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The Effect of STEM Training with Educational Robotics Applications Designed for Classroom Teachers on the STEM Awareness and Attitudes of Teachers

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Abstract
In today's conditions, the needs of the labor market are changing in parallel with technological developments and the need for individuals trained in STEM is increasing. For this reason, it is a priority to increase the skills and awareness of teachers who will guide individuals trained in the field of STEM. In this study, a STEM training with educational robotics applications was designed for classroom teachers. The education included theoretical and practical STEM instruction conducted by expert academicians, utilizing next-generation educational robotic kits to facilitate sample STEM activities. The primary aim was to equip teachers with skills aligned with the elementary school curriculum, emphasizing a focus on STEM learning outcomes. As a result of the training, teachers were able to develop their own STEM activities. The study, which was modeled with a one-group pretest-posttest research design, examined the changes in the attitudes towards STEM and STEM awareness of the participants as a result of the STEM education they received. In conclusion, it is observed that the participants' attitudes towards STEM education and their awareness of STEM have increased by the end of the education. Additionally, the participants believe that STEM educational activities should be included in the curriculum

Keywords: STEM, classroom teachers, educational robotics, STEM awareness, STEM attitude

1. Introduction

In today's conditions, where technological innovations largely determine the economic development of countries, it is more important than ever to educate the engineers and science experts of the future and to promote science and technology literacy (Miaoulis, 2009). For many years, preschool and primary education curricula have focused on basic literacy and numeracy literacy (Zigler & Bishop-Josef, 2006). However, changing living conditions due to technology requires different skills for today's individuals and these skills are expected to be acquired through an interdisciplinary approach. The STEM education movement, which has been popular all over the world in recent years, is thought to meet this expectation. STEM is based on the idea of teaching students in four disciplines; Science, Technology, Engineering and Mathematics, with an interdisciplinary and applied approach. Instead of teaching these four disciplines separately, STEM refers to a coherent learning approach based on real-world applications and into curriculum. The National Science Foundation of the United States has used the acronym STEM, which stands for science, technology, engineering and mathematics, to describe this approach, and many educators working in this field have not gone further than using this acronym when defining the STEM education movement, and have defined STEM education only with the subjects belonging to the disciplines that are the basis of this education. While these definitions are well-known usual and/or established descriptive terms for STEM fields, STEM is more than that (White, 2014). STEM education defines teaching and curriculum in a holistic approach, where the boundaries between the disciplines that make up STEM are removed and STEM is taught as a course (Morrison & Bartlett, 2009; as cited in Roberts, 2012).

Looking at the history of STEM education, it is stated that the purpose of its emergence is to provide critical thinking skills to all learners, make them creative problem solvers, and make them more valuable for today's business world (White, 2014). STEM education and research in this field are increasingly accepted globally as the foundation for national development, productivity, economic competitiveness and social well-being (Marginson, Tytler, Freeman & Roberts, 2013). Many countries think that their place in the global economy in the coming years depends on a generation that will be raised with STEM education. Countries are making national decisions, developing policies and realizing educational reforms in this direction.

Many countries around the world, including global economic powers such as the United States and the European Union (EU), are transforming their education systems with a focus on being competitive in the current era (Fensham, 2008). In many countries, education reforms focus on STEM education. The primary and most immediate goals of STEM initiatives in these countries are to increase the number and quality of STEM teachers and to help more students develop 21st century skills and the capacity to innovate with well-trained teachers in STEM (Corlu, Capraro & Capraro, 2014).

1.1 Studies on STEM Education in Turkey

The STEM movement, which has influenced the world, has started to manifest itself in our country in recent years. The Turkish Industrialists' and Businessmen's Association (TÜSİAD) has been working to draw attention to STEM education and raise awareness on STEM since 2014. In 2014, TÜSİAD published its first STEM report as a result of a survey on the demand and expectations for a STEM-educated workforce. In this report, it drew attention to the need for individuals trained in STEM in the business world of the future and the need to train these individuals (Turkish Industrialists' and Businessmen's Association [TÜSİAD], 2014). Since 2017, a series of activities such as STEM teacher training, STEM awareness campaign and report studies have been carried out under the title of "TÜSİAD STEM Project" in addition to TÜSİAD STEM Days. In the aforementioned report, TÜSİAD states that improvements in curricula, educational methods and teacher training will be beneficial for raising creative, innovative, analytical and critical thinkers with high problem-solving skills to meet the needs and expectations of the future business world (TÜSİAD, 2017). In addition, TÜSİAD conducts a STEM Project, which it introduced in 2017, and as a component of this project, it has implemented the "STEM Kit and Teacher Training Project" for teacher training prepared by Bahçeşehir University STEM Center (BAUSTEM).

The STEM education trend soon began to attract the attention of educators in Turkey. In 2016, a STEM education report was published by the General Directorate of Innovation and Educational Technologies of the Ministry of National Education. This report emphasizes the importance of STEM education and states that Turkey does not have a direct action plan prepared by the Ministry of National Education for STEM education (General Directorate of Innovation and Educational Technologies [YEĞİTEK], 2016). In the same report, it is stated that STEM teacher trainings should be planned and realized according to the results of STEM education researches for the integration of STEM education into the education system of our country. Within the scope of this report, a questionnaire was prepared to obtain teachers' opinions on the integration of STEM education into our education system and was applied to teachers within the scope of the Scientix project, which is related to STEM education.

The Scientix project is a project carried out by the "European School Network", which the Ministry of National Education joined in 2014. Within the scope of this project, it is aimed to be informed about STEM education taking place all over Europe, to create a platform where teachers and academicians can share their experiences and exchange ideas about STEM education, and to contribute to the training of teachers in the field of STEM education through online and face-to-face trainings (Scientix Project, 2017). %91.08 of the participants who participated in this project and were surveyed agreed with the view that it is necessary for universities' faculties of education to initiate STEM teacher training programs in order to train STEM course teachers. %91.96 of the participants, which corresponds to the majority of the participants, agree that in-service training programs should be prepared for science and mathematics course teachers to become STEM teachers (YEĞİTEK, 2016).

Although there is no direct reference to STEM education in the 2023 education vision of the Ministry of National Education, it is seen that most of the goals set in the vision document are parallel to the goals of STEM education and STEM education activities can be integrated into the curricula to be organized. In the vision document, it is stated that the most fundamental element regarding the opportunities that curricula will offer to children is that all kinds of knowledge, skills and attitudes learned should be established as a competence that can directly serve themselves and society, beyond emerging as a behavior (Ministry of National Education [MoNE], 2018a). To this end, it is stated that curricula will be improved to be flexible, modular and applied in line with children's interests, abilities and temperaments. Starting from primary school, "Design-Skills Workshops" have started to be established in schools at all levels of education in order to provide children with skills associated with their skill sets at the practical level. These workshops, which will emphasize designing, making and producing rather than knowing, will help children to recognize themselves, their professions and their environment. In addition, these workshops will be organized as concrete spaces for the acquisition of problem solving, critical thinking, productivity, teamwork and multiple literacy skills required by the new age (MoNE, 2018a). In addition, the curriculum changes announced in the vision document have started to be updated to include the STEM approach and, for example, the Science Course Curriculum published in 2018 was named 'Science, Engineering and Entrepreneurship Practices' (MoNE, 2018b). Various institutions affiliated to the Ministry of National Education carry out studies on STEM within their own organizations. The report prepared by YEĞİTEK and the "Acquisition-Centered STEM Practices" document prepared by the Ministry of National Education General Directorate of Private Education Institutions, which includes sample STEM activities at preschool and primary school level, can be given as examples.

In addition to the studies carried out by the Ministry of National Education, STEM teacher training are carried out in our country through various private organizations, universities and in-service training. Istanbul Aydın University conducts STEM teacher training certificate programs. In addition, STEM teacher trainings are organized in many universities such as Bahçeşehir University, Yeditepe University, Hacettepe University, Middle East Technical University, Muş Alpaslan University (Kızılay, 2018). STEM teacher trainings at these universities are provided through a STEM center established within the university or through a project. In particular, academics at the university carry out project-based STEM trainings through various calls opened by TUBITAK.

The Scientific and Technological Research Council of Turkey (TUBITAK) Science and Society Support Programs "4005 Innovative Education Practices Support Program" aims to provide teachers and academics with innovative approaches, strategies, methods and techniques specific to their own branches and the teaching profession in general. Of the 51 projects supported by TUBITAK in the 2017-2018 call period, 14 of them are directly aimed at providing teacher training in the field of STEM. This study focuses on the results of a project supported by TUBITAK within the scope of "Innovative Education Practices Support Program".

As stated by Çorlu (2014), it is necessary to develop research-based STEM instructional designs that will increase cooperation among mathematics, science and technology-design teachers in our schools and support students' critical and creative thinking skills, and to prepare, test and share the results of professional development materials adapted to the conditions of our country on STEM education. As mentioned in the previous paragraphs, many universities and special education courses offer trainings and certificate programs on this subject. Teachers, who are suddenly faced with a new educational trend, want to be informed about STEM education and need guidance on integrating it into their lessons. Within the scope of this research, a training process was designed and implemented to close this gap in STEM education in our country.

1.2 STEM Education and Educational Robotics Applications

In recent years, awareness of the prevalence and impact of technology has increased as the impact of artificial intelligence, automation and big data on business has been imagined and increasingly recognized (Freeman, Marginson & Tytler, 2019). In particular, changes have started to occur in the definitions of the workforce needed in the industry. Less human factor is needed in technology-related automation systems, and technologies such as artificial intelligence, big data analysis, mobile technologies, cloud technology, robots are used in most of the tasks from production to management. Aware of this change in the world order, Saraç (2019), the president of the Council of Higher Education (CoHE), stated that CoHE is in the process of determining the road map for the professions of the future. He states that the expectation that new competencies in education should be acquired as soon as possible and new skill trainings should be implemented rapidly is justified; he points out that we do not have time to postpone and spread it over time. However, when we consider that today's children are born into a world equipped with technology, it is thought that certain skills develop until they reach the Higher Education stage and that it would be appropriate to start orienting them to the professions of the future at earlier education stages. As a matter of fact, it can be said that the studies carried out in the field of STEM around the world serve this purpose.

In addition to easily accessible and recyclable materials, technological materials are also used in STEM education. Educational robotic kits, which are frequently used in STEM education, attract the attention of today's students. Some of the studies on the use of robots for educational purposes show that robots increase students' motivation towards mathematics and science lessons (Robinson, 2005; Rogers & Portsmore, 2004), provide an application ground for the theoretical principles of STEM (Rogers & Portsmore, 2004), and improve students' problem solving skills (Beer et al., 1999; Nourbakhsh et al. 2004; Robinson, 2005; Rogers & Portsmore, 2004; as cited in Üçgül, 2017).

Many universities, schools and private courses organize technology and robotics-themed camps for students, attracting students' interest and encouraging parents to send their children to such courses. Teachers who are responsible for educating 21st century learners working on science, technology, and engineering and mathematics applications with robots cannot be expected to be uninformed about this subject. In this context, the main purpose of the trainings planned in this study is to inform classroom teachers, who guide 21st century learners in the first years of their education lives, about educational robotic kits, which are an integral part of contemporary STEM education, to gain the ability to produce their own robotic materials for their lessons, to provide them with theoretical and practical knowledge about STEM education, and to develop their positive attitudes and awareness towards STEM. In this direction, the questions to be answered in the research are as follows:

- Before the training, what are teachers' attitude levels towards STEM education, STEM awareness levels and attitude levels towards scientific research?
- Is there a significant relationship between teachers' attitudes towards scientific research and their attitudes towards STEM education?
- Is there a difference between pre-test and post-test scores of teachers' attitudes towards STEM education?
- Is there a difference between teachers' STEM awareness pre-test and post-test scores?

2. Method

This study was conducted with 19 classroom teachers working in Kırşehir province and participating in the project voluntarily during the summer semester of the 2017-2018 academic year. The study, which was modeled with a one-group pretest-posttest research design, examined the changes in the attitudes towards STEM and STEM awareness of the participants as a result of the STEM education they received. In this one-group pretest-posttest study, the effects of STEM applications designed with robotic activities on teachers' STEM attitudes and STEM awareness were examined. The independent variable of the study was STEM practices designed with robotic activities, while the dependent variables were STEM attitudes and STEM awareness.

2.1 Participant Characteristics

The research covers the results of a project supported within the scope of TUBITAK Innovative Educational Practices during the summer semester of the 2017-2018 academic year. The research steps were planned according to the project schedule proposed to TUBITAK. In this plan, a one-month process was planned for the selection of teachers to be included in the research. The application process for the project was carried out with an online form. The target group of the project consisted of primary school classroom teachers. Among the volunteer teachers who applied, the participant selection process was carried out by paying attention to ensuring homogeneous distribution in terms of gender, professional experience and grade level taught. The study group consisted of 19 classroom teachers. Six of the participants were female and thirteen were male. Figure 1 and Figure 2 show the ratios of the professional experience of the participant and the grade level at which they teach.

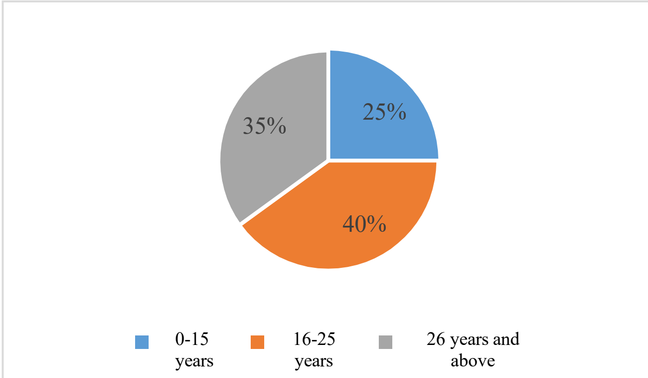

Figure 1. Participants' Professional Experience

Of the participants', % 25 have 0-15 years of professional experience, % 35 have 16-25 years of professional experience, and % 40 have 26 years or more of professional experience.

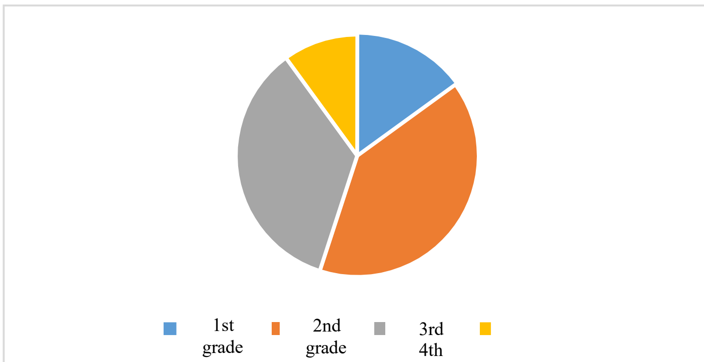

Figure 2. Participants' Grade Level

As can be seen in Figure 2, care was taken to select participants who teach at different grade levels. In the voluntary participation, there are mainly primary school 2nd grade teachers.

2.2 Data Collection Tool

In order to determine the participants' attitudes towards scientific research, the "Attitude Scale towards Scientific Research (ASTCR)" developed by Özgen, Şahin & Yeşil (2011) was used. The ASTCR is a five-point Likert-type scale and consists of 30 items that can be grouped under four factors. Each of the items in the factors is graded as: Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly Agree (5). "Attitudes towards Scientific Research Scale" consists of 30 items with 4 factors, 8 of which are Reluctance to Help Researchers, 9 of which are Negative Attitudes towards Research, 7 of which are Positive Attitudes towards Research and 6 of which are Positive Attitudes towards Researchers. The KMO value of the scale was 0.874 and Barlett's test values were x2 = 6773.126; sd =435; p<0.000. The Cronbach alpha reliability coefficient of the scale varies between 0.765 and 0.851.

The "STEM Education Attitude Scale" developed by Berlin & White (2010) and adapted into Turkish by Derin, Aydın & Kırkıç (2017) was used to determine the attitudes of the participants' towards STEM education. The validity and reliability studies of the STEM Education Attitude Scale were conducted by Derin, Aydın & Kırkıç (2017) and it was seen that a two-dimensional structure emerged as in the original scale. In order to determine the reliability of the dimensions in the scale and the scale as a whole, the Cronbach alpha coefficients of the dimensions separately and the total Cronbach alpha coefficients of the scale were calculated.

The alpha value of the meaningfulness dimension of the Turkish scale (0.92) was quite close to the alpha value of the original scale (0.94). In addition, the alpha value (0.84) measured for the second dimension (Constructability), which was found to be weak and strengthened by the addition of items, was much higher than the alpha value (0.63) in the original scale. This showed that the added items strengthened this dimension.

In order to determine the STEM awareness levels of the participants, the "STEM Awareness Scale" developed by Çevik (2017) was used. The original name of the scale is "STEM Awareness Scale". However, in order to avoid confusion in the research, the abbreviation STEM used in the original definition was used. As a result of the exploratory factor analysis conducted within the scope of validity studies, a 15-item scale consisting of 3 sub-dimensions ("Impact on Students", "Impact on Lesson" and "Impact on Teacher") was obtained. Confirmatory factor analysis confirmed that the scale had 3 sub-dimensions. The reliability coefficient for the whole scale is .82; for the sub-dimensions, it is .81, .71 and .70 respectively. STEM Teacher Awareness Scale is a five-point Likert-type scale. There are options such as Strongly Disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly Agree (5). The first dimension of the scale consists of items measuring the awareness of STEM's impact on students, the second sub-dimension consists of items measuring the awareness of STEM's impact on the lesson, and the third sub-dimension consists of questions measuring the awareness of STEM's impact on the teacher.

2.3 Data Collection Process

On the first day of the project training, the participants' were informed about the purpose of the project, the kind of training they would receive, the planning and content of the training, and the STEM education attitude scale, the attitude towards scientific research scale and the STEM awareness scale were administered as a pre-test before the training started. After the introductory meeting, the trainings started on the same day. Theoretical and practical trainings on STEM education were given to teachers by academicians who are experts in their fields. In the trainings where new generation educational robotic kits were used as materials, sample activities and lessons for STEM were carried out with these materials.

The design of the activities and the robotic materials developed were developed within the scope of a scientific research project previously conducted by the researcher. The activities were also tested in a primary school within the scope of this research project. While planning the activities, it was aimed to provide teachers with skills that they can use in the real classroom environment, especially by associating them with the acquisitions in the primary education program. In the market, especially in courses offered under the name of private "STEM and robotics education"; it is not possible to go further than teaching the construction and programming of the sets, and even if teachers know how to use these sets, they need guidance on how to integrate them into their lessons. For this reason, each workshop and activity within the scope of this project was related to one or more learning outcomes in different courses in the curriculum. Teachers can clearly see what the STEM education they receive within the scope of this training will do and what learning outcomes they will gain in which lesson. In the trainings lasting 56 hours in total, teachers first received theoretical information about STEM. Teachers who had theoretical knowledge about STEM education took an active role by participating in outcome-supported STEM activities in electricity, coding, algorithm and robotics workshops accompanied by field experts. Participants' were introduced to many different materials and robotic sets used in STEM education and developed applications with these materials themselves. At the end of all training activities, teachers were asked to develop a STEM activity for a subject that they had difficulty in teaching in the primary education program with the materials they used.

In this activity, teachers had the opportunity to apply the knowledge and skills they acquired during the training to a problem scenario that they encountered or were likely to encounter in the real teaching process. The groups were asked to make a presentation about the problem they identified, the stages of producing a solution, its relationship with STEM and how they would apply it in the classroom. The presentations were watched by all participants' and trainers working in different workshops in the project, and the presenting groups received feedback from the teachers and trainers and made arrangements to make the activities they prepared more effective. After the project presentations, the trainings ended with post-tests.\

3. Results

The findings related to the sub-problems addressed within the scope of the research are presented below under headings. Descriptive statistics of teachers' attitudes towards STEM education, STEM awareness levels and attitudes towards scientific research related to the problem "What are teachers' attitudes towards STEM education, STEM awareness levels and attitudes towards scientific research?" are presented in Table 1.

Table 1. Descriptive Statistics of STEM Education Attitude, STEM Awareness and Attitude towards Scientific Research Levels

Scales	N	□	s
STEM Education Attitude	19	133,21	13,16
STEM Awareness	19	56,52	5,92
Attitude towards Scientific Research	19	90,84	8,80

Teachers' attitudes towards STEM education (□= 133,21) at a high level, STEM awareness (□= 56,52) at high level and attitudes towards scientific research (□= 90,84) is at a medium level. The spearman brown rank differences correlation coefficient values found to examine the relationships between the scale scores of the teachers regarding the problem *"Is there a significant relationship between teachers' attitudes towards scientific research and their attitudes towards STEM education?"* are presented in Table 2.

Table 2. Spearman Brown Rank Difference Correlation Coefficients of Teachers' Attitudes towards Scientific Research and STEM Education Attitude Levels

	Attitude towards Scientific Research	STEM Education Attitude
Attitude towards Scientific Research	1	-,165
STEM Education Attitude	-,165	1

When Table 2 is examined, no statistically significant relationship was found between the attitude levels of the teachers included in the study towards scientific research and STEM education attitude levels ($r=-,165$; $p>.05$). While examining the data related to the problem "*Is there a difference between the pre-test and post-test scores of teachers' attitudes towards STEM education?"*, since the sample size was less than 50, the normal distribution of the data was examined with "Shapiro-Wilks". Shapiro-Wilks is one of the methods used to determine whether the scores obtained from the data used in the research are normally distributed (Büyüköztürk, 2011). The results of the Shapiro-Wilks test for the Attitude Toward STEM Education Scale of the study group are given in Table 3.

Table 3. STEM Education Attitude Scale Shapiro-Wilks Normality Test Results

	Statistics	df	p
STEM Education Attitude	0,964	19	0,662

According to the results of the STEM Education Attitude Scale Shapiro-Wilks Normality Test obtained from Table 3, it is seen that the relevant data set is normally distributed ($p>0.05$). For this reason, Paired-Samples T-Test was used to determine whether there was a significant difference between the STEM Education Attitude Scale pre-test and post-test scores of the study group.

Table 4. STEM Education Attitude Scale Dependent Samples T-test Pre-test and Post-test Results

	N	□	S. Deviation	t	df	p
STEM Education Attitude Pre-Test	19	130,473	12,271	-4,418	18	0,000
STEM Education Attitude Post-Test	19	143,000	10,408			

Table 4 shows the results of the Dependent Samples T-Test for the participants' STEM Education Attitude Scale pre-test and post-test scores. According to the results obtained from the table ($p<0.05$), there is a significant difference in the pre-test and post-test scores of the data obtained from the sample. At the same time, when the average score obtained from the pre-test (□= 130,473) and the average score obtained from the post-test (□= 143,000) are examined, it is seen that there is a significant increase in favor of the post-test. Accordingly, it is seen that the participants' attitudes towards STEM education increased positively at the end of the training.

"Shapiro-Wilks test was used to examine the data related to the problem *"Is there a difference between the STEM awareness pre-test and post-test scores of teachers?"* in terms of normality. The results of the Shapiro-Wilks test for the STEM Awareness Scale of the study group are given in Table 5.

Table 5. STEM Awareness Scale Shapiro-Wilks Normality Test Results

	Statistics	df	p
STEM Awareness	0,157	19	0,141

According to the results of the STEM Awareness Scale Shapiro-Wilks Normality Test obtained from Table 5, it is seen that the relevant data set is normally distributed ($p>0.05$). For this reason, Paired-Samples T-Test was used to determine whether there was a significant difference between the STEM Awareness Scale pre-test and post-test scores of the study group.

Table 6. STEM Awareness Scale Dependent Samples T-test Pre-test and Post-test results

	N	□	S. Deviation	t	df	p
STEM Awareness Pre-Test	19	56,526	5,928	-3,435	18	0,013
STEM Awareness Post-Test	19	60,947	3,566			

Table 6 shows the results of the Dependent Samples T-Test for the participants' STEM Awareness Scale pre-test and post-test scores. According to the results obtained from the table ($p<0.05$), there is a significant difference in the pre-test and post-test scores of the data obtained from the sample. At the same time, when the average score obtained from the pre- test (□= 56,526) and the average score obtained from the post-test (□=60,947) are examined, it is seen that there is a significant increase in favor of the post-test. Accordingly, it is seen that the STEM awareness of the participants increased at the end of the training.

The STEM awareness scale consists of the sub-dimensions of impact on students, impact on the lesson, and impact on the teacher. Specific to these sub-dimensions, it is seen that the participants' scored above the average in the STEM awareness scale STEM education practices increase students' self-confidence, STEM education motivates students to the lesson, STEM education increases students' problem solving skills. When the post-test results of the student impact category were compared with the pre-test results, there was an increase in favor of the post-test. Based on this, it was observed that there was a positive increase in the attitudes of the participants' in the category of the effect of STEM education on students after the activity.

The STEM awareness scale pre-test results of the category of impact on the lesson showed that the mean of the results was high. According to this result, it can be stated that teachers think that STEM education activities should be included in the curriculum and that it is inevitable for STEM education to be reflected from the lesson to daily life. It is seen that there is a very low difference between the mean scores of the pre-test and post-test Mi the STEM awareness scale in the category of impact on the lesson, and the activity did not have a significant effect on STEM awareness.

When examining the pre-test and post-test results in the teacher impact category of STEM awareness scale for participants', it is observed that there is no significant difference in the mean scores. The high pre-test scores may have contributed to this situation. It can be concluded that the participants believe that the training they attended has no impact on their views regarding the necessity for teachers to take an active role in STEM education, the use of technology in the classroom, the opportunity for teacher self-improvement, and the ease of planning STEM education in in-class and out-of-class activities in this category.

4. Discussion and Conclusion

STEM education is a topic that is the center of attention in Turkey as well as all over the world. Especially academics and teachers did not have difficulty in adopting this interdisciplinary approach and volunteered to adapt it to the education system in a short time. In order to sustain STEM education, it needs to be supported with teaching materials; these materials should be up-to-date, renewable and technologically intertwined (Timur & İnançlı, 2018). Within the scope of this research, an education was planned with educational robotics kits, which are frequently used in today's educational environments, especially in STEM activities, and are technologically up-to-date and popular. It was investigated what kind of changes the STEM education designed with educational robotics kits could lead to in participants' STEM attitudes and awareness.

STEM education is useful in developing problem solving skills, developing creativity in the field of engineering by using knowledge and skills, developing self-confidence, and contributing to logical thinking (Yıldırım & Altun, 2015). It is important to reveal the extent to which teachers have all these skills, which are the requirements of scientific research, and their attitudes towards these skills. If necessary, teachers should be supported with various trainings in this regard. In many studies, it is emphasized that the attitudes of many teachers and prospective teachers towards scientific research are not at the expected level (Akınoğlu 2008; Ayvacı & Devecioğlu 2009; Crawford 2007; Duncan et al. 2010; Lee et al. 2006; Macaroğlu & Özdemir 2003; Schwarz & Gwekwerere Taşar 2007; Varma 2007; as cited in Baykara, 2019). In this study, similarly to what is mentioned above, it is observed that participants do not have a high level of attitudes towards scientific research. At the same time, although there was no significant relationship between teachers' attitudes towards scientific research and STEM education, it is thought that it is important to contribute to the development of positive attitudes in both areas.

In many studies, it is mentioned that it is necessary to carry out projects that will improve the STEM skills of teachers and pre-service teachers, to plan in-service trainings and make various collaborations (Tezel & Yaman, 2017). Çolakoğlu & Gökben (2017) emphasize that it is important to educate prospective teachers studying in faculties of education about STEM education during their undergraduate education and to develop positive attitudes towards STEM fields in terms of the development of the country, achieving economic competitiveness in the global arena and producing solutions to the problems encountered in daily life in the light of science and technology. In our country, only 30 out of 61 Faculties of Education (49%) provide STEM education for students in their faculties. This rate, which is low considering today's conditions, includes teachers who will take office in the next few years. Currently, teachers who have been working for many years continue their duties without receiving this education from faculties of education. For this reason, in-service trainings and projects such as the one conducted in this study are important in providing teachers with STEM skills. As a matter of fact, as can be understood from the results of this study, it can be said that the training had a positive effect on the attitudes of the participants towards STEM education and their STEM awareness.

As a result of the research, it was observed that there was a positive effect on the participants' attitudes about the effect of STEM education on students. At the same time, it was observed that there was a positive effect on their attitudes about the effect of STEM awareness on the lesson, but it did not make any difference in their attitudes about the effect on the teacher. STEM activities within the scope of this research were designed for students and teachers gained experience on how to implement these activities in their classrooms. For this reason, teachers easily perceived how STEM education can make a difference in terms of impact on students. However, what kind of impact it would have on the teacher was not fully realized. The reason for this is that teachers may not have been able to predict what kind of effects STEM education would have on them without applying STEM education in their own teaching experiences. For this reason, in future studies, the effects of STEM education on teachers' professions and individual development will give more meaningful results on teachers who implement STEM education.

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