning environments, including science centers and museums. In Turkish Science Curriculum for 3rd to 8th grades (MNE, 2018), places like school gardens, science centers, museums, planetariums, zoos, botanical gardens, natural environments are defined as non-formal learning en-

1 Baskent University, Faculty of Education, kostur@baskent.edu.tr
2 Aksaray University, Faculty of Education, hozcan@aksaray.edu.tr

vironments which are suggested for meaningful learning. Having similar science education aims, preschool education curriculum also suggests field trips to non-formal learning environments not only for science but for all the domains (MNE, 2013).

Non-formal learning environments have been a research subject since 1970s. Thier and Linn (1976) discusses the value of interactive learning experiences in science centers, Kimche (1978) indicates the increasing popularity of science centers as they help visitors understand the contemporary scientific issues of society, Feher and Rice (1985) questions how scientific concepts develop through interactive exhibits, and in late 80s, Grinell (1988) reports that 50 million Americans visit science centers every year.

It can be considered that science centers have a major role among non-formal learning environments. In 1992, with the effort to comply with the science centers trend in the world, Ankara Municipality made a contract with Ontario Science Center resulting the opening of the first interactive science center in Turkey in 1993 (The Official Gazette, 1992). Following this development, government raised funds to build science centers to every city in Turkey. Since then, many science centers have been opened and they host thousands of visitors every day.

Preschool science education is reported to be an underexplored subject (Greenfield et al., 2009). Tu (2006) identified that 86,8% of preschool teachers choose non-science activities to engage. This is a serious issue to investigate as there are many science goals in preschool education throughout the world. In Turkish educational system, preschools organize field trips and visit science centers a few times every year because non-formal learning environment visits are suggested for students in all grades including preschool. Primary school teachers have sufficient science background as they take science courses in university education and teach science to 3rd and 4th graders. However, preschool teachers do not have such background knowledge regarding science because they graduate from a non-science discipline without taking any science courses since high school. Therefore, it is significant to examine the opinions of pre-service preschool teachers about visiting science centers in preschool education. To this end, this study aims to investigate pre-service preschool teachers' opinions about school trips to science centers in preschool education.

Method

The data included reflection papers of 30 third grade pre-service preschool teachers who were registered to science education course in 2018-2019 fall semester at a private university in Ankara, Turkey. The assessment techniques of the course consisted of two formal pen and paper exams (i.e., a mid-term exam, a final exam), a project presentation, and a reflection paper about a visit to a science center. The participants were free to choose any of five science centers in the city. The task of writing a reflection paper required responding to certain semi-structured questions to reveal the participants' opinions thoroughly. In addition, the participants were asked to take a photograph of a scene by which they were impressed the most and attach it as an appendix to the reflection paper. The data were analyzed through content analysis in order to identify emerging themes, codes, and categories.

Results

The main categories emerged and sub-categories of each main category are shown below.

a) Things to do before, during, and after visiting science centers

- Discuss what's inside a science center
- Ask if children know anything about science centers
- Try to increase the excitement and curiosity

- Role playing, painting and showing videos about interesting things in science centers (such as dinosaurs, whales and planets)
- Discuss what children saw and like most

b) Things that impress in science centers

- Dinosaurs
- Fossils
- Valuable minerals (like Amethyst)
- Van de Graff generator
- Voice changing machine
- Robots
- Mirrors

c) Pedagogical aspects of school trips to science centers

- Many prediction questions can be asked
- Developing museum and science center culture
- Observation skill can be developed
- Real life experiences
- Learning by doing
- Learning and entertaining
- Curiosity and excitement to learn science
- Discussion and Conclusions

An important stakeholder of non-formal learning environments, science centres have been a research subject for almost half a century. Preschool children, with their teachers, are frequent visitors of science centres. Contrary to the expectations, preschool teachers are not eager to choose science activities in their courses (Tu, 2006) and preschool science is an underresearched school readiness domain (Greenfield et al., 2009). In this study, there was an effort to engage pre-service preschool teachers in hands-on interactive science exhibitions through science centres. As participants were soon-to-be preschool teachers, visiting a science centre task was their first experience in university period. Categories and sub-categories constructed important results on visiting science centres in preschool education. Opinions of pre-service preschool teachers reported in this study can be considered as a guide for preschool science centre trips. Other than the results of this research, participants general opinions were very positive against visiting science centres in preschool education.

References

Feher, E., & Rice, K. (1985). Development of scientific concepts through the use of interactive exhibits in a museum. Curator: The Museum Journal, 28(1), 35-46.

Greenfield, D. B., Jirout, J., Dominguez, X., Greenberg, A., Maier, M., & Fuccillo, J. (2009). Science in the preschool classroom: A programmatic research agenda to improve science readiness. Early Education and Development, 20(2), 238-264.

Grinell, S. (1988). Science centers come of age. Issues in Science and Technology, 4(3), 70-75.

Kimche, L. (1978). Science centers: A potential for learning. Science, 199(4326), 270-273.

MNE (Ministry of National Education) (2013). Preschool education curriculum. Ankara, Turkey: Ministry of

National Education. Retrieved from https://tegm.meb.gov.tr/dosya/okuloncesi/ooproram.pdf

MNE (Ministry of National Education) (2018). Science education curriculum (Primary and Middle School 3., 4., 5., 6., 7., 8th Grades). Ankara, Turkey: Ministry of National Education. Retrieved from http://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=325

NRC [National Research Council] (1996). National science education standards. National Academy Press, Washington, DC. Retrieved from https://www.csun.edu/science/ref/curriculum/reforms/nses/nses-complete.pdf

The Official Gazette (1992, March 9th). The official gazette article about purchasing a science center (Number: 21166). Retrieved from http://www.resmigazete.gov.tr/arsiv/21166.pdf

Thier, H. D., & Linn, M. C. (1976). The value of interactive learning experiences. Curator: The Museum Journal, 19(3), 233-245.

Tu, T. (2006). Preschool science environment: What is available in a preschool classroom?. Early Childhood Education Journal, 33(4), 245-251.

Girls in STEM: A Perspective of Female Students at the Vocational School of Technical Science in Turkey

Meryem DEMİR-GULDAL[1], *Funda SAVASCI-ACIKALIN*[2]

Abstract

The purpose of this study is to investigate views of female students studying at the vocational school of technical science about pursuing their further career in STEM fields in Turkey. Qualitative research methodology is adopted for the current study. Participants were purposively selected among students studying at the vocational school of technical science since vocational schools have a significant role for preparing students to pursue career in STEM. Six female students voluntarily participated in the study. Data were collected from semi-structural interviews. An interview protocol has four main questions revised and validated based on expert views in addition to demographic questions about participants' background information. Findings of the study indicated that girls studying at the vocational school of technical science were pleased to see a female instructor as a role model in their school. All participants indicated that they were eager to pursue in their further career in STEM. They are not concerned about being few girls at their school. They think that being few female students at the technical vocational school can be an advantage for finding a job. However, they still are concerned about finding a job since men are more desirable as operators in industry.

Keywords

STEM; Girls; Vocational Schools of Technical Science; Career Selection; Gender

Introduction

In recent years, STEM education has received much attention as a result of the global economic competition. Today's world requires more interdisciplinary studies since there is an increasing need for educated people in STEM related fields. STEM education has become an economic factor especially in developed and developing countries (Kennedy & Odell, 2014). Turkey is one of the countries that paid more attention on STEM education in the last years (Akgündüz & Ertepınar, 2015). Although STEM is getting more interests, girls' engagement in STEM is not at the desired level (Broadley, 2015). Moreover, there is a meaningful relationship between gender equality and girls' attitudes towards STEM (Stoet & Geary, 2018). Gender is one of the factors affecting the choice of career in STEM and the exis-

1 Istanbul University-Cerrahpasa Vocational School of Technical Science meryem.demir@istanbul.edu.tr
2 Istanbul University-Cerrahpasa Hasan Ali Yücel Faculty of Education, fsavasci@istanbul.edu.tr

tence of implicit gender may be one of the reasons why girls do not choose career in STEM (Smeding, 2012). Girls especially need more teacher support to participate in mathematics and science while boys are more interested in mathematics and science when they decide to pursue career in STEM fields (Fredricks, et al., 2018). Dubetz & Wilson (2013) also indicated the lack of representation of girls in engineering, mathematics and science in the United States. However, the situation is still promising since international studies such as TIMSS and PISA point out girl's success in STEM in Japan and Singapore. Bamberger (2014) listed possible reasons why girls feel fear in choosing career in STEM as cognitive or developmental gaps, and cultural context. Cultural factor can be an important affecting girl's choice in STEM. It is needed to investigate girls' views from different cultural contexts about pursuing career in STEM. Therefore, the purpose of the current study was to investigate views of female students studying at the vocational school of technical science in one of the largest university of Turkey about pursuing further career in STEM and their experiences and feeling as being a female student at the technical vocational schools. The following research questions were investigated for the current study:

1. What do female students think about pursuing their further career in STEM related fields?
2. What are female students' experiences and feelings about studying at the vocational schools of technical science?

Data Collection

Qualitative research methodology was adopted for the current study. The main purpose of the qualitative studies is to understand how participants construct meaning and how they make sense of their experiences (Merriam, 2018). Purposeful sampling was used as a sampling technique since it provides more information related to purpose of the study. Participants were six female students studying at vocational school of technical science in one of the largest universities of Turkey. All of them were voluntarily participated in the study. Data were collected from semi-structured interviews. An interview protocol consists of four main questions in addition to demographic questions related to participants' background information. All questions were designed based on the literature by researchers and revised by two experts in science education. Each interview took approximately 20-25 minutes.

Data Analysis

All interviews were transcribed and organized for data analysis. Data from interviews were inductively analysed. All transcripts were coded and categorized based on the research questions. Researcher triangulation and member checking techniques were used for trustworthiness and credibility (Merriam, 2018).

Findings

1. Research Question: What do female students think about pursuing their further career in STEM related fields?

Data from interviews were analysed in terms of two categories (career preferences and role modelling) in order to response the first research question. All of the participants were planning to continue on their further education at undergraduate programs related to STEM. One of the student said that she wants to be a chemical engineer and added that she wanted to work in cosmetics. Most of the participants indicated that they preferred working in the laboratory rather than in industry.

Role model seemed to be one of the significant factors affecting girls' choices to pursue careers in STEM related fields. Except one student all participants indicated that their career choices were affected by role models working in STEM areas. For example, one of the students said that her role model was a female chemical engineer at the factory where she did her internship. All participants agreed that they felt lucky for having female instructors at their schools. One said that "I felt as if there was not anybody and I shouldn't be here since almost all of my classmates were male. When I saw the female instructors at my school, the situation has been changed.' Another said that "Oh, then that means we can also be like that"

2. What are female students' experiences and feelings about studying at the vocational schools of technical science?

All participants agreed that course work at the vocational school should be more practice-based. They all agreed with the only three courses they took were practical as technical drawing, solid woks, and computer classes. One said that "in high school, we mostly worked in the laboratory it was pretty useful then we learned how to do different things in there".

Participants stated that they were generally happy to be a female student at the vocational school of technical science. They were not concerned about being few female students since they thought that less girls meant more job opportunities. Even if they were not concerned, they still wanted to increase the number of female students at their school. One said that she preferred to ask a favour from females rather than males. She said that she felt uncomfortable to ask anything from male classmates. Another student said that she felt more privilege for being the only female student in the classroom. One student added that there were not any advantages or disadvantages since men and women were equal. She also added that "people usually think that men do better but I believe that women do better and more carefully than men". She did not think that gender could not an important factor in finding a job in STEM fields. Except her, all the other participants agreed that men had much more chances for finding a job in industry than women. One of the participants said that "one can say that men and women are equal but I do not agree with this view. I think if I apply for a job and one of male classmates do, he would be chosen rather than me"

All participants indicated that their families had concern about sending her daughters to the technical vocational schools but they began to feel more comfortable for a while. One girl said that "my family firstly made fun of me by saying that was it a rubber [department name](by laughing)? Then they observed my assignments with solidworks which is used for designing in engineering, their prejudices were decreased"

Discussion and Suggestions

The findings of the current study indicated that girls' interest in STEM related areas was positive while they felt they were unlucky finding a job when compared to men. Findings of the study is consistent with findings of the studies in the literature (Bamberger, 2014; Broadley, 2015). As indicated by Bamberger (2014) and Broadley (2015), role model is a significant factor affecting girls' career choices in STEM. Although there has been progress in narrowing the gender gap in science over the past thirty years, girls remain underrepresented in many areas such as physics, engineering, and technology (Brotman & Moore, 2008). Dasgupta & Stout (2014) studied on gender inequality in STEM and explored certain factors such as learning environments, peer relationship, family characteristics may affect STEM interest. Similarly, the current study indicated that society especially family may have some prejudice against girls in some STEM areas especially in industry. Further studies will shed light on the question of how girls can be more represented in the STEM field.

References

Akgündüz, D. & Ertepınar, H. (2015). STEM eğitimi Türkiye raporu. Scala Basım: İstanbul.

Bamberger, Y. M. (2014). Encouraging girls into science and technology with feminine role model: Does this work? Journal of Science Education and Technology 23(4), 549–561.

Broadley, K. (2015). Entrenched gendered pathways in science, technology, engineering and mathematics: Engaging girls through collaborative career development. Australian Journal of Career Development 24(1), 27–38.

Brotman, J.S. & Moore, F.M. (2008). Girls and science: A review of four themes in the science education literature. Journal of Research in Science Teaching 45(9), 971-1002.

Dasgupta, N. & Stout, J. G. (2014). Girls and women in science, technology, engineering, and mathematics: Steming the tide and broadening participation in stem careers. Policy Insights from the Behavioral and Brain Sciences 1(1), 21– 29.

Dubetz, T. & Wilson, A. J. (2013). Girls in engineering, mathematics and science, GEMS: A science outreach program for middle-school female students. Journal of STEM Education 14(3), 41.

Eccles, J. S. & Wang, M. (2016). What motivates females and males to pursue careers in mathematics and science? International Journal of Behavioral Development 40(2), 100–106.

Fredricks, J. A., Hofkens, T., Wang, M., Mortenson, E. & Scott, P. (2018). Supporting girls' and boys' engagement in math and science learning: A mixed methods study. Journal of Research in Science Teaching 55(2), 271–298.

Glesne, C. (2015). Nitel araştırmaya giriş. Anı Yayıncılık: Ankara.

Kennedy, T. J. & Odell, M. R. L. (2014). Engaging students in STEM education. Science Education International 25(3), 246-258.

Merriam, S.B. (2018). Nitel araştırma desen ve uygulama için bir rehber. Nobel Yayıncılık: Ankara.

Siew, N. M., Amir, N. & Chong, C. L. (2015). The perceptions of pre-service and in-service teachers regarding a project-based STEM approach to teaching science. Springer Plus 4(8), 1-20.

Smeding, A. (2012). Women in science, technology, engineering, and mathematics (STEM): An investigation of their implicit gender stereotypes and stereotypes' connectedness to math performance. Sex Roles 67, 617–629.

Stoet, G. & Geary, D. C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. Psychological Science 29(4), 581–593.

STEAM-Boats: A Material Design Activity

Hakkı Ilker KOSTUR[1], Hasan ÖZCAN[2]

Abstract

Many schools adopted STEM approach and STEM centers were funded in several cities in Turkey. STEM has become an important academic focus. There are various studies carried out in Turkey which report positive contribution of STEM approach on science education. On the other hand, some of these studies showed evidence of failures in pre-service teachers' material design processes (Delen & Uzun, 2018; Kinik-Topalsan, 2018; Tarkin-Celikkiran & Aydin-Gunbatar, 2017). As it is an important component of STEM education (Cepni, 2018, p.V; MNE, 2018), it can be concluded that more attention should be paid on material design. In this study, pre-service primary school teachers (PTs) were involved in a 2-hour material design activity: STEAM-Boats. STEAM-Boat -can also be called STEM-Boat- was named with the effort to relate the steamboat vessels and the STEM approach in order to draw attention. Content analysis technique was used to analyze the essays and videos. As a result, almost all of the PTs indicated that they enjoyed the activity very much. Findings showed that STEAM-Boats is a convenient and fruitful activity to involve participants in a material design process. As a plus, this activity can be applied in every grade level. It is recommended to be conducted while teaching buoyancy, and force and motion topics. In addition, this activity should be a part of in-service trainings to foster teachers to design materials.

Keywords

Pre-school education, STEM education, Material design, Buoyancy experiments

1 Baskent University, Faculty of Education, kostur@baskent.edu.tr
2 Aksaray University, Faculty of Education, hozcan@aksaray.edu.tr

Introduction

A few years ago, studies reported that there had been a STEM education reform in Turkey (Çınar, Pırasa, Uzun, ve Erenler, 2016; Akgündüz vd., 2015). With the launch of the STEM based 2018 science education curriculum in Turkey (MNE, 2018), popularity of STEM education has reached at its highest level ever. Now, STEM can be encountered every day. Many schools adopted STEM approach and STEM centers were funded in several cities in Turkey. In addition, STEM has become an important academic focus.

There are various studies carried out in Turkey which report positive contribution of STEM approach on science education. On the other hand, some of these studies showed evidence of failures in pre-service teachers' material design processes (Delen & Uzun, 2018; Kinik-Topalsan, 2018; Tarkin-Celikkiran & Aydin-Gunbatar, 2017). As it is an important component of STEM education (Çepni, 2018, p.V; MNE, 2018; NGSS, 2013; NRC, 2012), it can be concluded that more attention should be paid on material design.

In this study, pre-service classroom teachers (PCTs) were involved in a 2-hour material design activity: STEAM-Boats. STEAM-Boat -can also be called STEM-Boat- was named with the effort to relate the steamboat vessels and the STEM approach in order to draw attention. The activity was prepared by the authors of this study. Participants of the study were PCTs who were registered to Science Laboratory II course in a private university in Ankara, Turkey in 2018-2019 spring semester. There were 48 participants who were grouped in 4-person collaborative groups. One week before the application, PCTs were informed to bring the materials needed to build STEAM-Boats. In addition, they were told to search about toy boats and bring additional materials if they would need.

Method

The materials included easy to find and cost-effective which were mainly milk boxes, plastic straws, balloons, toy motors, batteries, propellers and hot glue.

At the beginning of the course, rules for designing a STEAM-Boat were presented to groups:

1) It will be designed with the materials groups brought to class in given time;

2) It should cruise a distance of 2 meters straight in the water pool which is in front of the faculty building;

3) It will float balanced on water without leaking any water in;

4) Each group will shoot a video of their final trial and e-mail it to the authors.

PCTs had 90 minutes to design and try their materials in the pool. All of the groups completed their tasks. At the final part of the course, PCTs opinions were collected through short essays. Content analysis was used to analyze the essays and videos were investigated to see and hear PCTs reactions.

Findings

Almost all of the PCTs indicated that they enjoyed the activity very much although some of them complained and wished to have more time for the design process. PCTs opinions were grouped in two categories: a) Feelings about the activity (Table 1), b) Benefits of the activity (Table 2).

Table 1: Participants' feelings about the activity

Feelings about the activity	**N**
Entertaining	34
I like this activity very much	25
I would like to have more time	8

Table 2: Participants' statements about the benefits of the activity

Benefits of the activity	N
Instructive	23
Science process skills can be learned	15
Buoyancy can be taught	13
This is a STEM activity	9
Force and motion can be taught	9
Easy to find materials	6

Result

Authors believe that STEAM-Boats is a convenient and fruitful activity to involve participants in a material design process. As a plus, this activity can be applied in every grade level.

It can be recommended to be conducted while teaching buoyancy, and force and motion topics. In addition, this activity should be a part of in-service trainings as well as pre-service teachers' course activity to foster teachers to design materials.

References

Cepni, S. (2018). Kuramdan uygulamaya STEM egitimi. Ankara: Pegem.

Delen, I., & Uzun, S. (2018). Evaluating STEM based learning environments created by mathematics pre-service teachers. Hacettepe Journal of Education, 33(3), 617-630.

Kinik-Topalsan, A. (2018). Evaluation of the elementary school teacher candidates' engineering design based science instruction activities. Van Yuzuncu Yil University Journal of Education, 15(1), 186-219.

MNE (Ministry of National Education) (2018). Science Education Curriculum (Primary and Middle School 3., 4., 5., 6., 7., 8th Grades). Ankara, Turkey: Ministry of National Education.

Tarkin-Celikkiran, A., & Aydin-Gunbatar, S. (2017). Investigation of pre-service chemistry teachers' opinions about activities based on STEM approach. Van Yuzuncu Yil University Journal of Education, 14(1), 1624-1656.

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