Journal of STEAM Education
Journal of Science, Technology, Engineering, Mathematics and Art Education
2021, July. (Issue: 2, Volume: 4)

DETERMINING THE STUDENTS' ATTITUDES TOWARDS STEM: E-TWINNING PROJECT FROM STEM CLUB TO STEM SCHOOL

Cem MORAN[1], Candan KİLBUL[2] & Gizem MORAN[3]

Article History

Received: 27 Dec 2020

Received in revised form:

25 Jan. 2021

Accepted: 16 Mar. 2021

Published: 30 July 2021

ABSTRACT

In the research, the attitudes of the participants studying at primary school level towards STEM education approach were examined. e-Twinning project was created from "STEM club to STEM school" to integrate STEM education approach into the program. The aim of our project is to make students do STEM activities and increase their interest in STEM fields. The aim of this research is to determine the STEM attitudes of the students who are doing the e Twinning project on STEM. It was used in the screening model from quantitative research methods in the research. STEM primary school attitude Survey was used as a data collection tool in the research. The sample of the research consists of 215 students attending the 3rd and 4th grades in the project. In the research, the data were collected with STEM primary school attitude scale consisting of 37 substance sub-dimesons developed by Faber, Wiebe, Corn, Townsend and Collins (2013) and adapted to Turkish by Özyurt, Kusdemir and Başaran (2018) for primary schools. Analyzed with SPSS 21 Program. The confidence of the scores obtained from the scale was found to be 0.95. In the research, it was reached that students' attitudes regarding STEM education were high. According to the findings of the research, it was determined that the attitudes of the students who went to the science center in STEM e Twinning project were more positive than the students who did not go. It was determined that STEM attitudes were more positive for students who experimented outside the lesson than students who did not. It can be said that students who experiment outside the lesson develop a more positive attitude in science, engineering – technology and 21st century skills than students who do not conduct extra-lesson experiments. Students who used interactive boards in the lesson were found to have a more positive attitude in science and 21st century skills in their sub-dimensions than students who did not use interactive boards in the lesson. A positive correlation was found between science, technology, engineering and mathematics and STEM, which are the sub-dimensions of STEM.

Keywords: STEM, Attitude, e Twinning, Primary School.

[1]Primary Teacher, Ministry of National Education, Çanakkale, Turkey, cem_moran20@hotmail.com, 0000-0001-8267-3193
[2]Primary Teacher, Ministry of National Education, İzmir, Turkey, candankilbul@gmail.com, 0000-0003-0554-9708
[3]Primary Teacher, Ministry of National Education, Çanakkale, Turkey, severmorangizem@gmail.com, 0000-0002-6393-6258

Moran, C., Kilbul, C. & Moran, C. (2021). Determining the students' attitudes towards STEM: e-Twinning project from STEM club to STEM school. *Journal of STEAM Education, 4*(2), 102-117.

INTRODUCTION

New situations such as the change of expectations for schools, the new generation student profile and the reflections of technological developments on education have necessitated the development of new models in the field of education (Sağsöz, 2019). Advances in technology is pushing to change the education system in Turkey. One of the training models that meets the requirements of our time is the STEM education model (Yıldırım, 2016). STEM consists of the initials of the words Science, Technology, Engineering and Mathematics. (Gonzalez, & Kuenzi, 2012). The concept of STEM was first put forward by Judith Rahmaley in the world in 2001 (White, 2014) but is based on the early 19th century (Ostler, 2012: 55). STEM education can be considered as an approach where different disciplines are used together, allowing students to specialize in different fields, directing individuals to research and question (Akgündüz et al., 2015; Yıldırım, 2016). With STEM education, students will discover their own skills and gain an entrepreneurial and producing identity (Katz, 2010; Lindeman, Jabot & Berkley, 2014). They will have education in accordance with the 2030 sustainable development goals (Avan, Yılmaz, & Doğanay, 2019; Soylu, 2016). STEM education is an approach that can meet the human resources needed by the state economy (Kılıç & Ertekin, 2017).

STEM education can be defined as an interdisciplinary approach that includes a wide educational life from preschool to higher education (MoNE, 2016: 12). This educational model is an important element in developing interdisciplinary integration in accordance with 21st century skills (Roberts, 2012; Sarıpınarlı, 2018). Individuals who are raised in accordance with 21st century skills and countries that organized schools in accordance with 21st century skills adapt to this age by progressing in science and technology (Öztürk, 2020; Akgündüz et al., 2015).

In order to provide STEM education correctly, the learning teaching process needs to be planned correctly. There are many learning model methods and techniques used to fully transfer STEM education to students. These are mastery learning, 5E model and project-based learning (Gülen and Yaman, 2018). The most preferred STEM education model is the 5E model (Gülen & Yaman, 2018).

In STEM education, as in constructivist education, it is aimed to give students the skills of critical thinking, creativity, collaboration, and solving daily life problems, which are shown as 21st century skills. When the 5E learning model is applied in STEM education, the student concentrates the attention of the lesson, researches the information, groups it and uses what they learn in solving different situations (Bybee, 2009; Güven, Selvi, & Similar, 2018; Donkoh, Osei & Kofi-Annan 2021). The 5E learning model consists of Engage, Explore Explain, Elaborate and Evaluate stages (Güven et al., 2018; Donkoh et al., 2021).

Today, it is important for countries to use STEM to improve their economies. With the developments in science, technology, engineering and mathematics, the technologies of the countries are also developing. With these technological innovations, the economies of the countries are rising. Technically leading countries in the world are the most powerful countries in the world. Therefore, STEM education helps develop the economies and technologies of countries (Yildirim, 2016). The great promises of STEM education encouraged the spread of the idea to many other countries. One of these countries is Turkey (Soylu, 2016; Akgündüz et al., 2015).

In recent years, it has been working to integrate STEM practices into courses in private schools and public schools (Soylu, 2016). Various studies have been carried out in STEM field by the Ministry of National Education (since 2019). For example, they prepared a research called "Gain Based STEM Applications" by the General Directorate of Private Education Institutions and presented it to teachers. Many in-service trainings have been organized and tried to address the need in this field. In the reports on innovative practices in the field of education in Turkey, it is stated that we should improve STEM education. By attaching importance to STEM issues in Turkey, calls are made to develop the individuals that the business world wants (Ebony, 2020).

When the literature in the field of STEM is examined, it is understood that there are many studies for students studying in different types of schools (Abanoz, 2020; Bozdoğan & Yalçın, 2006; Damar, Durmaz & Önder, 2018; Demiral & Özacar, 2018; Güneş, Şener, Gonzalez, & Kuenzi, 2012, Topal-Germi, & Can, 2013; Katz, 2010; Keskin, Karagölge and Ceyhun, 2019; Öztürk, 2020; Lindeman et al, 2014; Şahin, Ayar and Adıgüzel 2014; Yıldırım, 2016; Yıldırım and Selvi, 2018; Yıldırım and Altun, 2015).

eTwinning project was created from “STEM club to STEM school" to integrate STEM education approach into the education program. eTwinning (partner school network) is a platform for inter-school collaboration platform supported by the European Union.

The aim of this research is to examine the primary school students' attitudes with STEM plans for STEM education in terms of various variables. These variables are going to the science center, doing experiments in the classroom, doing experiments outside of the lesson, using the laboratory in the lesson, using a tablet in the lesson, using an interactive board in the lesson, being interested in the project homework, participating in the project competition, and getting information from the STEM specialist. With this research, primary school students' attitudes with STEM will be determined and STEM activities suitable for primary school students can be planned.

METHOD

It was used in the survey model from quantitative research methods in the research. The survey model is a model that aims to describes the situation that has happened before or is still ongoing as it exists (Karasar, 2015). The aim of this research is to determine the STEM attitudes of the students who have been in the STEM e Twinning project. The students who took part in the study carried out studies in stem project one Twinning portal for 6 months. The attitudes of the students regarding STEM activities during this period were tried to be revealed with a quantitative understanding. STEM primary school attitude scale was applied to students. The collected data of the students were translated into findings and interpreted. Surveys were applied to students by classroom teachers in their classrooms.

Sample

The research group of the research consists of 215 students attending 3rd and 4th grade who participated in the Twinning project from "STEM Club to STEM School". Students participated in the STEM Club to STEM School project in September 2019-2020 academic year. Many STEM activities were carried out in the project. Participating students are students who are involved in the STEM project from different schools. The research was conducted in November of the 2019 -2020 academic year.

Data Collection Tool

Developed by Faber, Wiebe, Corn, Townsend, and Collins (2013), Primary / Secondary School Students' Attitude Towards STEM scale adapted to Turkish by Özyurt et al. (2018) was applied. The scale was applied to primary schools in Gaziantep province in the 2016-2017 academic year. The scale has been found to be applicable to primary schools. The questions in the findings section of the research (Science Center etc.) are the questions in the original of the scale. Since these 8 questions were in the questionnaire, they were asked to the students. The scale consists of 4 sub-dimensions, 5-point Likert type 37 items. It consists of STEM attitudes on scale and sub-dimensions of science, mathematics, technology-engineering and 21st century skills. The measurement tool was scored with a sequential 5-point Likert-type scale such as I do not agree (1), I strongly agree (5).

Practice Process

The project was implemented in classrooms for 6 months. Project partner teachers prepared STEM activities. STEM activities were held with students in the classroom. Since it was thought that it would be more meaningful for students to understand the questionnaire questions and answer the questionnaire themselves, it was administered to 3rd and 4th grade students. Participants filled in the questionnaires online in classrooms under the supervision of their teachers.

Data Analysis

Data analyzed with SPSS 21 Program. The reliability alpha score obtained from the scale was found to be 0.95. In this research, students' attitudes to STEM and sub-dimensions were examined. Substances of scale were examined in 5 topics: STEM, science, engineering, technology, 21st century skills and mathematics sub-dimensions. Arithmetic mean, standard deviation analyses of STEM and its sub-dimensions were carried out. T-test was performed for STEM and its sub-dimensions. For each item "Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly Agree (5). STEM attitudes of the students were accepted as the average between 1.00 - 2.33 "low", the average between 2.34 - 3.66 as "medium", and the average between 3.67 and 5.00 as "high" and interpreted accordingly. Correlation analysis was performed to determine which sub-size of STEM is the relationship with STEM.

Frequency was used to determine students' attitudes and sub-dimensions. Correlation test (Pearson moments product correlation coefficient) was used to detect the relationship between sub-dimensions. The level of meaningfulness in the research was taken as $p<0.01$ and $p<0.05$. The research findings were analyzed by sub-sections and converted into tables.

FINDINGS

STEM education and sub-dimensions of the students in primary schools were examined. STEM attitude scale is discussed in four sub-dimensions: science, mathematics, engineering, technology and 21st century skills. STEM attitudes and sub-dimensions were examined.

Table 1. Average and standard deviation values for STEM and sub-dimensions of primary schools

Dimensions	N	X	SD
Science	215	4.09	.67
Engineering - Technology	215	4.09	.69
21st Century Skills	215	4.21	.61
Mathematics	215	4.13	.69
STEM	215	4.13	.56

Primary school students had high attitudes to the science sub-dimension (X=4.09), high attitudes to the lower dimension of mathematics (X =4.09), high attitudes to 21st century skills (X=4.21), high attitudes to mathematics (X=4.13) and high attitudes to STEM (X =4.13). It can be said that primary school students have a high attitude towards STEM.

Findings of the Variable to Go to the Science Center

The results of the t-test for independent samples made in order to find out whether there is a difference in the attitudes of primary school students towards STEM and its sub-dimensions in terms of going to the science center variable are shown in Table 2.

Table 2. Findings on the variable to go to the science center

	Going to the science center	N	X	S	sd	t	p
Science	Yes	85	4,16	.73	215	1.24	.21
	No	130	4,05	.63			
Engineering - Technology	Yes	85	4,20	.74	215	1.98	.04*
	No	130	4,01	.66			
21st century. Skills	Yes	85	4,28	.62	215	1.21	.42
	No	130	4,17	.62			
Maths	Yes	85	4,19	.69	215	1.04	.12
	No	130	4,09	.71			
STEM	Yes	85	3.75	.60	215	1.66	.69
	No	130	3.73	.53			

When we looked at Table 2, it was found that there was no significant difference between students who went to the science center and those who did not go and STEM attitude [$t_{(213)}$=1.66, p>0.05]. When we looked at the sub-dimensions of STEM, there was a significant difference with the Engineering-Technology sub-field between those who went to the science center and those who did not go [$t_{(223)}$=1.98, p<0.05]. According to this finding, it can be said that students who go to the science center have a more positive attitude towards engineering, technology than students who do not go to the science center. There was no significant difference between other sub-dimensions and going to the science center.

Findings on the Variable for Experimenting in the Lesson

The results of the t-test for independent samples conducted to find out whether there is a difference in the attitudes of primary school students towards STEM and its sub-dimensions in terms of the experiment in lesson variable are shown in Table 3.

Table 3. Findings on the variable of experimentation in the lesson

	Experimenting in class	N	X	S	SD	t	p
Science	Yes	189	4,10	.66	215	.50	.62
	No	26	4,03	.81			
Engineering - Technology	Yes	189	4,13	.69	215	1.56	.12
	No	26	3,89	.71			
21st century. Skills	Yes	189	4,23	.61	215	1.02	.30
	No	26	4,20	.69			
Maths	Yes	189	4,16	.68	215	1.59	.11
	No	26	3,93	.82			
STEM	Yes	189	4,15	.55	215	1.42	.16
	No	26	3,97	.62			

When we look Table 3, there was no significant difference between students who experimented and students who did not experiment in the lesson and STEM attitude [$t_{(213)}$=1.42, p>0.05]. No significant difference was found between the sub-dimensions of STEM, science, engineering - technology, mathematics and 21st century skills, and the students who experimented in the lesson and did not. It can be said that experimenting in the lesson does not affect students' STEM attitudes.

Findings on the Variable for Experimenting Outside the Lesson

T-test results are shown in Table 4 for independent samples to find out if primary school students' attitudes toward STEM and their sub-dimensions differ in the variable of experimenting outside the lesson.

Table 4. Findings on the variable of experimentation outside the lesson

	Experimenting outside of class	N	X	S	sd	t	p
Science	Yes	143	4,18	.66	215	2.65	.01*
	No	72	3,92	.67			
Engineering - Technology	Yes	143	4,22	.69	215	3.98	.00*
	No	72	3,83	.63			
21st century. Skills	Yes	143	4,30	.64	215	2.97	.00*
	No	72	4,04	.55			
Maths	Yes	143	4,16	.69	215	.72	.48
	No	72	4,08	.72			
STEM	Yes	143	4,21	.56			
	No	72	3,97	.51	215	3.09	.00*

When we look Table 4, a significant difference was found between the STEM attitude of the students who did and did not experiment outside the lesson [t (213) = 3.09, p <0.05]. It can be said that students who do experiments outside of the classroom have a more positive attitude towards STEM than students who do not do it. When the sub-dimensions are examined, the students who do experiments outside the lesson have science [t (213) = 2.65, p <0.05], engineering - technology [t (213) = 2.98, p <0.05] and 21st century. It can be said that the skills [t (213) = 2.97, p <0.05] developed a more positive attitude than the students who did not do the experiments outside the classroom. There is no significant difference between the mathematics sub-dimension of those who do experiments outside the classroom and those who do not. It can be said that students who do experiments outside of the classroom have developed a positive attitude towards STEM and its sub-dimensions compared to students who do not do it.

Findings on the Variable for Using a Laboratory in a Lesson

T-test results for independent samples conducted to find out if the attitudes of primary school students towards STEM and its sub-dimensions differ in terms of the variable of using laboratories in the lesson are shown in Table 5.

Table 5. Findings on the variable of using laboratories in the lesson

	Using the laboratory in the classroom	N	$\bar{x}$	S	sd	t	p
Science	Yes	41	4,18	,60	215	1.03	.30
	No	174	4,06	,69			
Engineering - Technology	Yes	41	4,18	,59	215	1.00	.32
	No	174	4,06	,72			
21st century. Skills	Yes	41	4,34	,50	215	1.46	.14
	No	174	4,18	,64			

Maths	Yes	41	4,09	,81	215	.3 7	.71
	No	174	4,14	,67			
STEM	Yes	41	4,20	,52	215	.92	.36
	No	174	4,11	,57			

When we look Table 5, there was a significant difference between the STEM attitude of the students who did not use the laboratory [$t_{(213)}$=. 92, p>0.05]. There was no significant difference between the sub-dimensions of STEM: science, engineering – technology, mathematics and 21st century skills and students who used laboratories in the lesson and students who did not. In the lesson, it can be said that students who do not use laboratories do not have the effect of developing a positive attitude to STEM.

Findings on Tablet Use Variable in the Lesson

The results of the t-test for independent samples conducted to find out if the attitudes of primary school students towards STEM and their sub-dimensions differ in terms of the variable of using tablets in the lesson are shown in Table 6.

Table 6. Findings on the variable of using tablets in the lesson

	Using tablets in class	N	X	S	SD	t	*p*
Science	Yes	99	4,08	,74	215	-.27	.79
	No	116	4,10	,61			
Engineering - Technology	Yes	99	4,08	,78	215	-.19	.85
	No	116	4,10	,63			
21st century. Skills	Yes	99	4,21	,67	215	-.02	.98
	No	116	4,21	,58			
Maths	Yes	99	4,14	,69	215	.22	.83
	No	116	4,12	,71			
STEM	Yes	99	4,13	,60	215	-.08	.94
	No	116	4,13	,52			

When we look Table 6, there was no significant difference between students who used tablets and students who did not use tablets and STEM attitude [$t_{(213)}$=-.08, p>0.05]. There was no significant difference between science, engineering – technology, mathematics and 21st century skills, which are the sub-dimensions of STEM, and students who did not use tablets in the lesson. It can be said that using and not using tablets in the lesson does not improve students' attitude towards STEM.

Findings on the Variable for Using Interactive Boards in the Lesson

T-test results were shown in Table 7 for independent samples to find out if the attitudes of primary school students towards STEM and their sub-dimensions differed in terms of the variable of using interactive boards in the lesson.

Table 7. Findings on the variable of using interactive boards in the lesson

	Using smart boards in class	N	X	S	SD	t	*p*
Science	Yes	193	4,12	,64	215	1.99	.04*
	No	22	3,82	,85			
Engineering - Technology	Yes	193	4,10	,66	215	.81	.42
	No	22	3,97	,99			
21st century. Skills	Yes	193	4,25	,54	215	2.64	.01*
	No	22	3,89	1,04			
Maths	Yes	193	4,15	,69	215	1.01	.31
	No	22	3,99	,80			
STEM	Yes	193	4,16	,51	215	.00	.06
	No	22	3,92	,85			

When we look Table 7, there was no significant difference between STEM attitude and students who used and did not use interactive boards in the lesson[$t_{(213)}$=0.00, p>0.05]. Students who use interactive boards in the lesson have science[$t_{(213)}$=1.99, p<0.05] and 21st century skills [$t_{(213)}$=2.64, p<0.05] was found to have a more positive attitude in the lesson than students who did not use interactive boards. There was no significant difference between engineering – technology, mathematics and 21st century skills, which are the sub-dimensions of STEM, and students who used interactive boards and did not use interactive boards in the lesson. It can be said that students develop science and 21st century skills according to students who do not use interactive boards.

Findings on the Variable of Interest in Project Homework

t-test results for independent samples conducted to find out if the attitudes of primary school students towards STEM and their sub-dimensions differ in terms of the variable of interest in project homework are shown in Table 8.

Table 8. Findings on the variable of_interest in project homework

	Be interested in project assignment	N	X	S	SD	t	p
Science	Yes	204	4,10	,66	215	.41	.68
	No	11	4,01	,98			
Engineering - Technology	Yes	204	4,10	,68	215	.92	.36
	No	11	3,90	,93			
21st century. Skills	Yes	204	4,22	,61	215	.27	.79
	No	11	4,17	,85			
Maths	Yes	204	4,14	,69	215	1.08	.28
	No	11	3,91	,80			
STEM	Yes	204	4,14	,55	215	.83	.41
	No	11	4,00	,74			

When we look Table 8, there was no significant difference between STEM attitude and students who were not interested in the project homework [$t_{(213)}$=-. 83, p>0.05]. There was no significant difference between the sub-dimensions of STEM: science, engineering – technology, mathematics and 21st century skills and students who were not interested in project homework. It can be said that interest in project homework does not affect students' attitudes to STEM.

Findings on the Variable for Participating in the Project Competition

T-test results are shown in Table 9 for independent samples to find out if the attitudes of primary school students towards STEM and their sub-dimensions differ in terms of the variable of participating in the project competition.

Table 9. Findings on the variable for participating in the project competition

	Getting information from a STEM specialist	N	X	S	SD	t	p
Science	Yes	85	4,08	,67	215	-.26	.79
	No	130	4,10	,68			
Engineering - Technology	Yes	85	4,10	,73	215	.14	.89
	No	130	4,08	,68			
21st century. Skills	Yes	85	4,25	,62	215	.78	.43
	No	130	4,19	,62			
Maths	Yes	85	4,15	,72	215	.24	.81
	No	130	4,12	,69			
STEM	Yes	85	4,14	,57	215	.26	.80
	No	130	4,12	,55			

When we look Table 9, there was no significant difference between the STEM attitude of the students and the students who participated and did not participate in the project competition

[$t_{(213)}$=1. 13, p>0.05]. There was no significant difference between the subdimensions of STEM: science, engineering-technology, mathematics and 21st century skills and students who participated in the project competition. It can be said that participating and not participating in the project competition did not affect the STEM attitudes of the students.

Findings on getting information from a STEM expert

T-test results for independent samples to find out if primary school students' attitudes toward STEM and their sub-dimensions differ in terms of the variable of receiving information from the STEM specialist are shown in Table 10.

Table 10. Findings on the variable for receiving information from a STEM expert

		Science	Engineering - Technology	21st century skills	Maths
STEM	PearsonCorrelation	,880**	,873**	,844**	,722**
	Sig. (2-tailed)	,000	,000	,000	,000
	N	215	215	215	215

**. Correlation is significant at the 0.01 level (2-tailed).

When we look Table 10, there was no significant difference between students who received information from the STEM expert and students who did not receive it, and STEM attitude [$t_{(215)}$=. 26, p>0.05]. There was no significant difference between the sub-dimensions of STEM: science, engineering – technology, mathematics and 21st century skills, as and students who received information from STEM expert and students who could not get information. It can be said that getting and not getting information in the STEM field does not affect STEM attitudes.

Relationship Between Primary School Students' Attitudes Toward STEM and Sub Dimensions

Correlation analysis and results conducted to determine the relationship between primary school students' attitudes toward STEM and their sub-dimensions are given in table 11.

Table 11. Pearson Multiplication Moments Correlation Analysis Results Between Attitudes of students toward STEM and sub-dimensions

	Science	Engineering - Technology	21st century skills	Mathematics
Pearson Correlation	,880**	,873**	,844**	,722**
Sig. (2-tailed)	,000	,000	,000	,000
N	215	215	215	215

**. Correlation is significant at the 0.01 level (2-tailed).

When the results of the correlation in Table 11 are examined, there is a significant relationship between the students' attitude, to STEM and the sub-dimensions of STEM. It is seen that there is a significant relationship between the science sub-dimension and STEM (r=0.880, p<0.01). It is seen that there is a significant relationship between the Engineering Technology sub-dimension and STEM (r=0.873, p<0.01). There is a significant relationship between 21st century skills sub-dimension and STEM (r=0.844, p<0.01). There is a significant relationship between the math sub-dimension and STEM (r=0.722, p<0.01). The area with the highest significant relationship with STEM was found to be the field of science.

CONCLUSION, DISCUSSION AND SUGGESTIONS

According to the findings of the research, the STEM attitude of the students who did the e Twinning STEM project was found to be high. In addition, their attitude to sub-dimensions such as science, engineering-technology, 21st century skills and mathematics was found to be high.

It has been determined that students who go to the science center from primary school students who do STEM e Twinning project have a more positive attitude towards engineering, technology than students who do not go. It can be said that students who experiment outside of lesson develop a more positive attitude towards STEM than students who do not experiment. When the sub-dimensions are examined, it can be said that the science, engineering – technology and 21st century skills of the students who experimented outside the lesson developed a more positive attitude than the students who did not experiment outside the lesson. It was found that students who used interactive boards in lesson had a more positive attitude than students who did not use interactive boards in science and 21st century skills alt sizes.

It was determined that primary school students who experimented with STEM eTwinning project, used laboratories in the lesson, used tablets in the lesson, were interested in project assignments, participated in project competitions and received interest in STEM subjects from a expert showed no significant difference between STEM.

Students who went to the science center were found to have a positive attitude towards STEM. It can be said that students' interest in science in science center's increases their interest in STEM. Bozdoğan and Yalçın (2006) also showed that students who went to the science center increased their interest in science. Based on this research, it is thought that those who go to the science center have a high attitude towards STEM because it is thought that their interest in science has increased. It was determined that experimenting in the lesson did not show students a positive attitude towards STEM. It can be said that the experiments students do outside of the classroom increase the STEM attitudes of the students. It can be said that extralesson studies positively increase students' attitudes to STEM. It can be said that the experiments conducted by the students after the lessons voluntarily increased the STEM attitudes of the students. In the research conducted by Şahin, Ayar and Adıgüzel (2014), it was determined that outside of school activities increased the positive attitude to STEM. The research conducted by Keskin, Karagölge and Ceyhun (2019) also found that science festivals positively affected the attitude towards science lesson. Primary school students who used interactive boards in the lesson were found to have a positive attitude to STEM. It can be said that students increase interest in technology and design with the use of interactive boards. Özyurt, Kusdemir Kayıran and

Başaran (2018) also found significant difference between interactive board and attitude to STEM in their research.

It was found that it did not significantly affect STEM attitudes of students who used laboratories in the lesson. As a result of the research conducted by Güneş Sener and Topal Germi, Can (2013), it was determined that although there are laboratories in schools, their use, experimental applications are not adequately included and science does not increase interest. In the research conducted by Demiral (2013), it was also found that using a laboratory does not positively affect the attitude towards science. It can be said that students' staying passive in the experiments did not affect their STEM attitudes just because they watched the experiments. Using tablets in the lesson was found not to affect STEM attitudes. In his research, Özacar Halvacı (2018) found that adding technology discipline to STEM activities does not change STEM attitudes. Even if interactive tablets attract students' attention, it can be said that students do not work with tablets and do not affect STEM attitudes because they do not produce anything. Interest in project assignments has been found to not meaningfully affect students' STEM attitudes. It can be said that the positive attitude does not develop because the students usually do research in their project assignments and do not do studies involving technology and engineering. There was no significant relationship between participating in project competitions and STEM attitude. It can be said that students do not fully realize the impact on STEM attitude because a small number of projects are being done in primary schools. There was no significant difference between the process and STEM attitudes that they received from a specialist in STEM subjects. It can be said that such a result emerges because STEM experts do not give verbal lectures and practices to students. A significant relationship was found between science, technology mathematics and engineering and STEM. Damar, Durmaz and Önder (2018) found that students' science, technology, engineering and mathematics practices increased students' STEM attitudes. It can be said that studies in science, technology mathematics and engineering increase students' interest in STEM and direct them to STEM. e Twinning projects can be implemented to increase students' STEM attitudes. Schools can increase students' interest in science and engineering by enabling students to participate in STEM studies. This survey can also be applied to smaller classrooms in primary schools with teachers.

REFERENCES

Abanoz, T. (2020). *Examining the Impact of SCIENCE Activities in Accordance with STEM Approach on The Scientific Process Skills of Preschool Children*, (Unpublished doctoral thesis). Gazi University, Institute of Educational Sciences, Ankara.

Akgündüz, D., Aydeniz, M., Çakmakçı, G., Çavaş, B., Çorlu, M. S., Öner, T., & Özdemir, S. (2015). *Turkey STEM education report: Does the requirement of the day or is it fashion?* Access address: http://www.aydin.edu.tr/belgeler/IAU-STEM-Egitimi-Turkiye-Raporu2015.pdf

Avan, Ç., Gülgün, C., Yılmaz, A., & Doğanay, K. (2019) Out-of-School Learning Environments in STEM Education: Kastamonu Science Camp. *Science, Technology, Engineering, Mathematics and Art (J-STEAM) Education Journal, 2*(1), 39-51.

Bozdoğan, A. E. & Yalçın, N. (2006). Impact of science centers on the changing level of interest of primary students against science and their academic achievements: Energy park. *Ege Education Journal*, 7(2), 95-114.

Bybee, R. W. (2009). *The BSCS 5E instructional model and 21st century skills.* Colorado Springs, CO: BSCS.

Damar, A., Durmaz, C. & Önder, İ. (2018). Attitudes of secondary school students towards STEM practices and their views on these practices. *Journal of Multidisciplinary Studies in Education, 1*(1), 47- 65.

Demiral, S. (20 07) & Özacar Helvacı, D. (2018). *Interdisciplinary STEM Education: Exploring technology and engineering integration in mathematics and science classes* (Unpublished Master Thesis). Gazi University, Institute of Educational Sciences, Ankara.

Donkoh, S., Osei, J. & Kofi-Annan, M. (2021). Demystifying the ‘dense’ problem of density using 5E learning cycle. *Journal of STEAM Education*, *4*(1), 31-42.

Gonzalez, H. B., & Kuenzi J. (2012). Congressional research service Science, Technology, Engineering, and Mathematics (STEM) Education: A primer. Retrieved May 20, 2020 from http://www.stemedcoalition.org/wp-content/uploads/2010/05/STEMEducationPrimer.pdf

Gülen S. & Yaman S. (2018). The Argumentation Process and the Use of STEM Disciplines in the Science Course. *YYU Journal of Education Faculty 15*(1), 1184-1211.

Güneş, M. H., Şener, N., Topal-Germi, N. & Can, N. (2013). Teacher and student evaluations for laboratory use in science and technology class. *Dicle University Ziya Gökalp Faculty of Education* Journal, *20*, 1-11.

Güven Ç., Selvi M. & Benzer S. (2018). Teaching applications' based on 7E learning model centered STEM activity effect on academic achievement. *Anemon Muş Alparslan University Journal of Social Sciences 6*(18), 73-80.

Katz, L. G. (2010). *STEM in the early years. Early childhood research and practice*. Collected Papers from the SEED (STEM in Early Education and Development) Conference. Access: http://ecrp.uiuc.edu/beyond/seed/index.html

Karasar, N. (2015). *Scientific Research Method*. Ankara: Nobel.

Keskin E., Karagölge Z., & Ceyhun İlhami (2019). Determining the impact of science festivals on students' attitudes towards science courses and project assignments. *Journal of eKafkas Educational Research, 6*(3), 1-10.

Kılıç, B. & Ertekin, Ö. (2017). *Science Technology Engineering Mathematics for MONE-Education with FeTeMM Model (STEM)*. Retrieved from http://tbae.bilgem.tubitak.gov.tr/ at 27. 09.2020.

Lindeman, K. W., Jabot, M., & Berkley, M. T. (2014). *The role of STEM (or STEAM) in the early childhood setting*. In Learning Across the Early Childhood Curriculum (pp. 95- 114). Emerald Group Publishing Limited.

Ministry of National Education (MoNE GM) (2016). *STEM Education Report.* Retrieved from http://yegitek.MoNE.gov.tr/www/MoNE-yegitek-genel-mudurlugu-stem-fenteknoloji-muhendislik-matematik-egitim-raporu-hazirladi/icerik/719 20 at 20. 09.2020.

Ministry of National Education (MoNE GM) (2019). *Gain Centered STEM Applications*. Retrived from http://ookgm.MoNE.gov.tr/MoNE_iys_dosyalar/2019_01/29164143_STEM_KitapYk. pdf. at 22.06. 2020

Ostler, E., (2012). 21st century STEM education: a tactical model for long-range success. *International Journal of Applied Science and Technology*, *2*(1), 28-33.

Özacar Helvacı D. (2018). *Interdisciplinary STEM education: Exploring technology and engineering integration in mathematics and science classes* (Unpublished Master Thesis). Yıldız Technical University, Institute of Science, Istanbul.

Özturk D. (2020). *Elementary school 4. Impact of STEM Activities on Academic* Success *in Class Science Course* (Unpublished Master's Thesis). Ordu University, Institute of Social Sciences, Ordu.

Özyurt M., Kuşdemir Kayıran, B. & Başaran M. (2018). Examining primary school students' attitudes to STEM in terms of various variables. *Turkish Studies*, *13*(4), 65-82.

Roberts, A. (2012). *A Justification for STEM Education. Technology and Engineering Teacher*. Retrieved from http://www.iteaconnect.org/mbrsonly/Library/TTT/TTTe/0412roberts.pdf

Sarıpınarlı, L. (2018). Integrating brain maps into the STEAM cycle. *Journal of Science, Technology, Engineering, Mathematics and Art (J-STEAM) Education, 2*(1), 50-78.

Sağsöz, G. (2019). STEAM in illustrated children's books: “creative and critical thinking skills”. *Science, Technology, Engineering, Mathematics and Art (J-STEAM) Education Journal, 2*(1), 1-20.

Soylu, Ş. (2016). STEM education in early childhood in Turkey. *Journal of Educational and Instructional Studies in The World*, *6*(1), 38-47.

Şahin, A., Ayar, M. C. & Adıgüzel, T. (2014). After-school activities with science, technology, engineering and mathematics, and their impact on students. *Educational Sciences: Theory and Practice*, *14*(1), 297-322.

White, D.W. (2014). What Is STEM education and why is it important? *Florida Association of Teacher Educators Journal, 1*(14), 1-9.

Yıldırım B. (2016). *Examining the Effects of Science Technology Engineering Mathematics (STEM) Applications and Full Learning Integrated into the 7th Grade Science Course* (Unpublished Doctoral Thesis). Gazi University, Institute of Educational Sciences, Ankara.

Yıldırım B. & Altun Y. (2015). Examining the Effects of STEM Education and Engineering Applications in Science Laboratory Course. *Al-Jazeera Journal of Science and Engineering 2*(2), 28-40.

Yıldırım B. & Selvi M. (2018). Examining the Views of Secondary School Students on STEM Applications, *Anemon Mus Alparslan University Journal of Social* Sciences, *6*(18), 4754.