Indonesian Society for Science Educators
Journal of Science Learning
journal homepage: ejournal.upi.edu/index.php/jslearning

The Effect of Engineering Design-based STEM Activities on the Refugee Students' Sense of School Belonging

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ABSTRACT In the research, the effect of engineering design-based STEM activities on the school belonging to seventh-grade refugee students was examined. A mixed-method was used in the research. The research sample consists of 32 Syrian refugee students studying in the 7th grade in the fall semester of the 2019-2020 academic year. The study lasted for ten weeks, with two lessons per week. In addition, the "School Attachment Scale for Children and Adolescents" was used as a quantitative data collection tool. On the other hand, qualitative data collection tools were used as "STEM Education Reflective Diary Form, STEM Education Interview Form, and Teacher Interview Form," which were prepared based on quantitative scale items. Statistical methods were used to analyze the quantitative data obtained in the research, and content analysis was used in the qualitative data analysis. The quantitative data showed a significant difference between the pre-test and post-test scores. As a result, It was concluded that the engineering design-based STEM activities carried out contributed positively to the individual and social development of Syrian refugee students; their positive attitudes towards the lesson and the teacher impacted their sense of belonging to the school.

Keywords School belonging, Refugee, Engineering design-based, STEM

1. INTRODUCTION

Approximately 6 million people were forced to leave their homeland with the escalation of the civil war in Syria in 2011. According to the United Nations High Commissioner for Refugees (UNHCR) data, Turkey has been the country hosting the highest number of refugees in the world since 2016 (UNHCR, 2018). About 63% of the one and a half million school-aged refugees continue their unfinished education (Duman, 2019). Since they were initially thought to return to their countries, Arabic courses were taught in the short-term target by the curriculum in Syria to educate the refugee children (Uysal & Dinçer, 2012). The continuation of the war and instability in Syria in 2013 led to increased immigration to Turkey and its neighboring countries. Although it was not taken into consideration in the education problem much in the beginning years of the immigration, day after day, like other basic needs, education inevitably came to the fore (Saidi, 2014). The 'Project on Promoting Integration of Syrian Kids into the Turkish Education System' (PICTES) was started in cooperation with UNICEF and the Ministry of National Education (Cemalcılar,2010). Education, training, and schooling play a leading role in refugee children's avoiding the negative effects of the war. Herewith, education is the most significant factor for them to re-establish social relations, cope with the poor conditions that refugee children encounter, and have an environment in which they feel safe against the traumas they experienced (Özdemir, Sezgin, Şirin, Karip & Erkan, 2010). Education is one of a nation's fundamental sources of achievement and wealth (Özden & Turan, 2013). The countries must integrate STEM, which is the current field of education, into their curricula to compete with current and future technological developments, meet their needs, and raise well-equipped individuals (Dugger, 2010). STEM is an educational approach, formed by the combination of the initials of the disciplines of Science, Technology, Engineering, and Mathematics written in English, aiming to provide individuals with knowledge and skills and including in-school and out-of-school educational activities at each grade level (Çakır & Altun Yalçın, 2021a; Gonzalez

Received: 04 January 2022
Revised: 10 May 2022
Published: 26 November 2022

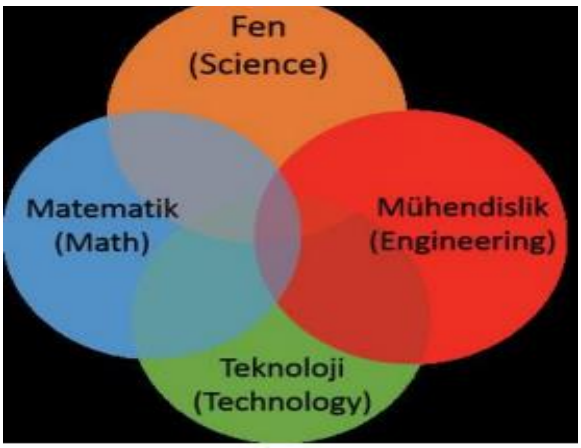

Figure 1. Integrated STEM education (Akgündüz, 2015)

& Kuenzi, 2012). Figure 2 shows integrated STEM education (Akgunduz, 2016).

According to the United States National Security Council, STEM has three primary aims increasing the number of students who will continue their careers in STEM fields in higher education, expanding the participation in the STEM workforce, and raising individuals with STEM literacy. STEM education is important because of its contribution to scientific and technological progress and the development and sustainability of innovation (Altun Yalçın, 2019). One method that is applied in the STEM approach is the Engineering Design Process (EDP). Engineers solve the design problems with the patterns they develop and handle them within the scope of some criteria and restrictions to conclude this process successfully. EDP is a cyclic, creative and dynamic process consisting of producing various solutions ways to solve an engineering problem and determining the most appropriate course of solution, and designing a product by using the best way of a solution that has been determined (Çepni, 2017; Altun Yalçın & Yalçın, 2018). As a result of successfully implementing EDP in a teaching environment, students may have the opportunity to solve the design problems as engineers by applying their creativity. In EDP, individuals need proper materials, technology, and mathematics knowledge to analyze the data obtained for the scientific concepts to be understandable and for an innovative product to be produced accordingly (Aydın & Karslı Baydere, 2019).

The EDP training approach focuses on real-life problems relevant to several disciplines. Individuals should plan, design, and apply the activities they implement to solve these problems (Çepni, 2017). At the same time, it contributes to the child's socialization and positive feelings toward the school in the activities created in cooperation (Samur & Altun Yalçın, 2021). Thus, the students' feelings toward school and their sense of belonging to school may play a significant role in forming their perceptions of themselves and their environment (Balak, 2017). In addition to the fact that individuals who feel happy and peaceful, a school society with positive emotions, and the school climate that develops with the continuation of this situation increases the quality of education, the students' positive attitudes towards school will be practical in fulfilling their duties and responsibilities willingly (Yildiz, Alkan & Cengel, 2019). The sense of belonging is the individual's feeling of being accepted, loved, approved by their social environment, and feeling like a member of the society in which s/he lives in connection with them, seeing themselves as a valuable asset (Özgök, 2013). The students' feeling of belonging to school is also significant in terms of academic development as well as their social and psychological development (Arıkan, 2015). Therewithal, it was revealed that the sense of belonging to the school is a significant factor not only in terms of achievement and development at school but also in terms of development that will continue throughout life (Bellici, 2015). Considering this information for the thousands of young, dynamic Syrian refugee students living in Turkey not to be a lost generation and not to grow up society that is ignorant, illiterate, unaware of technology, engineering, science, and knowledge which damages the country they live in, even if they do not benefit their country in the long run, it was mainly focused on the education of refugee children and emphasizing primarily on reinforcing their sense of belonging to the school. In this scope, as the STEM applications for the current curricula were explored, it was noticed that there were no studies in which the refugee students' sense of belonging to school was studied. STEM can produce effective results due to its properties. STEM activities improve students' adaptation to school and motivation for science, technology, mathematics, and other courses. In addition, it contributes to concrete and permanent learning in science education, using technology and engineering design skills. With group work and hands-on activities, it contributes to students' developing positive feelings towards school and teacher (Çakır & Yalçın, 2022). The research was conducted to determine whether the engineering design-based STEM activities created with simple materials influence the sense of belonging to the school of the 7th-grade secondary school Syrian refugee students.

2. METHOD

2.1. Research Model

A mixed method was employed in the research. The mixed-method research studies are not simply a combination of the qualitative and quantitative methods but the integration studies in which the strengths of these methods are covered by supporting research (Creswell, 2006). The mixed research method is applied when no answer was found to the quantitative and qualitative research questions alone. One of the essential features of the mixed-method is that it does not limit the researcher's options throughout the research, but broader and more

comprehensive answers are obtained from the research problem (Baki & Gökçek, 2012). The consolidation design of the mixed method was applied in the research. A simultaneous triangulation model, equivalent to Creswell's (2003) mixed-method, was employed. This pattern collects and analyzes the quantitative and qualitative data simultaneously. Data analysis is generally performed separately, and combining occurs during the interpretation of the data. Consolidation is the triangulation of data, that is, the discussion of how close they are to each other. This pattern is proper when it is aimed to validate, strengthen and cross-validate the research findings.

2.2. Study Group

The sample of the research consists of 32 Syrian refugee students (22 female, ten male) who were students in the 7th grade of a secondary school of the Ministry of National Education in a province located in the Southeast Anatolia Region in the fall term of the 2019-2020 education year. The students were aged between 13 and 15 in general. After the Syrian refugees came to Turkey in 2011, they were included in the Pictes project following the education in GEM established primarily in the camps. After the Turkish proficiency examination, they could continue their education in Turkish schools. Besides, were students directly registered in Turkish schools from the camps without being involved in the Pictes project. Most of the students also lost their siblings, father, and close relatives, in addition to being exposed to the negative effects of the war in Syria they faced. It was determined that the Syrian refugee students who participated in the study had not previously taken any training in STEM education. Then, STEM activities were applied to the 32 Syrian refugee students over ten weeks. The most significant reason that the 7th graders as the sample group of the study were that the teachers giving the STEM education entered into the lessons of the students for two years before and had no problem in terms of communicating and knowing the students, that the students were willing for the in-class activities.

2.3. Data Collection Tools

The School Attachment Scale for Children and Adolescents (SAS-CA) to collect qualitative data in the research to evaluate the school attachments of children and adolescents in the USA in 2005 Hill (2002). The scale consists of 15 items describing the students' attitudes towards the teacher, friends, and school. For instance, the Cronbach Alpha internal consistency coefficient was found as 0.84.

The Teacher Interview Form, STEM Education Interview Form with Simple Materials, and STEM Education Reflective Journal Form with Simple Materials were applied in collecting the quantitative data of the research. The forms developed by the researcher in parallel sub-dimensions of the quantitative scales and considering the characteristics of the STEM education aimed to be acquired.

STEM Education Interview Form with Simple Materials: It consists of 5 open-ended questions describing the purpose of the STEM activities, the students' belonging to STEM activities, and the school after the activity.

Teacher Interview Form: In this form, the opinions of the teacher who carried out the activities were given about whether the actions affected the students after the STEM activities and about the changing and developing student behaviors. In contrast, the activities were being carried out. It consists of 2 open-ended questions. The questions were created within the basis of the teacher attachment and peer attachment sub-dimension items of the SAS-CA.

STEM Education Reflective Journal Form with Simple Materials: After each activity, six open-ended questions are prepared to reveal the thoughts of the students about the activities, to determine the situations in which they have problems while doing the exercises, to enable the students to think and dream after the activities and support the sub-dimensions of the SAS-CA were included in this form,

2.4. Implementation Process

The research was carried out by a teacher who is a professional in STEM education and has entered the lessons of the Syrian refugee students for two years as a teacher at the Ministry of National Education. The research continued for ten weeks with 2 hours per week in the Science Applications course. "The School Attachment Scale for Children and Adolescents" was applied with the help of Arabic translators before its application as a pre-test. Sample applications relevant to the Engineering Design-based STEM education were shared with the students by determining as a result of the literature reviews. The process of students' solving the engineering problems was started with a problem situation for them to acquire scientific knowledge, use their design skills by actively participating in the design process, use their creativity, and make the design testable. The problem situation was presented with a problem scenario in which the students will need information within the scope of the science topic discussed so that they can encounter and relate to the subject in their daily lives, directing them to research and questioning. During the Parachute Egg activity applied within the scope of the study, the achievements for this activity were determined under the name of "Science, Engineering, Mathematics and Technology Outcomes". In the applications activities, the students were asked to create groups with three and four primarily for them to study in comfort, and interventions were made to ensure a balanced distribution to the groups in case of need.

The study by Çepni (2017) was considered in the implementation stages of performing STEM activities with Syrian refugee students. They were expected to describe the problem by associating it with a problem situation we encounter in daily life after giving theoretical information

Figure 2. The visuals of STEM student products of car with balloon, car with ping pong and catapult

Table 1. The order of application of the questionnaires and activities in the study

Pre-test Application (SAS-CA)	30/10/2019
My Dream Car	07/11/2019
Jiggling Ant	14/11/2019
Car with Ping-pong	21/11/2019
Car with Baloon	28/11/2019
Art Robot	05/12/2019
Parachute Egg	12/12/2019
Catapult	19/12/2019
Vane	26/12/2019
Post-test Application (SAS-CA)	14/01/2020
STEM Interview Form with Simple Materials	14/01/2020
Teacher Interview Form	15/01/2020

appropriate to the course of the course. For instance, "an emergency coded meeting is held in the Turkish Armed Forces. Sending supplies to children stuck in the war zone is required. In the meeting, you are asked to design material that provides a safe landing for aid to land in the war zone. "Determine the problem situation, and what are your solution recommendations for the problem situation?" Discuss with your group members and write down what are your ways of solution."

Then, the teacher asks the students to design their products according to their determined solutions. In this stage, they were asked to decide which simple materials they could encounter daily and which could be easily found to design the solution to the problem. (for example, garbage bags in different sizes, grocery bags, rope, tape, scissors, ruler, pet cup, egg, cotton aluminum foil, and paint materials). Afterward, each student group was enabled time to design their standard product and create a product with the selected simple materials. Finally, the students presented their products to their peers after testing them. In this stage, each group expresses ideas about the product the other groups develop. " Share the product that you have developed with your friends."

The students examine their designs considering the recommendations of their teachers and peers in other groups and complete the activity. After each exercise, the refugee students were asked to reply to the STEM Reflective Journal Form with Simple Materials appropriate to the activity. The applied STEM activities are convenient in terms of cost, time, and readily available materials. In this process, the learning processes of building, testing, recording the data and evaluating the results that enable to solve the problems, as in real life of engineers and scientists, to the students. With the expression of Lachapelle et al. (2011), the engineering design is as ask, imagine, plan, design, and improve. In the asking step, the students are asked to describe the problem situation of that week given to them in the group. In the stage of imagining, they are provided to create ideas related to the product that will be created by researching the problem. They are expected to develop possible solutions with these ideas in the plan step. In the design step, they are expected to make group designs by selecting the best among the solutions. In the improvement phase, they are expected to configure the prototype and test the product they have created.

After the eight activities, the students were asked to reply to the STEM Interview Form with Simple Materials to learn the general thoughts of the students relevant to the activities and determine their effects. Finally, the opinions of the teacher constituting the activities were taken in the teacher interview form. Some of the products (car with balloon, car with ping pong, catapult) that the students produce are presented in Figure 2.

2.5. Data Analysis

The quantitative data obtained in the research were analyzed with statistical analysis methods. As the Kolmogorov–Smirnov (since the sample number was above 30) significance value was found below the 0,05 at the end of the analysis of the SAS-CAtable data, it was realized that the data were insufficient in providing normal distribution. Therefore, the decision was reached by considering the data's kurtosis, skewness, and median values. According to Can (2016), it can be accepted that the data show a normal distribution as the kurtosis and skewness numbers are divided by their standard errors if the values are between (+1,96) and (-1,96). It considered to have a normal distribution when the median and mean values of the data are close to each other or the same. As a result of the analyses, the paired sampling t-test was applied to determine whether a significant difference was observed between the pre-test and post-test results of the scale data.

Qualitative data analysis was carried out on the STEM education reflective journal form with simple materials, STEM education interview form with simple materials and teacher opinion form after the STEM education was used as the qualitative data collection tools. The data obtained

within the scope of the research were analyzed as appropriate to the content analysis method. The content analysis technique is an iterable and systematic technique that enables to summarise in smaller categories by using some words of a topic with codes, following specific rules (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz & Demirel, 2016). The stages that should be followed in using the content analysis can be defined as identifying the concepts, determining the units of analysis, determining the location of the data related to the subject, determining the coding categories, evaluating and interpreting the obtained results in the table. Spending time with Syrian refugee students for ten weeks and having the activities performed by the teacher, who had entered the lessons of the students in the sample group for two years, spending 6 hours a week with the students in the sample group support the validity of the study. The reliability formula to calculate the reliability of the research suggested by Miles & Huberman (1994) as reliability = Consensus / (Agreement + Disagreement) was applied. The reliability of the study was 85% due to the content analysis depending on the consensus of the two experts. That the reliability calculations have been found as over 70% is regarded that the study is reliable (Miles & Huberman, 1994). So, the result reached was accepted as reliable for the research.

3. RESULT AND DISCUSSION

Considering this information, As a result of the data analysis, the kurtosis pre-test value of the data was found to = -1,165, the pre-test skewness value = -1.012, the mode pre-test = 4.44, the arithmetic mean pre-test X=4.4438, the median pre-test = 4.34. Mode post-test was found as =4.66 arithmetic mean post-test X=4.6678, median post-test 4.61, post-test kurtosis=1.837 and post-test skewness=-1.302. It was assumed that the data were normally distributed as the kurtosis and skewness pre-test and post-test values were divided by their standard errors. The resulting values were (+1,96) and (-1,96), and the values (arithmetic mean, mode, median) were close to each other.

The general pre-test and post-test scores related to the 'School Attachment Scale for Children and Adolescents' to determine the refugee students' school attachment skills with the STEM activities applied with simple materials are presented in Table 2.

The pre-test and post-test scores of the school attachment paired samples t-test applied to the Syrian refugee students are presented in Table 2. Paired sample t-test determines the effect of STEM activities and specifies the differences in pre-test and post-test results. The test results show a significant difference between the pre-test score averages obtained before the application of the STEM activities =55.096 and the post-test score averages after the activity =57.871 (t30: 2.13; $p<0.05$). Thanks to this result, it can be claimed that the applied STEM activities affect the school attachment (belonging) of the Syrian refugee students.

The paired samples t-test pre-test and post-test results related to the peer attachment, which is the sub-dimension of the school attachment scale applied to the Syrian refugee students, are presented in Table 3. Before the t-test was analyzed in the research carried out with a single group, it was determined to have a normal distribution. The pre-test kurtosis value for the peer-attachment sub-dimension was 1.614, and the post-test kurtosis value was 1.98. The peer attachment sub-dimension pre-test is =-1.355 and post-test is =- 1.313 ($p<0.05$). The activities were applied to determine the relationship between the refugee students and their peers. The paired samples t-test was applied to determine the significant difference between the pre-test and post-test scores. In the test results, the pre-test score average was as =21.093; the post-test score average obtained after the activity = was 22.093, and no significant difference was encountered (t31:1.478, $p>0.05$).

Table 2. The paired sample t-test results for the school attachment scale for children and adolescents

Measurements	N	$\bar{x}$	Ss	t	Sd	p
Pre-test	32	55.096	4.307			
				2.13	30	.041
Post-test	32	57.871	6.179			

$p<0.05$

Table 2. The paired samples t-test results related to the sub-dimensions of the school attachment scale for children and adolescents

Measurements	N	$\bar{X}$	Ss	t	p
1 pre-	32	21.09	2.319	1.478	.150
1 post-	32	22.09	3.108		
2 pre-	32	18.03	1.379	.732	.470
2 post-	32	18.31	2.054		
3 pre-	32	24.05	2.113	3.039	.005
3 post-	32	25.58	2.029		

1st Sub-dimension: Peer Attachment, 2nd Sub-dimension: School Attachment, 3rd Sub-dimension: Teacher Attachment

No significant difference was found between the pre-test average obtained before the application of the STEM activities as =18.031 and the scoring average received after the activity post-test as =18.312 in the pre-test and post-test results of the applied STEM activities related to the school attachment situations of the Syrian refugee students (t31: 732, p>0.05). Therefore, it can be stated that the test results were insignificant and necessitated more activities that would provide Syrian refugee students' attachment to school.

At the end of the STEM activities, a significant difference was found between the pre-test=16.00 before the activities and the post-test mean score obtained after the activity=17.58 in the results of the paired samples t-test pre-test and post-test to determine the refugee students' attitudes towards the teacher conducting the activities (t30: 3.039, p<0.05). Therefore, it can be stated that the test results were significant and demonstrated that the applied STEM activity applications influenced the Syrian refugee students' attitudes towards the teacher.

3.1 The Findings and Interpretations related to the STEM Education Reflective Journal Form with Simple Materials

In the qualitative part of the research, six items take place in the reflective journals. The numbers given in Table 1 represent these items. The number 1 refers to the item "Were the STEM activities you did with simple materials appropriate for your level? Why?"; the number 2 refers to the thing "What problems did you encounter while doing STEM activities? How did you solve it?"; the number 3 "What did you learn with the STEM activities"; the number 4 "What did you like most about STEM activities? Why?"; the number 5 "How did STEM activities contribute to you?"; the number 6 "What else would you like to do with these simple materials from the STEM activity? Why?". These question items coded with numbers were analyzed, constituting the collective and cooperative codes for each Jiggly Ant, Ping-Pong Ball Car, Balloon Moving Car, Art Robot, Parachute Egg Event, Catapult, Wind Vane activity and interpreted in Table 4.

General and standard codes for the whole activities were placed in Table 4. Code 1 refers to the refugee students claiming that all activities were appropriate. Some students stated that the parachute activity was challenging and claimed it was less suitable. Code 2 refers that the students did not have problems while doing the exercises and had some difficulty. The students having problems referred that the engine used in the Jiggly Ant event did not work, so it could not walk, but this problem was resolved by mounting a new engine. In the Car with Ping Pong Ball activity, some students claimed that they could not provide the balance with the Art Robot. They fixed the problem by removing the balls and pencils and reinserting them to ensure balance. They also stated that they had difficulty cutting the wind vane's wings. Some of them even claimed they had problems as the wheel did not turn because they stuck the wheels too close to the bottle. The Car Moving with Balloon was appropriate to the students' levels, but they had difficulty in their first attempts while doing the activity as they did it randomly. They applied their knowledge of measurement from mathematics and engineering to fit the covers and balloon to overcome the problem correctly. Code 3 refers to learning to work collaboratively in the activities, build circuits, do new activities, and air resistance in parachute activity. In code 4, the students claimed that they enjoyed the movement of their car, which turned into a product, the waddling ant walking, the rotation of the flag they attached to the Car with Ping-Pong, the collaborative work in the group, the art robot drawing circles, the wind vane's turning most among the activities. In code 5, the students claimed that the lesson was fun, they learned a new activity, it was beneficial to work with the group, and they learned that the catapult device was used in wars. We can refer that the STEM activity provides positive development in students, as there is new learning, the lesson is entertaining, there is a problem, and there is cooperation while doing the activity. In code 6, the students referred to some expressions, including what else they wanted to do with these materials. As we consider, they stated that wished to design activities such as a house with a stick, robot, ship, car, plane, floating plane-engine, flying ship-house-car-balloon-elephant-lion, speaking car, floating plane-train, swing, helicopter, brace, rocket, make fire with sun rays, clock, volcano, color wheel, flying lion and watch. As it is understood from these wishes, we can state that students are generally interested in moving objects. In addition, it can be claimed that the STEM activity here influenced the students' world of thought and creativity.

Table 4. The analyses of reflective journal form with simple materials

Code Name	Frequency(F)
1. Appropriate-Partly Appropriate	193-9
2.No matter-A bit difficult	202-4
3. Making robots	73
New Activity	114
Cooperation	20
4. Loved-Enjoyed	203
5. Entertaining and good lesson	194
6. Designing authentic products	385

3.2. Findings and Interpretations Related to the STEM Education with Simple Materials Interview Form

The STEM education with simple materials interview form applied to the Syrian refugee students as the post-test consists of 5 items. The numbers written in italic in the Table 5 represent the items. For instance, the number *1* represents the question 'Do you want to get STEM Education with Simple Materials?'. While applying the school attachment scale for children and adolescents used

Table 5. Findings related to the STEM education with simple materials interview form

Code Name	Frequency (F)	Rate (%)
1- Activity	32	%100
2 - Activity	32	%100
3-No	14	%46,6
3 -Yes	16	%53,3
4 -Belonging	32	%100
5 –Peer	32	%100
5 -Peer	32	%100

in the research as the pre-test and post-test, the students were helped to understand the items in the questionnaire better by translating them by the Arabic teachers. The latter was working in the school and ensured to reply to them.

The students' answers to the interview questions were coded in Table 5 after the STEM activities with the Syrian refugee students. For example, according to the students' solutions, the first question, "Do you want to get STEM with Simple Materials?" was coded as activity *code: 1*. As the students loved the activities much, they claimed that they wanted to take STEM education and that they wanted to be engineers. Therefore, they thought of going to another place for a more comprehensive STEM education, and the school was better with the activities.

"Yes, I want to get a STEM education because I want to be an engineer."

"I want to get STEM education to make a talking and walking robot."

"I liked the activities much. So I want to get a STEM education to learn new activities."

Code:2 'Activity' code was created for the item "Do you want to get advanced STEM education?" It was stated that the students wanted to get advanced education as the activities in this code attracted their attention; some students were interested in engineering, loved the teacher who gave the STEM education, and learned new information in this code.

"Yes, I want to get advanced STEM education. Because I want to be an engineer, and I loved those activities much."

"I want to get advanced STEM education. I want to travel to space. I want to learn new things. The course is entertaining. I want to make robots."

Code:3 46% of the students replied, "Did the STEM education affect your career choice?" However, that did not have any effect 53.3% claimed that they decided to change their ideas related to their future jobs after the STEM education. At the same time, the students who changed their minds about their job preferences referred that they wanted to be mathematics teachers or engineers in general, and those who did not claim that they wanted to choose jobs such as a doctor, nurse, or lawyer.

Code: 4 To the item "Did the STEM education with simple materials influence your school belonging?" all of the students gave that it had an effect. The students also stated that they loved the activities and increased their curiosity. Moreover, as the teacher did the activity, they also loved the teacher, and they liked the school more after the activities as they had a good time during the two hours.

"…This school is like my home, my teacher is like my mum, and the activities are enjoyable; I hope the activities will continue…."

"…The school is like my home. I learn new things at school…."

Code: 15 the code "friend" was created for the question " Did the STEM education with simple materials affects your communication with your friends?" The refugee students said they communicated with friends and helped each other in the group, and the group members listened to each other while doing the activities.

"Yes, I learned to help my friend, and they helped me, too…."

"I learned Turkish in this activity. I learned new things…."

"Yes, I see; because I know Turkish a bit, I learned more after the activities…."

In general, as the data in the STEM Education with Simple Materials Interview Form were taken into account, it can be claimed that the activities carried out for eight weeks contributed to the student's development and changed the students' solidarity, communication, attitude toward school, lesson, teacher; influenced the job preferences of the 53% of the students.

3.3. The Findings and Interpretations Related to the Teacher Interview Form Aster the STEM Education

The teacher, who carried out the STEM activities for eight weeks, was asked, after the activities, the question, "What kind of changes did you observe among the students? Were any changes in the students' attitudes towards the school, the Science Applications course, and you after the STEM activities?" The teacher claimed that there was a positive increase in the attitudes of the refugee students towards her, and awareness was observed as few teachers perform such activities at school. She also stated that the students loved the Science Applications course more after the activities and were more willing to come to school on the days when the activities would be performed. The teacher replied the question, "Could you explain how the students communicated with you and their friends in the classroom while they were performing the activities?" by sharing the activities while the students were doing the activities, they interacted in the group and with the other groups; they helped the transfer students while they were doing the activities, and the students who were misbehaving in the classroom warned each other not to make their teachers upset.

3.4. Discussion

The basic aim of the research is to explore the effect of STEM activities on the sense of school belonging of the 7th-grade refugee students. The limitations of the study can be claimed as that the number of students were restricted to 32, that the sample groups only consisted of the refugee students, that the activities were only eight and that only

the experimental group exists, that is, there was no control group. The strengths of the study can be stated as getting help from an expert in the field of STEM, data collection, analysis and that follow-up of the process were carried out by three experts, that the study was supported by quantitative and qualitative data collection tools by using a mixed method.

The students' achievement, students' feeling safe at school, their relationships with their friends, and the teacher's supportive attitude are effective in creating a sense of school belonging. On the other hand, the study's qualitative data consist of the findings determining that the activities developed the students' sense of school belonging. Accordingly, it was found that the STEM activities applied to the Syrian refugee students cause a significant change in their school attachment skills, productive time at school, and contribution to their development. Yildiz, Alkan & Cengel (2019), supporting the finding that the positive relationship between the school belonging and school, suggested how happy students feel in their group of friends, in the classroom, or at school, how they feel belong to their social environment, the undesirable resistant behaviors will decrease to that extent and accordingly, perceptions of school life quality will increase positively. As mentioned above, it is evident from the students' attitudes towards their teacher who gave the STEM education at the end of the interview forms applied in the study. It is noticed that in addition to the activities enabling to develop of positive behaviors such as effective interaction in the group, listening, and expressing themselves, the students can construct their engineering processes with STEM activities and not only gain knowledge but also cause the desire to create new products that they expect. (Günalan, 2018), who refers that the communication of students with their teachers in their daily lives at school determines the structure of the social atmosphere, claims that the students' moral and social attitudes are the result of their one-to-one relationships with their teachers. In their study related to the school climate, In their study, Ersanlı & Koçyiğit (2017) determined that teachers and school managers should establish positive communication with students for students do not feel lonely at school and feel belonging to the school and create a positive school climate. Çakır & Altun Yalçın (2020) stated that STEM education for pre-school children increased student success, and they liked the lesson. A significant difference was encountered after the activities in the teacher attachment sub-dimension of the SAS-CA of the study. Alan (2020) claimed that STEM applications contribute positively to the children's cognitive process skills, knowledge, skills, emotions, and tendencies. Çakır & Altun Yalçın (2021a) claimed that the STEM education that they applied to the pre-school students increased their achievements and made them love the course. Yetkin & Aküzüm (2022) stated that STEM education developed the students' understanding of learning, improved their personal and social developments, contributed to acquiring and using knowledge, and positively affected their attiudes related to STEM.

According to the results reached from the Teacher Interview Form and student STEM Interview Form with Simple Materials, it was found that the STEM activities developed the sense of belonging to the school by attracting the attention of the refugee students, increasing their desires, and being happy to come to school. In addition, students who are more interested in school and lessons are more successful, want to continue their education after finishing secondary school, and want to improve themselves, which are among the positive effects of STEM education. In their study, Karışan & Yurdakul (2017) explored the effect of the STEM applications on the attitudes of the 6th graders towards STEM. At the end of the study, it was claimed that the students' attitudes toward the STEM field increased positively in the study by Gökbayrak & Karışan (2017), the 6th graders refer to their opinions on the STEM activities as they were entertaining, instructive, and motivating. Similarly, in addition to the studies suggesting that in addition that the STEM education approaches increased the students' positive attitudes, motivations, and achievements, there are even studies referring that the activities make the process more entertaining (Kucuk & Sisman, 2017). According to the Reflective Journal Form results of the study, it was concluded that the STEM activity applications had a positive effect on students. Şanlı & Özerbaş (2021) claimed that STEM education affected the secondary school students' general motivation and attitudes toward science positively, provided their socialization. In a study, Uğraş (2018) observed that STEM activities positively affected the seventh graders' attitudes towards courses, scientific creativities, and motivation beliefs. Piila, Salmi, & Yhuneberg (2021) claimed in their study that the STEAM learning model increased students' academic achievements.

It was concluded that the students found the application easy, attracted their attention, aroused a sense of curiosity, contributed to their learning, developed their skills of working with the group, sharing, cooperation, and communication, and created a desire to do creative new things. The results demonstrate similarity with the studies in the literature. Topsakal & Altun Yalçın (2020) stated that problem-based STEM education positively affects students' emotions, thoughts, and behaviors. In the form results held at the end of each activity, it was stated that the students learned how to conduct scientific research, discussion, and questioning. In addition, the students referred that their imagination and engineering skills were developed and that students wanted to choose STEM fields as a profession in the future. In the research carried out with 7th graders, Özcan & Koca (2019a) stated that STEM activities positively affect group work. Genç & Uğraş

(2018) claimed that STEM activities encourage students to collaborative learning. Çakır & Altun Yalçın (2021b) stated that they support cooperative learning in the results of their study, which includes Montessori approach-based STEM education. Karakaya, Yantırı, Yılmaz & Yılmaz (2019) suggested that the students participated actively while performing the STEM activities, provided the opportunity to reveal their creativity, and affected the success of the lessons. Kahraman & Doğan (2020) investigated secondary school students' opinions towards STEM activities. The students generally expressed that they achieved through in-group cooperation with the activities, produced original products, were willing in the activities, they loved and found the activities interesting. Yılmaz Baltabıyık & Duru (2021) found that the STEM applications developed the secondary school students' scientific creativity and understanding of science concepts. Neccar (2019) claimed that the students stated that the course, related to the process, was better during the STEM activities and ensured their learning by having fun. Özcan & Koca (2019b) stated, in their study with 7th-grade students, that the STEM applications made the learning environment more fun, contributed positively to learning information, and supported the development of self-confidence. Meral & Altun Yalçın (2019) claimed that STEM activities changed their viewpoints on science and created an effective course process by making the science course entertaining.

4. CONCLUSION

In conclusion, a significant difference was found between the pre and post-test scores of the quantitative data collected with the school attachment scale for children and adolescents. In other words, it was found that the engineering design-based STEM activities that were performed developed the Syrian refugee students' individual and social developments. The students learned with fun during the activities, contributed to their communication skills, created a feeling of curiosity, and positively affected their attitudes towards the course and teacher and their school attachments. The quantitative data of the research included the findings identifying that the activities developed the students' feelings of affection to school. Accordingly, it was found that the STEM activities provided significantly to the Syrian refugee students' school attachment skills, spent effective time at school, and contributed to their development. These recommendations are expressed to shed light on future research: STEM application can be given to the students not at only one class level but beginning from the pre-school period. The number of activities and groups can be increased. The refugee students' parents can be invited to school and informed about the importance of STEM education and encouragement for their students to get STEM education. STEM applications can also be given in other courses according to the curricula topics rather than in only one course.

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