Journal for Educators, Teachers and Trainers
The PROFESIOLab electronic, peer-reviewed, open-access Magazine

ISSN 1989 – 9572

DOI: 10.47750/jett.2022.13.05.028

The attitudes of secondary school students living in Northern Cyprus before and after STEM education

Sonay Dericioğlu[1]

Behcet Öznacar[2]

Fatma Köprülü[3]

Journal for Educators, Teachers and Trainers, Vol. 13 (5)

https://jett.labosfor.com/

Date of reception: 02 Aug 2022

Date of revision: 11 oct 2022

Date of acceptance: 14 oct 2022

Sonay Dericioğlu, Behcet Öznacar, Fatma Köprülü (2022). The attitudes of secondary school students living in Northern Cyprus before and after STEM education *Journal for Educators, Teachers and Trainers*,Vol. 13(5). 307-315.

---

[1]The University of Mediterranean Karpasia,Ecvet Yusuf Cad, Lefkoşa, Nicosia, Cyprus
[2]Near East University,Yakındoğu Blv, Lefkoşa, Nicosia, Cyprus
[3]Near East University,Yakındoğu Blv, Lefkoşa, Nicosia, Cyprus

Journal for Educators, Teachers and Trainers
The LabOSfor electronic, peer-reviewed, open-access Magazine

Journal for Educators, Teachers and Trainers, Vol. 13 (5)
ISSN 1989 – 9572
https://jett.labosfor.com/

The attitudes of secondary school students living in Northern Cyprus before and after STEM education

Sonay Dericioğlu[1], Behcet Öznacar[2], Fatma Köprülü[3]
[1]The University of Mediterranean Karpasia,Ecvet Yusuf Cad, Lefkoşa, Nicosia, Cyprus
[2]Near East University,Yakındoğu Blv, Lefkoşa, Nicosia, Cyprus
[3]Near East University,Yakındoğu Blv, Lefkoşa, Nicosia, Cyprus
Email:sonay.dericioglu@akun.edu.tr[1], behcet.oznacar@neu.edu.tr[2], fatma.koprulu@neu.edu.tr[3]

ABSTRACT
The scope of this research is to reveal the opinions of secondary school students after STEM Education Course in the Turkish Republic of Northern Cyprus. Quantitative research methods were used in the research. The study group consists of 15 secondary school students aged 12 years. The questionnaire form developed by Özcan and Koca (2018) was used by the researcher after obtaining the necessary permissions to collect the data. SPSS-21 program was used for data analysis and modeling of the emerging situation. The findings obtained as a result of the research were discussed with the relevant field. As a result of the analysis, it was concluded that after the STEM education course, students developed their skills, and this education should be given in their schools and that it benefits them. In line with the results obtained, recommendations were made on STEM applications.

Keywords: Northern Cyprus STEM, STEM Education Pre-Test, STEM Education Post Test.

1. INTRODUCTION

The success of nations in various fields is closely related to their adaptation to innovations. In our age, along with the technological developments, the needs of the nations and the dynamics of the labor force needed to meet these needs have also changed. Information, especially processed in formal educational institutions and converted into products or services, cannot meet the labor supply in our age. Hence, it is recommended that existing education programs should be studied and focused on raising labor force suitable for the next century. However, today there is a tough competition among nations in terms of technology. As a result of this competition, developed countries have turned to labor force who can work in the fields of science, technology and mathematics and started to make investments (Pekbay, 2017).

Although STEM is not a very new concept, it has recently become very popular. STEM education, in the simplest terms, aims to train qualified labor force that will adapt to the developing and changing era. In developed countries, STEM is becoming common day by day. However, the foundations of STEM education are just being laid in our country. Nations that want to bring talented individuals to society in the STEM fields and make progress in both technology and economy should review their education policies. In other words, integrating STEM into the lessons taught in educational institutions is vital for the future of nations.

With STEM education, it is extremely important to start this education in order for students to question life, do research, solve problems, realize their skills and find solutions to the problems they encounter, and to train students who offer new products and sign new discoveries.

The concept of attitude is described in different ways. It is simply defined as a tendency that constitutes the whole of an individual's attitude, emotion, and behavior. (Pehlivan, 2008). Therefore, the career plans of the students towards STEM branches are closely related to the attitude they will develop towards STEM education. In other words, the positive attitudes of learners towards STEM education will trigger career plans for STEM.

Different researchers have emphasized that in order for learners to have a career in STEM fields, they need to become aware of these fields through STEM education at an early age (Wyss, Heulskamp and Siebert, 2012). Starting STEM education at an early age is effective in attracting the attention of students. Besides, the priority for STEM education is not success, but learning by having fun. In studies based on combined education programs of STEM in order to understand content in the sense of K-5 and achieve an impressive result, STEM's combined learning-based education is of serious importance for advancing education levels in early and elementary school children (Lamb, Akmal and Petrie, 2015).

Although STEM is not a very new concept, it has recently become very popular. STEM education, in the simplest terms, aims to train qualified labor force that will adapt to the developing and changing era. In developed countries, STEM is becoming common day by day. However, the foundations of STEM education are just being laid in our country. Nations that want to bring talented individuals to society in the STEM fields

and make progress in both technology and economy should review their education policies. In other words, integrating STEM into the lessons taught in educational institutions is vital for the future of nations.

2. METHOD

2.1. Research Model

Experimental research pattern, one of the quantitative data collection methods, was used in the study. Experimental research is used to determine the extent to which an intervention will be under control and how successful it will be in solving problems, provided that a systematic method is used (Metin, 2016). Experimental and control groups are formed in the experimental research pattern and pre-test and post-tests are applied to these groups. From this perspective, in experimental research, the experimental and control groups should be similar to each other in terms of the research subject.

After the pre-test is applied to the participants, the experimental group will receive STEM education. When the education of the experimental group was completed, the researcher redistributed the Attitude Scale towards STEM to the experimental and control groups and applied a post-test. The data obtained in the post-test shed light on determining how much the attitude towards STEM has changed after STEM education.

2.2. Study Group

The experimental group of the study consists of 12-year-old children studying at Polat Paşa High School, GMTMK, Doğa College, English School of Kyrenia, Canbulat Özgürlük Middle School, Çanakkele Middle School and Bekir Paşa High School. The control group of the study consists of 12-year-old children studying at Bekir Paşa Middle School and Çanakkale Middle School in Famagusta and İskele districts.

2.3 Data Collection Tools

Attitude Scale Towards STEM

The attitude scale towards STEM was created by the Friday Institute for Educational Innovation (2012) and was developed in order to determine the attitudes of students who continue their education in grades 6-12 towards mathematics, science, technology, engineering and 21st century fields. The original scale consists of 37 items in total. Participants expressed their answers using the 5-point Likert rating scale.

In this context they gave their opinions by choosing one of the answers: 1= ‘strongly disagree', 2='disagree’, 3= 'neutral', 4= ‘agree', 5=‘strongly agree'. The internal consistency coefficients of the factors that make up the scale were calculated as Mathematics: **(α)** 0.90, Science: **(α)** 0.89, Engineering and Technology: **(α)** 0.90, and finally 21st century skills: **(α)** 0.92.

The scale was adapted to Turkish by Özcan and Koca (2018). While the researchers adapted the scale to Turkish, they started the research by obtaining the necessary permissions from the Friday Institute for Educational Innovation. The scale has gone through certain stages in the adaptation process to Turkish. These phases are respectively expressed as translation, back translation, language validity, pilot scheme, finalization, and actual implementation.

Immediately after obtaining the necessary permissions to adapt the scale to Turkish language, the scale was translated from English to Turkish by 4 experts who have completed their specialization in the field of science with Turkish language.

All translations were checked to determine the accuracy of the translations. The purpose of this check is to identify similarities and differences between translations. After detailed checks, it was determined that the English Scale and the scale adapted to Turkish match 81%. (Ozcan and Koca, 2018). In such a situation, it is possible to state that there is a very high level of match between the translated version and the original version of the scale (Roid & Haladyna, 1982). After the translations were completed, suggestions of Turkish linguists were received. Turkish linguists have expressed their expert views on the applicability of the scale to Turkish.

2.3. Collection of Data

In this study, the Attitude Scale towards STEM was applied to the experimental group before and after STEM education, as a pre-test and a post-test with a week interval outside the class hours. The questions in the scale form were answered by the participants. In addition, the STEM education was held at the Famagusta Campus of Istanbul Technical University in the 2018-2019 academic year.

Within the scope of this study, after the relevant visits to the schools in the control group were carried out in the spring 2019-2020 academic term, the Attitude Scale towards STEM was answered by the participants in the form of pre-test and post-test, outside of class hours.

2.4. Analysis of The Data

SPSS and AMOS 21.0 programs developed by IBM were used for statistical analysis of the research data.

For the validity-reliability study of the STEM Self-Efficacy Scale, factor analyzes (exploratory-confirmatory), Cronbach alpha test, split-half test and total item correlation coefficients were used. Frequency analysis was used to determine the socio-demographic characteristics of the teachers involved in the study.

2.5. Stages of Application

Within the scope of this study, the experimental group was primarily informed about "What is STEM? five-step process". Then, "egg breakage problem, unbreakable egg design, egg car design, 2 marble running, marble running design, energy transfer with marbles, marble race in liquid, kinetic sculptures, gears in kinetic sculptures, kinetic sculpture design, 4 bridges, Da Vinci bridge, suspension bridge design, if there is a cliff in front of us, what is a zipline? for what purpose is it used? "Wind-powered zipline design, science show" activities were organized.

The experimental group of the research consists of the students studying at the Famagusta Campus of ITU during a two-week period. Preliminary opinions of the participants were taken with the STEM Attitude Scale before education and the Pre-Interview Form towards STEM in the first week of the education. In the process after STEM education, the same procedure was followed, and the final opinions of the participants were taken with the STEM Attitude Scale and the Final Interview Form for STEM.

The control group of the study consists of 12-year-old children studying at Bekirpaşa Middle School and Çanakkele Middle School in Famagusta and İskele districts. After the relevant visits to the schools, the Attitude Scale towards STEM was answered by the participants in the form of pre-test and post-test with one-week intervals, in the form of the scale outside of class hours.

3. FINDINGS

Findings Regarding Students' Attitudes Towards STEM

Descriptive Information Regarding the Structure of the Institutions where Participating Students are Educated and the Names of these Institutions

Table 3.1 ***Distribution of Institutions and Schools***

Structure of Institution	**n**	**%**
Private	20	33,3
Public	40	66,7
School	**n**	**%**
Polat Paşa High School	8	13,3
GMTMK	6	10,0
Doğa College	16	26,7
English School of Kyrenia	4	6,7
Canbulat Özgürlük Secondary School	10	16,7
Çanakkele Secondary School	8	13,3
Bekir Paşa High School	8	13,3
Total	60	100,0

According to the data obtained, 66.7% of the participants are studying in public institutions, while 33.3% are in private institutions. 13.3% of the participants continue their education at Polat Paşa High School whereas 10% of them study at GMTMK, 26.7% at Doğa College, 6.7% at English School of Kyrenia, 16.7% at Canbulat Özgürlük Secondary School, 13.3% at Çanakkale Secondary School, and 13.3% at Bekir Paşa High School.

Pre-test results to determine whether the participants in the Experiment and Control Groups are equal to each other

Pre-test results for whether the participants in the Experimental and Control group are equal are shown in Table 3.2.

Table 3.2 ***Mann-Whitney U Test Results of STEM Scale Pre-Test Scores of Experimental and Control Groups***

Groups	STEM	N	Mean Rank	Rank Sum	U	P
Experimental	M	15	15,3	229,5	109,5	,899
Control		15	15,7	235,5		
Experimental	F	15	18,6	279	66	,053
Control		15	12,4	186		
Experimental	MT	15	14,67	220	100	,603
Control		15	16,33	245		
Experimental	YB	15	17,7	265,5	79,5	,169
Control		15	13,3	199,5		

According to the scores obtained from Table 3.2, the results of the Mann Whitney U test performed to determine the difference between the STEM Scale pre-test scores of the participants showed that there was no difference between the groups. With respect to this result, the statement that the experimental and control groups are equivalent to each other can be deducted.

Results of STEM Scale pre and post test scores of the experimental group

The Wilcoxon test results of the experimental group's STEM scale pre and post test scores are shown in Table 3.3.

Table 3.3 Wilcoxon Signed-Rank Test Results of the Experimental Group's STEM Scale Pre-Test and Post-Test Scores

Post test-Pre test	STEM	N	Mean Rank	Rank Sum	Z	P
Negative Rank	M	2	6	12	-2,359	**,018***
Positive Rank		11	7,18	79		
Equal		2				
Negative Rank	F	1	1	1	-3,242	**,001***
Positive Rank		13	8	104		
Equal		1				
Negative Rank	MT	0	0	0	-3,413	**,001***
Positive Rank		15	8	120		
Equal		0				
Negative Rank	YB	0	0	0	-3,409	**,001***
Positive Rank		15	8	120		
Equal		0				

In line with the results of the Wilcoxon Test conducted to determine whether the difference between the STEM scale pre-test and post-test scores of the experimental group participants is significant, a significant difference was found in favor of the experimental group.

Results of the STEM Scale Post-Test Scores of the Experimental and Control Groups

The results of the STEM Scale post-test scores of the experimental and control groups are shown in Table 3.4.

Table 3.4 ***Mann-Whitney U Test Results of the STEM Scale Post-test Scores of the Experimental and Control Groups***

Groups	STEM	N	Mean Rank	Rank Sum	U	P
Experimental	M	15	20,07	301	44	**,004***
Control		15	10,93	164		
Experimental	F	15	21,3	319,5	25,5	**,000***
Control		15	9,7	145,5		
Experimental	MT	15	23	345	0	**,000***
Control		15	8	120		
Experimental	YB	15	22,67	340	5	**,000***
Control		15	8,33	125		

According to the Mann Whitney U test conducted to determine whether the STEM Scale post-test scores of the experimental and control groups are significant, the difference regarding each STEM score is significant in favor of the experimental group.

Whether there is a significant difference in STEM according to the Institution Variable

The Mann Whitney U Test, which was applied to determine whether the STEM Scale has a significant difference according to the institution variable, is given in Table 3.5.

Table 3.5Mann Whitney U Test Results of the Scores of the Control Group According to the Institution Variable

Control	STEM	N	Mean Rank	Rank Sum	U	P
Private	M	5	9,70	48,5	16,5	,294
Public		10	7,15	71,5		
Private	F	5	8,90	44,5	20,5	,580
Public		10	7,55	75,5		
Private	MT	5	8,70	43,5	21,5	,664
Public		10	7,65	76,5		
Private	YB	5	9,5	47,5	17,5	,371
Public		10	7,25	72,5		

According to the data obtained from Table 3.5, the effect of the institution variable on the control group is not in question.

Table 3.6 *Mathematics Dimension Pre and Post Test Results*

Mathematics Dimension	Pre test x	Pretest ss	Post Testx	Post Test SS
1. Mathematics has been my worst lesson.	2.40	1.24	2.66	1.33
2. I would consider choosing a career related to mathematics.	3.26	0.88	4.13	0.75
3. Mathematics is exceedingly difficult for me.	2.26	0.71	1.80	0.56
4. I am a good student in mathematics.	3.73	1.17	2.40	1.30
5.Although I am good at most classes, I am not good at math.	2.13	1.42	2.16	1.13
6. I am sure that I can do advanced studies in mathematics.	2.47	1.28	4.06	0.97
7. I can get good grades in mathematics.	3.07	1.21	4.11	1.10
8. My math is good.	3.16	1.29	4.14	1.24
General	**2.81**	**1.15**	**3.18**	**1.04**

Table 3.6 shows the average analysis of the items of the mathematics dimension of the attitude scale towards STEM before and after STEM education. When pre-STEM education scores were compared, it was found that STEM education positively affected students' opinions about the difficulty level of the mathematics lesson except for the item "Mathematics has been my worst lesson".

Table 3.7 *Science Dimension Pre and Post Test Results*

Science Dimension	Pre test x	Pre test tr	Post Testx	Post Test SS
9. I am confident in dealing with science.	2.73	1.38	4.46	0.51
10. I can think of a career in science.	2.72	1.22	4.47	0.52
11. I hope to use science outside of school.	2.93	1.17	4.25	
12. Knowing science will help me earn a living.	2.53	0.51	3.66	0.81
13. I will need science in my future job.	2.26	0.79	3.93	0.71
14. I know that I can do well in the field of science.	2.80	1.26	4.49	0.54

15. Science will be important to me in my working life.	3.20	1.43	3.47	1.24
16. Although I am good at most classes, I am not good at science.	2.60	0.74	2.27	0.71
General	**2.72**	**1.06**	**3.35**	**0.63**

Table 3.7 shows the average analysis of the items of the science dimension of the attitude scale towards STEM before and after STEM education. When the pre-STEM education scores are compared, it is observed that after STEM education, students are more confident in dealing with science lesson, their perspective of having a career related to science is positively affected, they want to use science in different areas of their lives, and they need science in their future jobs. Moreover, it has been determined that students think they may need science in their future jobs and that they find themselves as good as their other courses in science lesson.

Table 3.8 ***Engineering Dimension Pre and Post Test Results***

Engineering Dimension	**Pre test x**	**Pre test s s**	**Post Testx**	**Post Test SS**
17.I like to imagine creating new products.	3.93	0.79	4.33	0.49
18. If I learn engineering, I can improve what people use every day.	3.80	0.86	4.86	0.35
19. I am good at fixing things.	3.53	0.83	4.47	0.65
20. I wonder how the machines work.	3.47	1.17	4.40	0.51
21. Designing products is important for my future business life.	3.49	0.63	4.87	0.35
22. I wonder how electronic devices work.	3.80	1.14	4.93	0.26
23. I would like to use creative applications in my future business life.	3.93	0.71	4.60	0.51
24. Knowing how to use Mathematics and Science together will enable me to invent useful things.	3.47	0.52	4.33	0.49
25. I believe I can be successful in the field of engineering.	3.80	1.14	4.93	0.26
General	**3.69**	**0.87**	**4.64**	**0.43**

Table 3.8 shows the average analysis of the items of the engineering dimension of the attitude scale towards STEM before and after STEM education. In line with the results, it was determined that with STEM education, students' attitudes towards the engineering dimension were positively affected in all items.

Table 3.9 ***21st Century and Its Technologies Dimension Pre and Post Test Results***

21st Century and Technology Dimension	**Pre test x**	**Pretest ss**	**Post Testx**	**Post Test SS**
26. I am sure that I can lead others to achieve a goal.	3.07	0.45	4.00	0.65
27. I am sure that I can encourage others to do whatever they can.	3.13	0.51	3.86	0.52
28. I am sure that I can do high quality work.	3.60	0.63	4.40	0.54
29. I am sure that I will respect my friends' differences.	3.73	0.71	4.86	0.35
30. I am sure I can help my friends.	3.67	1.04	4.87	0.36
31. I am sure that I will consider the opinions of others while making a decision.	3.40	1.21	4.89	0.36
32. I am sure that I can make changes when things do not go as planned.	3.13	0.83	4.93	0.26
33. I am sure that I can set my own learning goals.	3.87	1.13	4.87	0.36

34.I am sure that I can use my time wisely when I am working alone.	4.07	0.80	4.33	0.49
35. When I have multiple tasks, I can choose which one to do first.	3.33	0.89	4.14	0.35
36. I am sure that I will be able to work well with students whose past lives are different from mine.	3.20	0.77	4.13	0.37
General	**3,42**	**0.82**	**4,48**	**0,42**

Table 3.9 shows the average analysis of the items of the 21st century skills and technology dimension of the attitude scale towards STEM before and after STEM education. In accordance with the results obtained, it was determined that 21 century skills and attitudes towards technology of students were positively affected in all items with STEM education.

4. DISCUSSION

Yıldırım and Selvi (2018) asked students for their opinions on the benefits of STEM applications. Students have stated that it provides many benefits. On the other hand, they stated that these benefits enable learning by doing and experiencing, allowing the subjects learned to be connected with daily life, facilitating the teaching of lessons, increasing academic success and providing permanent learning.

As a result of the study conducted by Aydın and Bayderel (2019), it was determined that STEM activities contributed to students' 21st century skills such as collaboration, critical thinking, problem solving, creativity and self-confidence. Yıldırım and Selvi (2018) asked students for their opinions on the benefits of STEM applications. Students have stated that it provides many benefits. On the other hand, they stated that these benefits enable learning by doing and experiencing, allowing the subjects learned to be connected with daily life, facilitating the teaching of lessons, increasing academic success and providing permanent learning.

If we were to look at the research in the field, Akgündüz and Ertepınar (2015) emphasized the necessity of applying STEM applications in schools at an early age for Turkey to compete with other countries and develop. Thus, they also stated that 21st century skills such as research, inquiry, creativity, critical and analytical thinking, decision making and problem solving, which are among the STEM fields, will be gained at an early age. In another study, Timur and İnançlı (2018) found that with the renewal of the curriculum and the existence of STEM education, schools should adapt to this.

In the study, the attitudes of 15 students studying at the secondary education level in TRNC towards STEM were tried to be evaluated by applying the experimental research method. According to the results, the experimental and control group students are equivalent to each other in terms of readiness to learn. In other words, they have similar learning habits in Science, Technology and Engineering branches.

The other students in the experimental group, who received the education in these branches as STEM, continued their education in the form of traditional education model. In accordance with the results obtained, the attitude of the experimental group towards STEM education in all branches was positively affected compared to the control group. When the pre-test average scores are compared, the average score of the science branch is the lowest, the average score of the engineering branch is the highest. On the other hand, when the post-test average scores are compared, the average score of the mathematics branch is the lowest, and the engineering post-test average score is the highest. In the relevant field, there are several studies that compare attitudes towards STEM in terms of average score on a dimension basis. For instance, Dönmez (2019) found in his study that 21st century skills are at the forefront.

In the current study, 21st century and technology skills also have the highest average score after engineering skills. From this perspective, this finding of the study is parallel with Dönmez's (2019) finding, while Ceylan et al. (2018) found that the average of the science field has the lowest score, and the average of the mathematics branch has the highest score in their studies.

In the study, it was determined that the average score averages of science and mathematics fields are low compared to other fields. It is thought that the fact that the participant students are more prone to the skills required by the engineering, 21st century and technology fields and that they are more eager to make a career in these fields, contributes to the emergence of such a finding.

5. CONCLUSION

Students studying at the secondary education level were divided into two groups and received education in science, technology, engineering, and mathematics. The students in the control group were educated with the

traditional education method, whereas the students in the experimental group were educated with the STEM education approach. The results revealed that students in the experimental group had a higher average score in science, technology, engineering, and mathematics than students in the control group. On the other hand, it was determined that the post-test average scores of the students in the experimental group in science, technology, engineering, and mathematics branches after STEM education were higher than the pre-test average scores.
From this point of view, it has been revealed that STEM education has a positive effect on the proficiency levels of students in science, technology, engineering, and mathematics, and that there is an increase in the level of career acquisition and occupation in these fields.
This result indicates that with the application of STEM education to the secondary education level, the future generations' enthusiasm to acquire professions in the fields of science, technology, engineering, and mathematics will increase, their 21st century skills will develop in accordance with the age, they will join the society as qualified individuals. Moreover, it also means that they will contribute to the economic growth and development of our nation in line with the knowledge storage and information application habits they have acquired through STEM education.

6. Recommendations

- The STEM education approach can be integrated into the existing education system after the necessary infrastructure is completed, and the STEM education approach can be provided to learners by selecting the pilot schools of main schools. Most importantly, this can only be achieved through the cooperation of the Ministry of National Education with the schools that provide education at the secondary education level in the TRNC.
- STEM attitudes of the students and their interest in making a career in STEM can be examined together.
- By conducting a longitudinal study with STEM education students, their attitudes towards STEM can be measured again.

REFERENCES

1. Akgündüz, D., & Ertepınar, H. (2015). STEM Eğitimi Türkiye Raporu. İstanbul: İstanbul Aydın Üniversitesi.
2. Aydın, E., ve Karslı Baydere, F. (2019). Yedinci sınıf öğrencilerinin STEM etkinlikleri hakkındaki görüşleri: Karışımların ayrıştırılması örneği. On Dokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi, 38(1), 35-52. DOI: https://doi.org/10.7822/omuefd.439843
3. Ceylan, Ö., Ermiş, G., & Yıldız, G. (2018). Özel Yetenekli Öğrencilerin Bilim, Teknoloji, Mühendislik, Matematik (Stem) Eğitimine Yönelik Tutumları. In *Congress Proceedıngs (Full Text Paper), 65-75*.
4. Dönmez, İ. (2019). Evaluatıon Of Mıddle School Students'attıtudes Towards Stem Educatıon. *European Journal Of Education Studies*,6(5),379-394.
5. İnançlı, E, & Tïmur, B . (2018). Fen Bilimleri Öğretmen Ve Öğretmen Adaylarının Stem Eğitimi Hakkındaki Görüşleri. Uluslararası Bilim ve Eğitim Dergisi, 1(1), 48-68. Retrieved from https://dergipark.org.tr/tr/pub/ubed/issue/39599/438856
6. Lamb, R., Akmal, T., & Petrie, K. (2015). Development of a cognition-priming model describing learning in a STEM classroom. Journal of Research in Science Teaching, 52(3), 410–437. doi:10.1002/tea.21200.
7. Özcan, H., & Koca, E. (2019). STEM'e yönelik tutum ölçeğinin Türkçeye uyarlanması: Geçerlik ve güvenirlik çalışması. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 34(2), 387-401. doi: 10.16986/HUJE.2018045061.
8. Metin, Ş. (2016). Türkiye'de okul öncesinde kaynaştırmaya ilişkin yapılan çalışmaların incelenmesi. *Bayburt Eğitim Fakültesi Dergisi,* 8(1), 146-172.
9. Pekbay, C. (2017). Effects of science technology engineering and mathematics activities on middle school students. *Unpublished PhD thesis, Institute of Educational Secince, Hacettepe Universty, Turkey*.
10. Popa, R. A., & Ciascai, L. (2017). Students' Attitude towards STEM Education. *Acta Didactica Napocensia*, *10*(4), 55-62.
11. Selvi, M., & Yıldırım, B. (2017). STEM öğretme-öğrenme modelleri: 5E öğrenme modeli, proje tabanlı öğrenme ve STEM sos modeli. Çepni, S. (Ed.), Kuramdan uygulamaya STEM eğitimi içinde, (s. 204-238), Ankara: Pegem Akademi.
12. Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International Journal of Environmental and Science Education, 7*(4), 501-522. Retrived from https://eric. ed.gov/?id=EJ997137