ANADOLU UNIVERSITY | GRADUATE SCHOOL OF EDUCATIONAL SCIENCES
AJESI
ANADOLU JOURNAL OF EDUCATIONAL SCIENCES INTERNATIONAL

DOI: 10.18039/ajesi.1473749

Social Studies Integrated STEM (SSTEM): A Mixed Method Research[1]

Veysel KARAKAYA[2], Tuğba SELANİK AY[3]

Date submitted: *25.04.2024* ***Date accepted:*** *14.07.2024* ***Type[4]:*** *Research Article*

Abstract

This study is the evaluation of the social studies course taught with SSTEM implementations on the attitudes of the 4th grade primary school students towards Social Studies discipline, on the 21st century learning and renewal skills, as well as the evaluation of the social studies lessons conducted with SSTEM based on the views of elementary school students. Embedded design, one of the mixed research methods, was used in the research. In the quantitative dimension of the study, the pretest-posttest experimental design with control group was used, and in the qualitative dimension, the basic qualitative research design was used. The study group of the research consists of 40 primary school 4th grade students. The data in the quantitative part of the study were obtained by using the "Social Studies Attitude Scale" and the "21st Century Learning and Renewal Skills Scale". In the qualitative aspect of the research, data were collected with a semi-structured interview form, student diaries, engineering design diaries and researcher diaries. For the interviews, data were collected through a semi-structured interview form from 9 students with good-medium-low academic achievement, selected from the experimental group, with maximum variation sampling, one of the purposive sampling methods. Experimental application lasted for 6 weeks, and courses were carried out with SSTEM implementations in the experimental group of the research. Mann Whitney U in comparisons between groups in the analysis of quantitative data; Wilcoxon signed-rank test was used for intragroup comparisons, and descriptive analysis was used in the analysis of qualitative data. As a result of the research, it was concluded that SSTEM education approach implementations affected their attitudes towards social studies lesson positively, and 21st century skills such as creative thinking, cooperation, communication and problem solving changed positively while students were doing SSTEM implementations. In line with the results obtained from the research, it has been suggested that similar studies can be carried out not only with the science, technology, engineering and mathematics disciplines that make up the STEM disciplines, but also in all disciplines and all education levels, in order to use the SSTEM education approach more widely and efficiently.

Keywords: *SSTEM, STEM, social studies, 21st century skills, attitude, elementary school students.*

Cite: Karakaya, V., & Selanik-Ay, T. (2024). Social studies integrated STEM (SSTEM): A mixed method research. *Anadolu Journal of Educational Sciences International, 14*(2), 655-685. https://doi.org/10.18039/ajesi.1473749

[1] This study numbered 22.SOS.BİL.02 was supported by Afyon Kocatepe University Department of Scientific Research Projects (AKÜ-BAP).
[2] (Corresponding author) Social Studies Integrated STEM (SSTEM): A Mixed Method Research, Afyon Kocatepe University, Faculty of Education, Social Studies Education Department, Türkiye, tsay@aku.edu.tr https://orcid.org/0000-0003-1368-052X
[3] Social Studies Integrated STEM (SSTEM): A Mixed Method Research, Çayırbağ Elementary School, Türkiye, e-mail, https://orcid.org/0000-0002-6823-8280
[4] This research study was conducted with Research Ethics Committee approval of Afyon Kocatepe University, dated 18.01.2022 and issue number 73319.

Introduction

Social studies education is one of the important courses in shaping the personality of the individual, increasing daily life skills and creating a harmonious society (Deveci & Bayram, 2022). According to the National Council of Social Studies (NCSS), working together to support the civic skills of the social sciences and humanities; by integrating with social science disciplines such as anthropology, archaeology, economy, geography, history, law, philosophy, political science, psychology, religion and sociology; It is a systematic study area that also benefits from the appropriate content of mathematics and science (NCSS, 1993). However, one of the main purposes of social studies is to prepare individuals to fulfill their civic duties; another is to separate social studies from other disciplines by bringing together the knowledge, skills and behaviors needed. (Seefeldt, Castle & Falconer, 2015). In addition, "Social Studies as a field of reflective examination", which is among the basic Social Studies concepts, emphasizes finding solutions by noticing the problems in society. While finding this solution, the knowledge, skills and values acquired through social studies course are taken into consideration. In recent years, one of the most important approaches that has gained popularity in education has been STEM, due to reasons such as developments in technology and the fact that today's world problems encountered in daily life are too complex to be solved with the knowledge, skills and methods obtained from a single discipline. The fact that inquiry-based teaching, which is expressed as the basis of education, constitutes an important part of the social studies course, is important for the educational approach with the STEM model. Thus, it was emphasized that integrating all disciplines into each other for an effective STEM education will produce successful results. A problem (knowledge-based life problem) handled in STEM implementations is presented as a scenario and a product that can be a solution to this problem is developed by making use of all integrated disciplines. Social Studies, which is a discipline that can be integrated into STEM, comes to the fore in putting the problem into context, sometimes in the historical development of that problem, sometimes in the establishment of the relationship with the geography and society where the problem is experienced, and in considering its economic, social, environmental and cultural effects. Students' attitudes towards social studies, mathematics, English and reading courses are low; It has been understood that students consider the social studies course as a rather boring course (Schug, Todd & Beery, 1982; Chiodo & Byfprd 2004; Taş, 2007; Kadıoğlu Ateş & Vatansever Bayraktar, 2020). In this context, it can be said that it is important to make the social studies lesson more enjoyable, to teach it with activities that enable students to be active, and to clearly demonstrate its relationship with daily life, and SSTEM can serve this purpose. In addition, it has been demonstrated by research that STEM implementations, which enable students to be active from the beginning to the end of the process, make a significant difference on the attitude towards the lesson (Duban & Kolsuz, 2019; Karakaya, Yantırı & Yılmaz, 2019). In this context, SSTEM can contribute to both social studies education and STEM education. It has been emphasized that integrating all disciplines into each other for an effective SSTEM education will yield successful results (Dugger, 2010). In addition, by the social studies course that can be integrated into STEM, it can be ensured that students actively participate in the inquiry process, experience the importance of asking questions and the pleasure of finding solutions, associate them with daily life, and make problems and solutions more important and meaningful within themselves (Adams, Miller, Saul & Pegg, 2014). In this context, the mentioned SSTEM disciplines are shown in figure 1.

Figure 1

SSTEM Disciplines

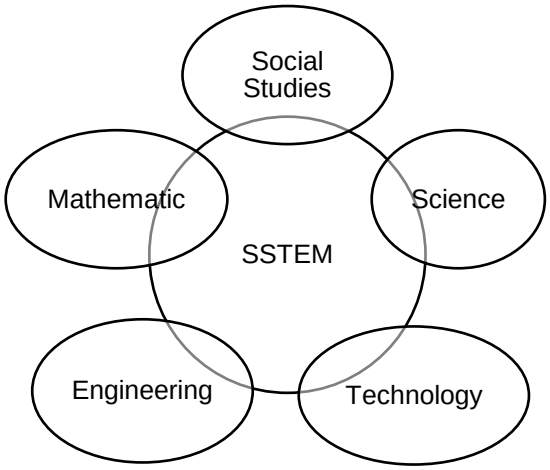


Figure 1 shows the combination of social studies, which has an interdisciplinary structure, with interdisciplinary STEM. This creates a very original and effective approach. In addition, in the integration of the disciplines that emerged with the STEM approach, social studies was added to STEM, making the content logical, uninterrupted and effective (Selanik-Ay & Duban, 2021). Despite all the contributions and limitations mentioned, it is seen that the social studies course has not been sufficiently included in the STEM approach-based learning in the literature studies. Regarding the subject, Selanik-Ay and Duban (2021) stated in their research that different types of patterned research such as qualitative, quantitative and action research can be carried out in the context of filling the lack of literature on SSTEM in Turkey. This study was carried out considering this deficiency in the field. This study was carried out considering this deficiency in the field. 21st Century skills; encompasses many skills such as communication, differentiation, problem solving, critical thinking, innovation, media literacy, information literacy, collaboration, adaptability, technology literacy, flexibility, self-management, participation, social skills, responsibility, productivity, leadership (Partnership for 21st Century Skills, 2009). Within the SSTEM education approach, there are many approaches that will equip individuals with 21st century skills.

Problem Situation

In the present age, it could be said seen that individuals need to use knowledge based on reason, observation and experiment in order to solve the problems they encounter and to live their lives in a quality and effective way. In this context, each country uses different approaches in their curricula that focus on the student and enable them to receive and process information based on reason, observation and experiment. Undoubtedly, one of these approaches is seen as the STEM education approach. STEM education, which aims to provide individuals with knowledge and skills from an interdisciplinary perspective, is an important factor for economic freedom and technological leadership (Lacey & Wright, 2009). In recent years, large investments are being made in this regard. It is a priority to raise individuals who can solve problems, be self-sufficient, make fast and rational decisions, think creatively and critically, work collaboratively, contribute to production, have innovation and entrepreneurship

skills, and have 21st century skills (Hebebci, 2019). This is one of the basic requirements for society to adapt to the age.

In recent years, there have been studies in the literature on the subject, integrating social studies into STEM and expressed as STEM+S, STEMS, SSTEM. In this research, it was decided to use the term SSTEM, which is generally accepted in the literature. When the literature on SSTEM in Turkey was examined, no research was found except for one study (Selanik-Ay and Duban, 2021). Moreover, considering that the research is a phenomenological research conducted on teachers, this research is the first research conducted with primary school students in terms of Turkish literature. In this respect, it is an original research. The research is also important in terms of filling the gap in the literature. In the research, in terms of SYSTEM applications carried out in the 4th grade social studies course of primary school; Answers were sought to the problems regarding students' attitudes towards the social studies course, its impact on 21st century learning and renewal skills, as well as the opinions of primary school students regarding SSTEM applications.

Purpose and Significance of the Study

It is important for the integrated education approach that the skills intended to be acquired by students are addressed with the social studies course integrated into STEM disciplines. For this reason, these skills are also associated with the social studies course through SSTEM studies. There are many studies on the STEM approach examining students' attitudes towards science, technology, mathematics and engineering disciplines and its impact on acquiring 21st century skills. (Bybee, 2010; Gonzalez & Kuenzi, 2012; Farisi, 2016; MEB, 2016; Yıldırım, 2016; Pekbay, 2017; Akgündüz et al., 2018; Bircan, 2019; Hebebci, 2019; Karakaya et al., 2019). However, Ecevit et al. (2021) state that research conducted at the primary school level in the field of STEM education approach is insufficient.

In this context, the SSTEM approach already includes 21st century skills in the context of its nature and the characteristics of the integrated disciplines. In the light of this information, the aim of the research is to evaluate the effect of the social studies course, which is taught with SSTEM implementations, on the attitudes of elementary school 4th grade students towards the Social Studies course and their 21st century learning and renewal skills, as well as the evaluation of the application process to be carried out with SSTEM based on the views of elementary school students. In addition, revealing the effects of SSTEM implementations; It is hoped that it will shed light on researchers and practitioners for more effective and efficient social studies teaching practices. In line with these purposes, answers to the following questions were sought:

- Does the Social Studies course taught with SSTEM implementations make a statistically significant difference in the attitudes of primary school students towards the Social Studies course?
- Does the Social Studies course taught with the SSTEM implementations make a statistically significant difference on the 21st century learning and renewal skills of elementary school students?
- What are the views of elementary school students about STEM implementation process?

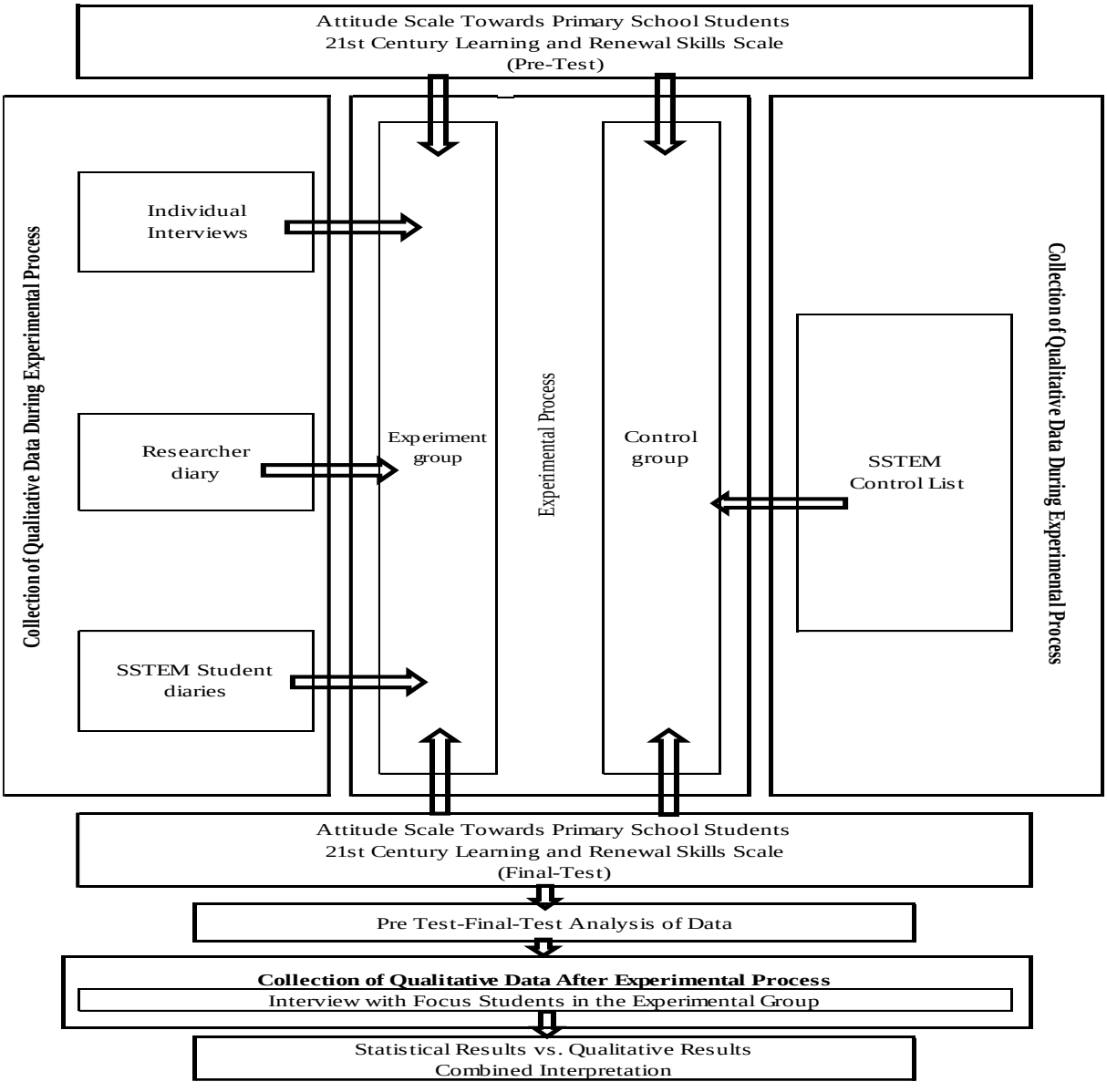
Method

Research Design

This research was carried out with an embedded mixed design. Today, a common concept that researchers frequently refer to is the “mixed method research model; It is an approach in which qualitative and quantitative data are collected by adopting a pragmatic and utilitarian universal view in researchers, and a multidimensional data set is created using the data obtained from these (Cameron, 2011; Creswell, 2014). In the embedded experimental mixed method, qualitative and quantitative data are collected together with the experimental process (Creswell & Plano Clark, 2011). The steps followed in the research are shown in Figure 2:

Figure 2

Embedded Mixed Pattern Flow Chart



In the research, an embedded mixed design, one of the advanced mixed method designs, was used in accordance with the structure of the applied process. The mixed method involves collecting as much data as possible on the subject under investigation and performing multifaceted analysis. For this reason, it provides access to in-depth and detailed data. In addition, it also increases the validity and reliability of the research. The design in question can be created by enriching the quasi-experimental design with a pretest-posttest control group with qualitative stages during and after the experimental process (Creswell, 2019). In accordance with the design, data were collected using attitude and skill scales for students before and after the experimental procedure, unstructured observation throughout the experimental procedure, problem-based researcher diary, SSTEM student diaries and interviews. After the experimental process, a multidimensional data set was tried to be created for the research topic by using student interview forms. Finally, the data set was analyzed step by step using quantitative and qualitative data analysis methods.

Study Group

The research was carried out in a public elementary school in a town of Afyonkarahisar city center in Turkey in the 2021-2022 academic year. The experimental group consisted of 20 (12 female and 8 male) 4th grade of elementary school; The control group consists 20 (9 female and 11 male) elementary students who attends 4th grade. There are 3 branches in the school where the application is made. From these branches, two branches that were academically close to each other were selected by taking the opinions of the classroom teachers. During the teaching process, students worked in groups and four groups were formed in total. Care was taken to ensure that the number of boys and girls in the groups was balanced. While creating the groups, an effort was made to ensure a balanced distribution. The opinion of the classroom teacher was taken to ensure equality in terms of academic success in the groups. In addition, personal information of the students in the experimental and control groups, such as gender, parents' education level, socio-economic levels, and parents' professions, was also taken into consideration.

Data Collection Tools

In this study, quantitative and qualitative data were used together in order to evaluate students' attitudes towards the social studies lesson and its effect on 21st century learning and renewal skills, as well as to evaluate the implementation process to be carried out with SSTEM based on the views of elementary school students. "Social Studies Attitude Scale" and "21st Century Learning and Renewal Skills Scale" were used to obtain quantitative data. Qualitative data, on the other hand, were analyzed by examining the semi-structured interview form, student and researcher diaries, engineering design diary, activity papers, self-evaluation forms, photographs and other studies in the field prepared by the researchers.

Social Studies Attitude Scale (SSAS): The Social Studies Attitude Scale developed by Ulu-Kalın and Topkaya (2017) as 12 items was used to measure students' attitudes towards the Social Studies course. SSAS consists of "I strongly disagree", "I do not agree", "I agree", "I completely agree" in the form of likert type and 4-spaced so that students can express their opinions. The internal reliability of the scale was determined by evaluating the Cronbach Alpha Coefficient. The Cronbach Alpha internal consistency coefficient was found to be .84 for the whole scale. Therefore, it can be stated that the entire scale is reliable.

21st Century Creativity and Renewal Skills Scale (CCRSS): The “21st Century Learning and Renewal Skills Scale” developed by Belet-Boyacı and Atalay (2016) for 4th grade primary school students was used as a second scale in the study. The scale consists of 39 items. 20 of the questions in this scale are about creativity and innovation skills (CIS), 12 of them are about critical thinking and problem-solving skills (CTPSS), and 7 of them are about cooperation and communication skills (CCS). Scale is formed in the form of “Never”, “Sometimes”, “Always” in a way that students can express their opinions, it is likert type and has 3 intervals. The Cronbach's alpha reliability coefficient for the scale was calculated as 0.89-0.95. Therefore, it can be stated that the entire scale is reliable.

Researcher Diary: The researcher used his diary to reflect his observations during the experimental process of the research. The researcher's diary was used to determine whether the researcher observed the views expressed by primary school students in their diaries or in the interviews and to explain and support student views in a deeper way. This data collection tool was used as a tool to increase the reliability of the research and to allow for data triangulation. The researcher followed the students' work both individually and with their group friends and took care to catch the changes in the students' attitudes and behaviors or in the dimensions of knowledge, skills and values. During the observation, the researcher observed the experimental process in terms of its compatibility with the nature of SSTEM, using the checklist he had prepared before and reflected his observations in the researcher's diary. Each diary was treated as a document and analyzed with content analysis.

Student Diaries: During the research implementation process, the students in the experimental group were asked to create diaries in which they could express what they did about the activities, the problems they experienced and the solutions they came up with for the problems they encountered, and the feelings and thoughts they felt during the implementation process at the end of each lesson in which the application was carried out. Each diary was handled as a document and analyzed with content analysis.

Engineering Design Notebook: From the beginning to the end of the implementation process of engineering design notebooks, students recorded their research, the information they obtained, the questions they had in mind, solution suggestions, draft drawings, improvements and changes to the drawings; It was used as a data collection tool in which they recorded the implementations they carried out covering every stage of the engineering design. Each engineering design notebook was handled as a document and analyzed with content analysis. In addition, as an example, the draft drawings and improvements of the students were directly scanned and took their place in the research in the form of student product.

Data Collection Process

The steps followed in the research implementation process are as follows:

- Creating SSTEM lesson plans (determining daily life problems and choosing the acquisitions that are suitable for daily life problems determined during the research process and that allow integration with each other)
- Knowledge Based Life Problems (scenarios) were prepared for the lesson plans to be used in the implementation process. The implementation process is structured around these knowledge-based life problems.
- The implementation process of the research was carried out in the classroom and school laboratory.

In the qualitative aspect of the research, interviews were conducted with 9 students after the activities were completed. Maximum diversity sampling, one of the purposive

sampling methods, was used in the selection of students for the interviews. The aim is to create a relatively small sample and to reflect the diversity of individuals for the problem studied in this sample at the maximum level (Yıldırım & Şimşek, 2018). For this reason, students' social studies attitude pre-tests were analysed and three students were selected from the pre-tests at low-middle-high levels. The research continued for 18 lesson hours during six weeks. During the study, the learning areas of "People, Places and Environments", "Science, Technology and Society" and "Production, Distribution and Consumption", which are in the curriculum of the 4th grade Social Studies course in primary school, were studied in both groups. SSTEM activities were applied in the teaching of the lesson in the experimental group, and the Social Studies Curriculum was adhered to during the teaching process of the lesson in the control group. In the research, the SSTEM implementation process was carried out based on two knowledge-based life problems (KBLP) as follows:

KBLP 1: Many houses were damaged in the earthquake that took place in Günbaşı Village of Gürpınar District of Van (In Turkey); citizens were trapped under the rubble. The lack of a road in the village and the problem in transportation made search and rescue efforts difficult. Design a search and rescue vehicle that can reach Günbaşı Village, which is 7 km inland from the district, over an earthen ground consisting of stones. The vehicle should be able to move easily in the field, remove debris, and detect the sounds of living things under the debris using sound technologies and determine their location. In addition, consider that the vehicle you will design should be an environmentally friendly vehicle that can be used in the most useful way with the lowest cost.

KBLP 2: Fresh tea harvest continues in the provinces of Rize, Trabzon, Artvin and Giresun in the Eastern Black Sea Region of Turkey. Due to the steep and rugged nature of the region, citizens transport the tea they harvest with primitive cable cars. In addition, in rough terrain, students frequently use these cable cars to reach their schools or families for various needs. Experts, in their reports on the subject, point out that the primitive ropeways, which cause many fatal and injured accidents, are used indiscriminately, and that no mechanism is smooth and the ropeways should be brought to a standard. Design a ropeway that will solve this problem. Your design should be able to do the transport job safely and quickly in this region. There must also be a reliable braking system. Remember, your design should be as robust, environmentally friendly and affordable as possible.

As seen above, in all knowledge-based life problems, it is aimed to produce solutions and to design solution-oriented products by integrating the fields of social studies, science, technology, mathematics, engineering, and using the knowledge and skills obtained from these disciplines. The practices and activities carried out during the research process are given in the Table 1 below:

Table 1

Implementation Process Calendar

Date	Implementations
1st Week	The SSTEM approach was introduced. In the introduction part of the plan, the lesson was introduced with videos and various visuals. Students were divided into 4 groups. Concept map activity. A presentation was made and a discussion environment was created. Student diaries were distributed.
2nd Week	Knowledge-based life problem (BTHP) was given. Earthquake map activity. Ideas were exchanged, ideas were noted. Vehicle drawings and presentations were made. An assessment rubric was created. MBLOCK coding program was introduced, implementations were made.
3rd Week	A prototype model was designed. Products are created. The products were tested at test points. Deficiencies have been corrected. The presentations were summarized by the groups. Evaluation studies were carried out and the diaries were filled.
4th Week	2nd SSTEM knowledge-based life problem was passed. Empathy was established by watching videos and images related to the subject. The students were divided into 4 groups of which their names were determined by themselves. Presentation was made, brainstorming technique was used. An object graph was created showing the weather. Knowledge-based life problem (KBLP) was given.
5th Week	A livelihood map of the given region was created. The ropeway drawings and presentations they designed were made. An assessment rubric was created. With the MBLOCK coding program, reminder applications were made to student groups.
6th Week	Vehicle prototypes were made. The design process has begun. The designs were tested at the test station and deficiencies were corrected. The designs were summarized by the groups. Evaluation studies were carried out and the diaries were filled.

Data Analysis

Quantitative data were obtained by using the Social Studies Attitude Scale and the 21st Century Learning and Renewal Skills Scale. In the qualitative aspect of the study, semi-structured interview form, unstructured observation, student diaries, engineering design diaries and researcher diaries were used. In the analysis of quantitative data, Shapiro Wilk test was used primarily in the analysis of normality, and it was determined that the data were not normally distributed; therefore, Mann Whitney U test was used for intergroup comparisons and Wilcoxon signed-rank test was used for intragroup comparisons. Content analysis was used in the analysis of qualitative data. Content analysis is carried out to reach concepts and relationships that can explain the collected data. The basic process in this analysis method is

to gather similar data within the framework of certain concepts and themes and to interpret them in a way that the reader can understand (Yıldırım & Şimşek, 2018). In this study, credibility, transferability, reliability and verifiability methods were taken as basis for validity and reliability studies.

Validity and Reliability

In this study, credibility, transferability, reliability and verifiability methods were taken as basis for validity and reliability studies. The fact that the students in the study had similar characteristics was effective in preventing bias. The fact that there was no loss of subjects in any group during the process was another factor that ensured internal validity.

Additionally, to increase the internal validity of the research; The selection of the groups was made impartially, the socioeconomic levels of the students were determined homogeneously, the number of girls and boys in the groups was balanced, the application data of the research was collected in the classroom and laboratory environments, and the researcher teacher who made the observation during the application during the research process remained the same. This supports the internal validity of the research. The fact that similar results can be achieved when this study is repeated by other researchers, the fact that the groups are selected impartially in the classroom and the entire application process is carried out during the school period, increases the external validity of the research.

In order to ensure credibility in the qualitative dimension of the research, triangulation and expert review strategies were used. During the preparation of the interview questions used in the study and the lesson plans applied during the research, the opinions of lecturers who were experts in their fields and teachers who had previously taught 4th grade were utilized. Different methods were used in data collection to ensure that the data supported each other. In addition to interviews with students, the results were enriched with unstructured observation, document review, diary keeping, and photographs.

To ensure consistency, the researcher guided the students throughout the process by observing them from outside. In addition, in the study, the codes created for the themes and sub-themes in the qualitative data analysis were given together with direct quotes taken from student opinions. While analyzing the data, the consistency of conceptualization and the relationship of data to results was followed.

Ethical Issues

Within the scope of the research, Ethics Committee Approval of Afyon Kocatepe University, Social Sciences Scientific Research and Publication Ethics Committee, dated 18.01.2022 and protocol number 73319, was received. In addition, research permission was obtained from the Provincial Directorate of National Education to which the school where the research would be conducted was affiliated. Permission to participate in the research was obtained from the students and their parents through a text explaining the scope and process of the research.

Findings

Findings obtained from the analysis of the qualitative data set within the scope of the research; They were discussed under the headings of student diaries, researcher diaries, and data obtained from interviews, in association with each other. In addition, examples from engineering design notebooks are presented. Quantitative findings are presented under the headings of attitudes towards social studies course and 21st Century renewal skills. The data obtained were shown in tables and figures, and the opinions of the student and the researcher were supported by direct quotations. The results of the Shapiro Wilk Test conducted within the scope of the research regarding the Social Studies course attitude scale are as follows:

Table 2

Social Studies Attitude Scale" Shapiro Wilk Result

Pre-test				**Post-test**		
Type of the group	N	Statistic	Sig.	N	Statistic	Sig.
Experimental Group	20	.837	.003	20	.850	.005
Control Group	20	.928	.144	20	.892	.030

According to Table 2, when Shapirowilk values of the scales tested for normality were examined, it was seen that the pretest-posttest values (difference in the experimental and control groups) were not normally distributed (p>0.05). It was decided to use nonparametric tests in the analysis of the Social Studies Attitude Scale data due to both the Shapirowilk values and the number of subjects in the groups being below 30. The findings obtained from 21st century Skills scale's Shapiro-Wilk analysis regarding the sub-dimensions of the r scale and the normality distribution according to the groups are given in Table 3 as follows:

Table 3

Normality Distribution by Sub-Dimensions and Groups of 21st Skills and Renewal Scale

	Pre-Test				**Post-Test**		
Sub-Dimentions od Scale	Type of Group	N	Statistic	Sig.	N	Statistic	Sig.
Creativity and renewal	Experimental Group	20	.979	.923	20	.926	.132
	Control group	20	.939	.230	20	.939	.354
Critical thinking and problem solving	Experimental Group	20	.961	.559	20	.976	.877
	Control group	20	.938	.219	20	.935	.191
Cooperation and communication	Experimental Group	20	.537	.000	20	.940	.235
	Control group	20	.896	.144	20	.892	.009

According to Table 3, when the Shapirowilk values of the scales with normality test were examined, it was found that the pretest-posttest values of the scale were normally distributed in the sub-dimensions of Creativity and renewal, Critical thinking and problem solving; however, it is seen that it is not normally distributed in the sub-dimension of cooperation and communication. However, since the number of subjects in both groups was less than 30, nonparametric tests were used in the analysis of the data obtained for all sub-dimensions of the scale. As a result of the normality tests, it was determined that the data obtained on the Social Studies Attitude Scale were not normally distributed. Wilcoxon signed-rank test was used for intragroup comparisons. As a result of the Mann Whitney U test, the findings regarding the social studies course attitude scale pretests of the Experimental and Control groups are as follows:

Table 4

Social Studies Attitude Scale Experimental Group and Control Group Pretest Comparison

Type of Group	N	Rank Average	Row Sum	U	p
Experimental Group Pre-test	20	20.02	400.50	190.500	.797
Control Group Pre-test	20	20.98	419.50		

When Table 4 is examined, it is seen that there is no statistically significant difference between the pretest scores of the experimental and control groups. In this case, it was determined that there was no difference between the attitudes of the two groups towards the social studies course at the beginning of the research process.

Table 5

Social Studies Attitude Scale Experiment Group and Control Group Posttest Comparison

Type of Group	N	Rank Average	Row Sum	U	p
Experiment Posttest	20	29.78	595.50	14.500	.000
Control Posttest	20	11.23	224.50		

When Table 5 is examined, it is seen that there is a statistically significant difference in favor of the experimental group between the posttest scores of the experimental and control groups. In this case, it was determined that social studies lessons conducted with SSTEM caused a significant difference between primary school students' attitudes towards social studies lesson, and their attitudes increased.

Table 6

Social Studies Attitude Scale Experimental Group Pretest and Posttest Comparison

Experimental group attitude pretest-posttest	N	Rank Average	Row Sum	z	p
Negative Rank	0	.00	.00	3.924	.000
Positive Rank	20	10.50	210.00		
Equal	0				

As can be seen in Table 6, when the pre-test and post-tests of the experimental group obtained from the social studies course attitude scale were compared, it was determined that there was a statistically significant difference in favor of the post-test. This situation revealed that the social studies lessons conducted with SSTEM increased the attitudes of the experimental group towards the social studies lesson.

Table 7

Social Studies Attitude Scale Control Group Pre-test and Post-test Comparison

Control group attitude pretest-posttest	N	Rank Average	Row Sum	z	p
Negative Rank	7	9.79	68.50	-.379	.705
Positive Rank	10	8.45	84.50		
Equal	3				

As seen in Table 7, when the pre-test and post-tests of the control group obtained from the social studies course attitude scale were compared, it was determined that there was no statistically significant difference in favor of the post-test. This situation revealed that the social studies courses that were not conducted with SSTEM did not change the attitudes of the control group towards the social studies lesson.

For non-normally distributed cooperation and communication dimensions, Mann Whitney U; Wilcoxon signed-rank test was used for intragroup comparisons. For the creativity and renewal sub-dimension, which was determined to be normally distributed, and for the sub-dimension of critical thinking and problem solving, paired samples t-test was used for intragroup comparisons, and independent samples t-test was used for intergroup comparisons. In Table 8, the findings of the 21st Century Learning and Renewal Skills Scale course attitude scale pre-tests of the Experimental and Control groups are as follows:

Table 8

Pre-test Comparison of 21st Century Learning and Renewal Skills Scale Experiment Group and Control Group

21st Century Learning and Renewal Skills Scale	Type of Group	N	Rank Average	Row Sum	U	p
Creativity and renewal	Experimental Group Pre-test	20	21.65	433.00	177.000	.553
	Control Group Pre-test	20	19.35	387.00		
Critical thinking and problem solving	Experimental Group Pre-test	20	21.35	427.00	183.000	.643
	Control Group Pre-test	20	19.65	393.00		
Cooperation and communication	Experimental Group Pre-test	20	17.80	356.00	146.000	.140
	Control Group Pre-test	20	23.20	464.00		

When Table 8 was examined, it was seen that there was no statistically significant difference when the pre-test scores of the experimental and control groups were compared. In this case, when the 21st century learning and renewal skills sub-dimensions of the two groups were examined at the beginning of the research process, it was determined that there was no significant difference.

Table 9

21st Century Learning and Renewal Skills Scale Experiment Group and Control Group Post-test Comparison

21st Century Learning and Renewal Skills Scale	Type of Group	N	Rank Average	Row Sum	U	p
Creativity and renewal	Experimental Group Post-test	20	22.13	442.50	167.500	.378
	Control Group Post-test	20	18.88	377.50		
Critical thinking and problem solving	Experimental Group Post-test	20	30.30	606.00	4.000	.000
	Control Group Post-test	20	10.70	214.00		
Cooperation and communication	Experimental Group Post-test	20	30.50	610.00	.000	.000
	Control Group Post-test	20	10.50	210.00		

When Table 9 is examined, when the post-test scores of the experimental and control groups are compared, it is seen that there is no statistically significant difference in favor of the experimental group in the creativity and renewal sub-dimensions, and there is a statistically significant difference in favor of the experimental group in the cooperation and communication, critical thinking and problem-solving sub-dimensions. However, when the averages of the experimental and control groups are examined, it is seen that the average of the experimental group is higher than the average of the control group. In this context, it is seen that it actually causes an increase in the creativity and renewal sub-dimension. However, this increase is not statistically significant. This shows that at the end of the research process, the creativity and

renewal skills, cooperation and communication, critical thinking and problem-solving skills of the social studies course conducted with SSTEM increased.

Table 10

21st Century Learning and Renewal Skills Scale Experimental Group Pre-test and Post-test Comparison

21st Century Learning and Renewal Skills Scale	Experimental Group Pretest-posttest	N	Rank Average	Row Sum	z	p
Creativity and renewal	Negative Rank	3	3.50	10.50	-3.531	.000
	Positive Sequence	17	11.74	199.50		
	Equal	0				
Critical thinking and problem solving	Negative Rank	7	7.07	49.50	-2.075	.038
	Positive Sequence	13	12.35	160.50		
	Equal	0				
Cooperation and communication	Negative Rank	4	10.38	41.50	-1.663	.096
	Positive Sequence	13	8.58	111.50		
	Equal	3				

When the pretest-posttest scores of the experimental group are compared in Table 10, it is seen that there is no statistically significant difference in favor of the posttest in the cooperation and communication skills sub-dimension; However, it was observed that there was a statistically significant difference in favor of the posttest in the dimensions of creativity and innovation and critical thinking and problem solving sub-skills. However, when the pre-test and post-test mean scores of the experimental group are examined, it is seen that the post-test average of the experimental group at the end of the process is higher than the pre-test average. In this context, it is seen that the 21st Century Learning and Renewal Skills scale also causes an increase in the cooperation and communication sub-dimension. However, this increase is not statistically significant. This situation indicates that the social studies course conducted with STEM; It shows a positive increase in creativity and innovation, critical thinking and problem solving, and collaboration and communication skills.

Table 11

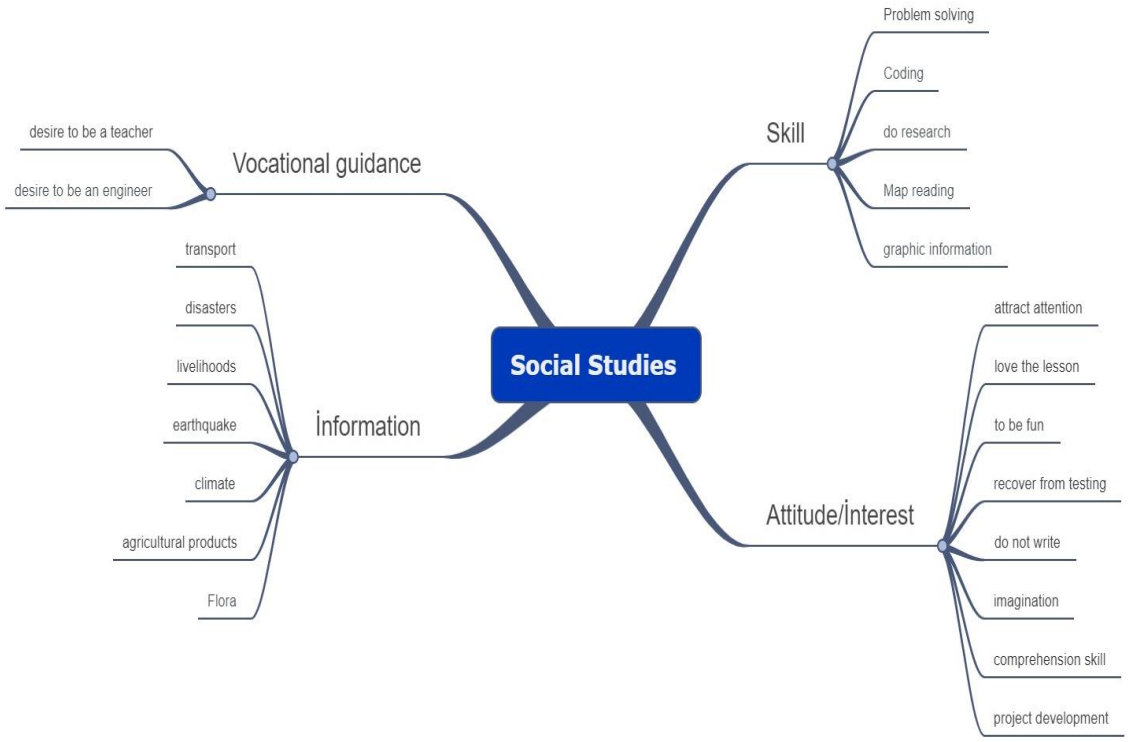
21st Century Learning and Renewal Skills Scale Control Group Pre-test and Post-test Comparison

21st Century Learning and Renewal Skills Scale	Control Group Pretest-posttest	N	Rank Average	Row Sum	z	p
Creativity and renewal	Negative Rank	7	6.36	44.50	-2.036	.042
	Positive Sequence	12	12.13	145.50		
	Equal	1				
Critical thinking and problem solving	Negative Rank	8	6.00	48.00	-1.895	.058
	Positive Sequence	11	12.91	142.00		
	Equal	1				
Cooperation and communication	Negative Rank	5	8.00	40.00	-1.454	.146
	Positive Sequence	11	8.73	96.00		
	Equal	4				

When Table 11 is examined, when the pre-test and post-test scores of the control group are compared, there is no statistically significant difference in favor of the post-test in the sub-dimensions of cooperation and communication, critical thinking and problem-solving skills; however, it was determined that there was a statistically significant difference in favor of the post-test in the creativity and renewal sub-dimensions. This situation determined that cooperation and communication, critical thinking and problem-solving skills did not change, while creativity and renewal skills increased in the social studies course that was not conducted with SSTEM. The findings obtained from the interviews with the students were gathered under two themes as “social studies” and “applications”. Findings under the theme of Social Studies are given in Figure 3 as follows:

Figure 3

Findings Given Under the Theme of "Social Studies"



As seen in Figure 3, the theme of social studies consists of four sub-themes: knowledge, skills, attitude/interest and vocational guidance. While the information theme consists of 7 categories; 5 of the skill sub-theme; 8 of the attitude interest sub-theme; It is seen that the sub-theme of vocational guidance consists of 2 categories. Regarding the sub-theme of knowledge, a student named Ece expressed as follows:

“I was very interested in the construction of fault lines, teacher. Because I don't know, I just learned because I never knew before. I learned what to do during an earthquake”

Regarding the skill sub-theme, a student named Zehra said, “The coding we made caught my attention. The questions intrigued me. It was fun because I saw it for the first time and did it.”

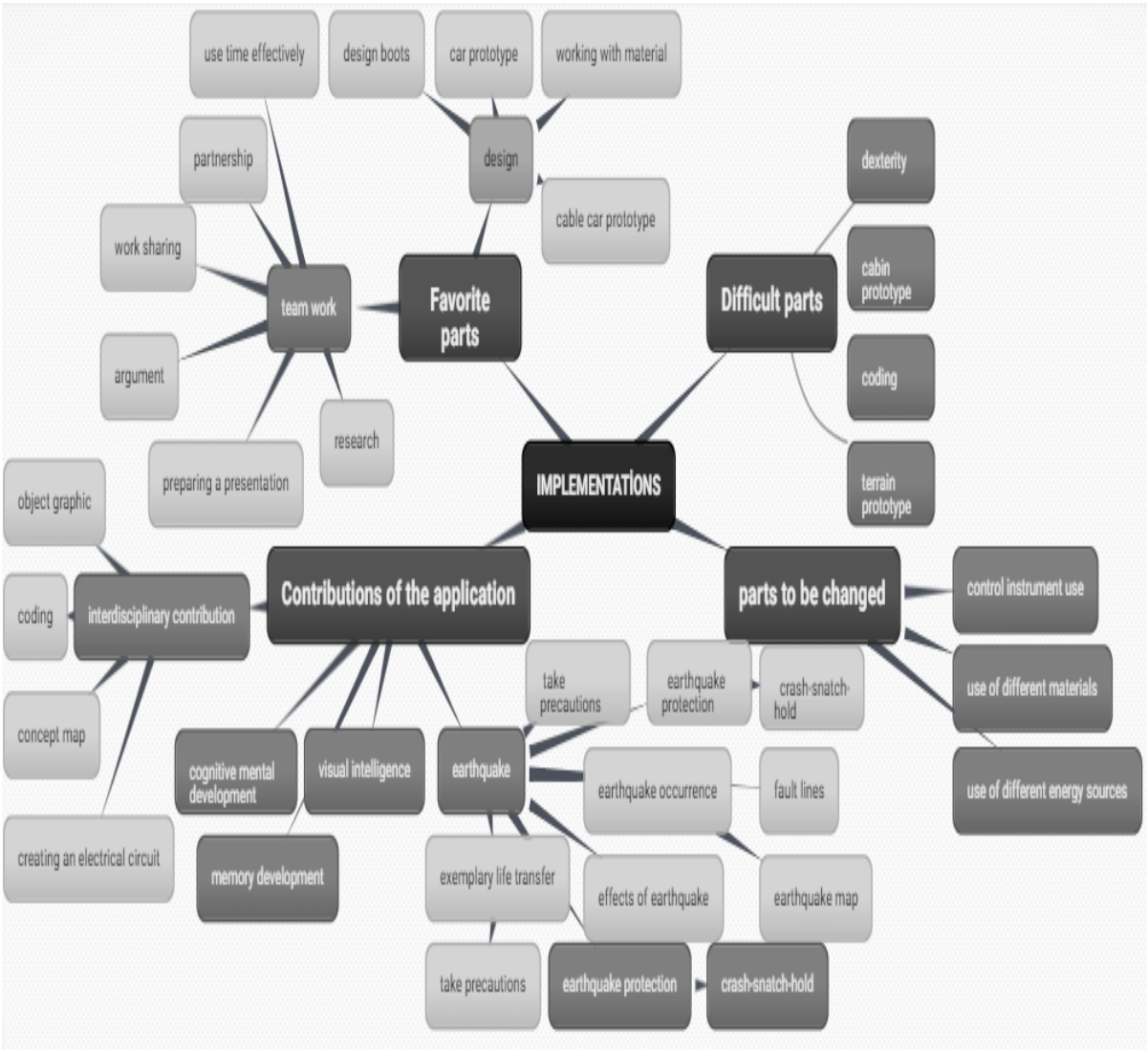
According to the findings related to the Attitude/Interest sub-theme, it was revealed that Social Studies lessons conducted with the SSTEM approach changed the perspectives of the

students towards the social studies lesson and contributed to their love of the lesson. In a direct quotation about the findings obtained from the interviews on the subject, a student named Nil said, “For example, we never did such activities in the social studies class. But in this social studies class, we do different projects every week. We learn more. We used to take tests in social studies class and we were bored. For example, we understand Social Studies better when it is fun”.

It was obtained from the findings that most of the students' vocational options changed after SSTEM activities. In the light of the data, it has been seen that there is an interest in social studies teaching and SSTEM professions. A student named Yiğit on the subject said, “Okay, sir, making the cable car has brought me closer to the engineering profession. I want to be an engineer now.” He stated that he was considering a choice in the field of engineering. The findings, which were created in the light of the data obtained from the interviews with the students and gathered under the theme of "Implementations", are as follows:

Figure 4

Findings Collected Under the Theme of “Implementations”



As seen in Figure 4, the "Implementations" theme consists of four sub-themes: "loved parts", "difficult parts", "parts to be changed" and "contributions of the implementation". Regarding the sub-theme of "loved departments", Aşkın, one of the students, said, “I felt the happiest during the SSTEM activities, the cable car. We gave a sound to the cable car, it worked. I was very happy then.” He stated that he did the activities with fun and enjoyment.

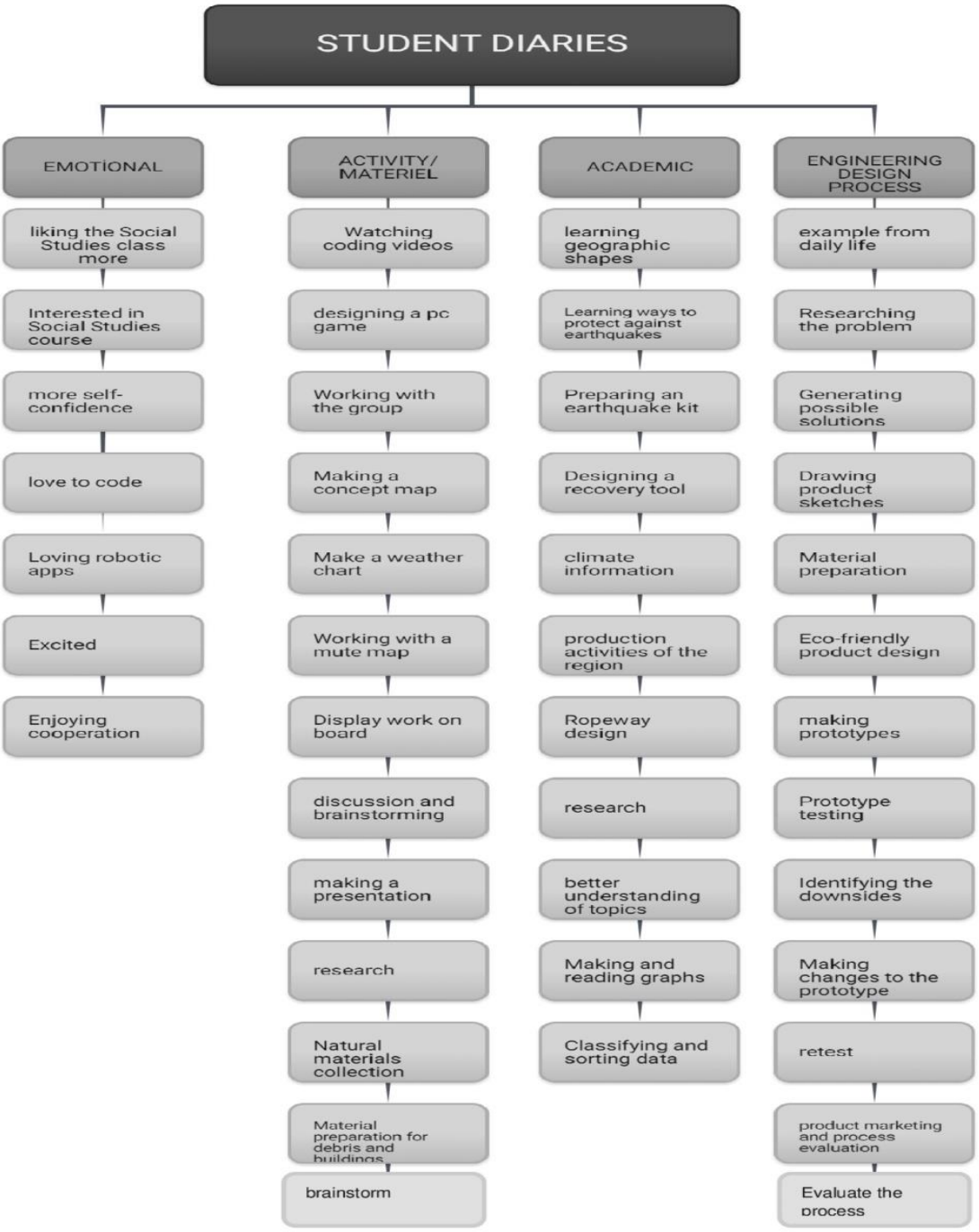
During the SSTEM activities, it was observed that the students had some difficulties both on the basis of the activities and while applying the process. It was observed that they had difficulties especially in the integration of technology and engineering. In the direct statement taken in line with these data discussed in the sub-theme of "difficult parts", a student named Eymen said, "I had difficulties in cutting and pasting, but I was not bored with anything. But I didn't know anything about coding. Until I learned coding robotics, I had a lot of difficulty and was afraid”.

In the process of SSTEM activities, it was observed that the students constantly produced new ideas and solutions about the subjects they did not understand during the process or about the activities carried out. In this context, it has been seen that there are parts that they want to change while designing or testing their activities. Under the main theme of “Implementations”, the findings obtained from the interviews that the students wanted to do different ways or different applications when they did the activities again were expressed in the sub-theme as “the parts that want to be changed”. Regarding the subject, Ahmet said, “When I was designing the excavator, I would have made it with other materials, it would have been more robust, sometimes ours could not carry the weight. I would also design it with other striking colors”.

The "contributions of implementation" section, which is another sub-theme of the research, has been a section in which the contributions of the courses taught with the SSTEM approach to the students are presented in a wide range. In this context, it is understood from the findings that the students develop a positive attitude towards the social studies course, that it has an impact on their academic success and improves them socially. In a direct quote taken on the subject, a student named Büşra said, “Yes, teacher, for example, I think that my visual memory has increased. Since we did it ourselves, now I remember the subject once I look at it.” He stated the contribution of SSTEM-active learning to memory development. Eymen said, “I would like the social studies course to be taught in this way all year long. In my opinion, such applications should be made in all courses, we learn by having fun, after all.” He stated that he wanted other courses such as social studies to be taught with a SSTEM approach. The findings obtained from the student diaries, another data collection tool in the research, are as follows:

Figure 5

Findings Obtained from Student Diaries



As seen in Figure 5, the theme of student diaries consists of four sub-themes: “affective”, “activity/material”, “academic” and “engineering design process”. The diaries of 20 primary school students were numbered, and direct quotations included “D1, D2, D3… etc.” given. In addition, by giving page numbers to the diaries, “P1, P2, P3…etc.” Regarding the affective sub-theme, a student named Asel said, “…this activity has changed my perspective on the social studies lesson. Disasters, natural disasters, AFAD (Disaster and Emergency

Management Presidency) …everything was great…Social Studies course added a new color to my life”

In the direct quotation under the "materials and activities" sub-theme, another sub-theme of the student diaries, a student named Hamza said, “First, we created an earthquake area. For this, we made paper trees with our group friends, we made soils, we painted our foams, we made debris. Afterwards, we tested the vehicles with our group friends and saw our shortcomings.” He described an activity he did with his friends during the process. In addition, each activity was displayed on the classroom board to increase students' motivation and self-confidence. Regarding the subject, a student named Büşra said, “We exhibited our works on the board. It made me very happy to be seen by everyone.”

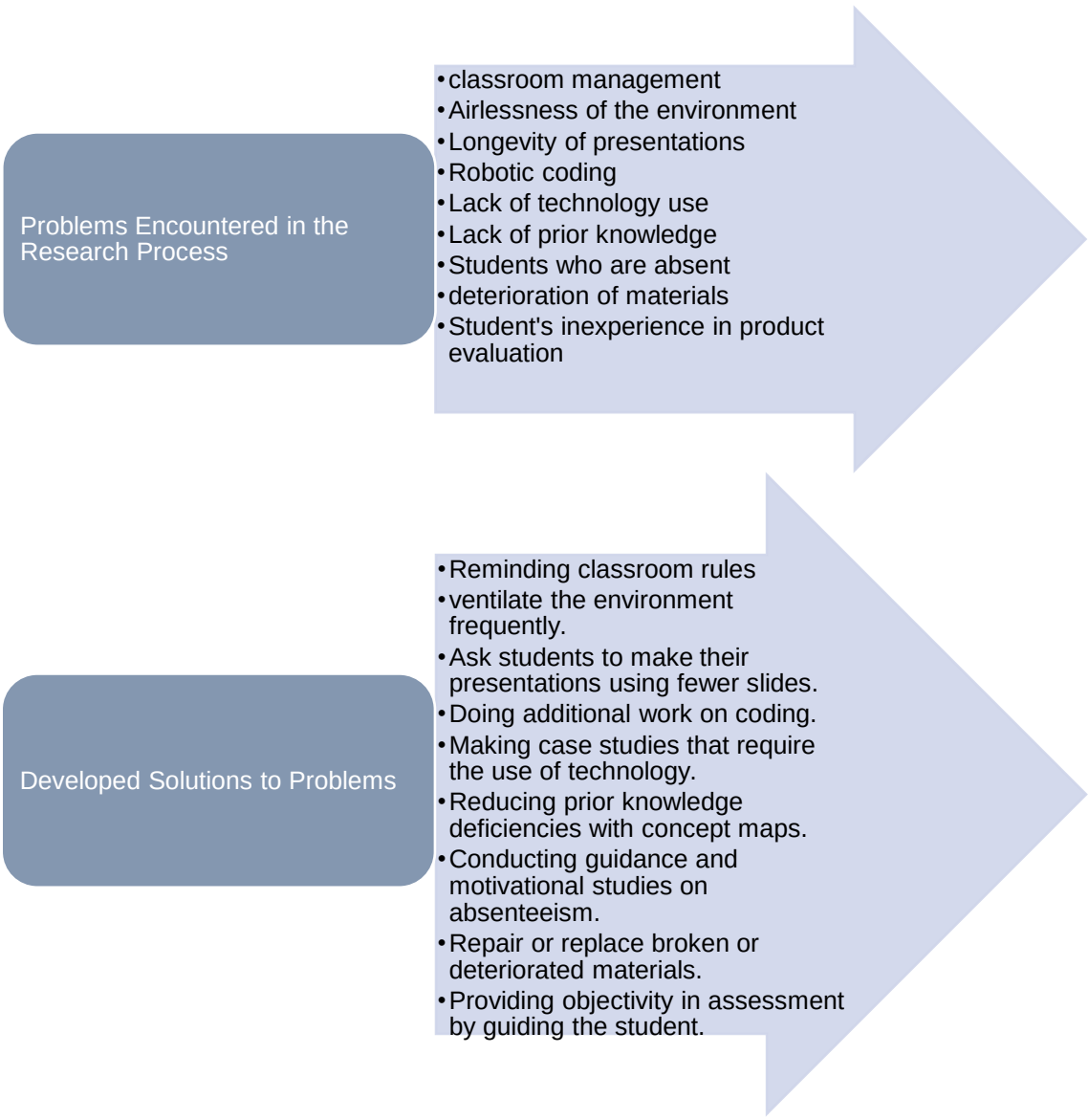
In the "academic" sub-theme of the main theme of the student diaries, it is seen that the students write in their research diaries where they have improved academically with the SSTEM activities. In the direct quotations obtained on the subject, a student named Zehra said, “I learned the earthquake map. We learned the provinces from the dumb map. I learned the location of the provinces and our teacher explained the regions”.

In the engineering design process, which is one of the most important components of the SSTEM approach, the findings obtained from the student research diaries were categorized. In addition, the engineering design process, which is an important step in solving problems, generating new ideas and putting these ideas into practice in students' daily lives, also contributed to the training of small environmentalist entrepreneurs. In direct quotations from the research diaries on the subject, a student named Eymen says, “Most importantly, I am happy to design a vehicle that works without harming the nature.” While acting with a sense of responsibility towards nature, a student named Melek stated the entrepreneurial dimension of the project they designed, “…we also made a cabinet window for our cable car to be used for tourism purposes.” states that they plan.

A diary was kept by the researcher throughout the research process. In this context, what was done about the SSTEM implementation process and the process were recorded through the diary. According to the findings obtained from the diaries kept throughout the research period, the problems experienced during the process and the solutions developed against these problems are shown in Figure 6 below.

Figure 6

Sub-Themes and Categories Obtained from Researcher Diaries



In Figure 6, the data obtained from the researcher's diary were collected under 2 themes. These; The problems encountered in the research process and the solutions produced by the researcher to these problems. In addition, it was stated that the researcher observed the experimental process in terms of its compatibility with the nature of SSTEM by using the checklists he had prepared before during the observation. In this context, the researcher also observed the situations he observed, whether the experimental process was carried out in parallel with the SSTEM approach, in accordance with the intended use of the prepared checklist. Checklists for determining the characteristics of the SSTEM learning process were implemented to both lesson plans, including the researcher, student, scenario and assessment variables.

Conclusion, Discussion and Implications

This research was carried out to determine the effects of SSTEM practices in primary school 4th grade social studies course on students' attitudes towards social studies course, 21st century learning and renewal skills, as well as their views on SSTEM practices. In this section, the results of the qualitative and quantitative findings obtained from the research data are discussed in relation to the relevant literature within the framework of the sub-objectives of the research.

In the findings related to the quantitative dimension of the study, it is seen that positive results in favor of the experimental group emerged in the comparison of the pre-test and post-test mean scores as a result of the analysis of the applied scales. In addition, in the semi-structured interviews, it was determined that SSTEM implementations increased the attitudes of the 4th grade primary school students in the experimental group towards the social studies lesson in a positive way. The findings obtained from the research are consistent with many studies in the literature (Maguth, 2012; Pryor, & Kang, 2013; Hartshorne, Waring & Okraski, 2019; Şahin, 2019; Luo, Wei, Ritzhaupt, Huggins-Manley & Gardner-McCune, 2019; Orak, Çilek & Yılmaz, 2020; Johnson, & Sondergeld, 2020; Noh & Khairani, 2020; Wang & Main, 2021; Selanik-Ay & Duban, 2021). In this respect, it can be concluded that the perspectives on the social studies course taught using SSTEM implementations have changed positively.

When the findings obtained in this study were compared with the results of the literature, it was observed that only one study was conducted on the SSTEM education approach in Turkey (Selanik-Ay & Duban, 2021). In this study, primary school teachers associated four of the eight learning areas (People, Places and Environments, Culture and Heritage, Production, Distribution, Consumption, Science, Technology and Society) in the social studies curriculum with SSTEM. They also stated that social studies can be integrated into STEM disciplines in the context of solving social problems. In this respect, it can be said that it is similar to the results of the research. Maguth (2012), in a qualitative research conducted on social studies programs in two STEM high schools that provide education with STEM approach related to social studies programs in STEM education, as a result of interviews with social studies teachers, principals and students; It has been stated that STEM education provides interdisciplinary and technology integration provided to social studies teachers and some difficulties of teaching social studies in a STEM school. In addition, the researcher emphasized the importance of integrating STEM education in all disciplines to ensure that citizens are equipped with the skills, knowledge and tendencies necessary to compete in a global and multicultural age. This study also supports the findings of SSTEM about finding different solutions to students' social life problems. In addition, Orak, Çilek and Yılmaz (2020) examined the views of teachers on STEM lesson designs supported by traditional Turkish games adapted to primary school social studies courses in their research. According to the findings obtained through the collected data, it was stated by the participants that they developed a meaningful perception in the students in terms of cognitive, affective and psychomotor aspects. Another finding obtained in this study is that in a multidisciplinary course such as a social studies course, in the learning processes where the student is passive and the teacher tries to convey the knowledge; It is stated that both abstract and incomprehensible information conveyed to the students can cause the lesson to be boring and when students do not have the opportunity to apply the information conveyed in daily life, they may have difficulty grasping the importance of the lesson. In order to prevent these negativities, they stated that with the inclusion of social studies course in the STEM education approach, it would be possible to use

many methods and techniques involving real life problems. In this research, according to the findings obtained from the student interviews, it is revealed that the students do not like the social studies course, which is taught in the traditional way. In addition, in quantitative findings, it was observed that there was a significant difference in favor of the experimental group who received SSTEM applications both in the pretest-posttest comparisons within the experimental group and in the pretest-posttest comparisons between the experimental group and the control group. In this case, it was determined that primary school students' attitudes towards social studies courses increased in social studies lessons conducted with SSTEM.

As a result of this research, a significant difference emerged between the pre-test and post-test mean scores of the 21st Century Learning and Renewal Skills Scale. When the relevant literature is reviewed, it is emphasized that one of the most important contributions of STEM education is the development of 21st century skills of individuals. When the literature is reviewed, many studies have concluded that STEM practices have a positive effect on gaining 21st century skills (Elliott, Oty, Mcarthur & Clark, 2001; Benek, 2019; Bircan, 2019; Bybee, 2010; Çınar & Kereci, 2020; Eguchi, 2016; Şahin, Ayar & Adıgüzel, 2014; Özçelik & Akgündüz, 2018; Tanın, 2021; Hacıoğlu & Gülhan, 2021). In this study, it was concluded that students gained many 21st century skills such as creative thinking, developing problem solving skills, and critical thinking. Bates (2000) also states that STEM education enables students to develop skills such as problem solving, critical thinking, creativity and cooperation. Thus, it is stated that students will gain better 21st century skills such as scientific and technological literacy, problem solving, critical thinking, communication and cooperation. Kutlu-Demir (2018) also concluded in his study that in the development of 21st century skills, using Web 2.0 tools can be more effective in helping students acquire these skills. Murat (2018), on the other hand, stated in his study with pre-service science teachers that they developed a positive attitude in acquiring 21st century skills with STEM education.

In the research, the students answered the question about the effect of SSTEM activities on the future career choices of primary school students; by citing reasons such as the desire to design, suitability for the profession they have dreamed of, and the desire to learn by doing; They stated that SSTEM activities affect the career choices they want to make in the future in the context of their orientation towards STEM professions. Numerous studies have concluded that STEM implementations have positive effects on students' perceptions of the engineering profession at different levels (Sadler, Coyle & Schwartz, 2000; Gülhan, 2016; Ercan, 2014; Moore, Stohlmann, Wang, Tank & Roehrig, 2014; Yıldırım, 2016) can be seen in the literature.

Primary school students generally expressed positive opinions about the SSTEM implementation process, stating that they enjoyed it and that it aroused excitement. Research findings are similar to many studies scanned in the literature. As a result of their research, Gökbayrak and Karışan (2017) concluded that STEM activities contributed to the students, that the students stated that they wanted to improve themselves more in this regard and that they wanted to do STEM implementations in other courses. Karahan, Canbazoglu-Bilici, and Unal (2015) also concluded that students learned through STEM activities by having fun and enjoyed the practice. In their study, Duban and Kolsuz (2019) concluded that with the STEAM education approach, students enjoyed the courses more, and at the end of the interviews with the students, they realized that STEM disciplines are interrelated and necessary in daily life. It is seen that these studies support the research results by showing a high similarity with the qualitative and quantitative data obtained with the study.

There were also moments when students had difficulties during SSTEM practices. In particular, students sometimes experienced difficulties due to their lack of prior knowledge of concepts and skills such as coding, dumb maps and soldering. However, they stated that with the coding training given by the researcher, they acquired new skills in the process and performed the implementation more easily and with pleasure. Keçeci, Alan and Kırbağ-Zengin (2017), who reached conclusions supporting this finding, also thought that students would have difficulties especially in coding before STEM implementations; After the implementation, they concluded that they evaluated the process as enjoyable and feasible. Güleryüz, Dilber, and Erdoğan (2020) also obtained similar results and stated in their research that the coding education provided ensures permanent learning and enjoyable courses, directs it to practice rather than theory, and contributes to developing different ideas.

In the research, the scenarios in the SSTEM plans developed according to the 5E learning model were made by considering real life problems. It has been thought that the scenarios created from the students' environment and the problems they may encounter in daily life may attract the attention of the students more. Many studies in the literature have found that designing scenarios in STEM implementations in a way that students can encounter in daily life increases the motivation of students (Günhan, 2006; Kılınç, 2007; Etherington, 2011; Guzey, Moore & Harwell, 2016; Çorlu, 2017; Yıldırım, 2018; Doğan, 2020) are highlighted.

As a result of the research, primary school students talked about the contributions of SSTEM in terms of their cognitive, affective, psychomotor development and 21st century skills. Similarly, many studies in the literature have concluded that STEM applications contribute to different areas of development and gaining 21st century skills (Daugherty, 2013; Eroğlu & Bektaş, 2016; Acar, Tertemiz & Taşdemir, 2018; Gülhan & Şahin, 2018; Gül, 2019; Orak, Çilek & Yılmaz 2020).

During the SSTEM practices, the activities were carried out with group work, and it was determined in the qualitative findings of the research that the students were more productive to work in collaboration with their peers. According to the results of the comparison of the pretest-posttest scores of the experimental group and the control group obtained from the quantitative findings of the research, it is seen that there is a significant difference in favor of the experimental group at the end of the implementations in the cooperation and communication dimension of the students at the end of the process. It has been observed that students' learning model based on the SSTEM approach increases their social skills such as friendships, helping and sharing, and it is similar to many studies in the literature. For example, Yıldırım and Selvi (2018), in their study, concluded that group work increases cooperation and solidarity among students, develops empathy and taking responsibility, imposes leadership characteristics on the individual, and group work enables the emergence of different ideas by creating brainstorming. Karakaya et al. (2019) applied STEM-centered activities to the students for 6 weeks in a study of 4th grade primary school students. As a result, they determined that group work is important in STEM activities and it provides opportunities for situations such as acting together, cooperation, mutual interaction and social communication. In this context, in many researches (Bybee, 2013; Kim, Ko & Han, 2014; Çorlu, 2018; Yıldırım & Selvi, 2018; Bircan, 2019; Karakaya et al. 2019; Özcan & Koca, 2019; Kaplan & Yılmaz, 2021; Öztürk, 2020) in the literature, in which students develop skills such as effective communication, decision making, sharing, cooperation, learning by doing, developing different thinking skills, problem solving and innovation with STEM education.

In the research, one of the foundations obtained from the researcher's diary, which functions as a data collection tool, is the theme of problems encountered in SSTEM implementations. Under this theme, students' lack of prior knowledge, inability to use time efficiently, lack of use of technology, engineering design process, problems arising from the failure of some of the materials and the extra cost incurred in this case, the increase in the responsibility of the absent students in their groups and the inadequacy of the students in product evaluation were determined. On the subject, Wang, Moore, Roehring & Park (2011) also mention the problems in the courses taught with the STEM education approach, and state that the disruptions that may be experienced in technology will cause the STEM applications to not be fully efficient. Similarly, many studies supporting this result (Yıldırım, 2018; Özbilen, 2018; Gökçe & Yıldırım, 2019; Ozan, 2019) are found in the literature. In the light of the results obtained, the following recommendations can be made:

• Various researches can be done by integrating the SSTEM approach into different disciplines or by implementing it at different levels.

• In order to gain time management skills, this skill can be gained by increasing the frequency of SSTEM implementations.

• SSTEM research can be done with different methods such as action research.

Contribution Rate of the Researchers

The study is a part of the master's thesis completed by the first author under the supervision of the second author. The second author guided the entire process of the study.

Statement of Conflict of Interest

There is no conflict of interest between the authors.

References

Acar, D., Tertemiz, N., & Taşdemir, A. (2018). The effects of stem training on the academic achievement of 4th graders in science and mathematics and their views on stem training. *International Electronic Journal of Elementary Education, 10*(4), 505-513. Retrieved July 1, 2022, from https://www.iejee.com/index.php/IEJEE/article/view/465

Adams, A. E., Miller, B. G., Saul, M., & Pegg, J. (2014). Supporting elementary pre-service teachers to teach stem through place-based teaching and learning experiences. *Electronic Journal of Science Education, 18*(5), 1-22. Retrieved July 2, 2022, from http://ejse.southwestern.edu

Bates, A. W. (2000). *Managing technological change.* San Francisco: Jossey-Bass. Retrieved May 15, 2022, from https://eric.ed.gov/?id=ED438793

Belet-Boyacı, D. Ş., & Atalay, N. (2016). A scale development for 21st century skills of primary school students: a validity and reliability study. *International Journal of Instruction*, 9(1). Retrieved April 28, 2022, from https://doi.org/10.12973/iji.2016.9111a

Benek, İ. (2019). *Sosyobilimsel stem etkinliklerinin öğrencilerin tutumlarına ve 21. yüzyıl becerilerine etkisinin incelenmesi*. (Yayın No. 611696) [Yayımlanmamış doktora tezi]. İstanbul Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 19.5.2022 tarihinde erişilmiştir.

Bircan, M. A. (2019). *Stem eğitimi etkinliklerinin ilkokul dördüncü sınıf öğrencilerinin stem'e yönelik tutumlarına, 21. yüzyıl becerilerine ve matematik başarılarına etkisi.* (Yayın No. 600567) [Yayımlanmamış doktora tezi]. On Dokuz Mayıs Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 12.5.2022 tarihinde erişilmiştir.

Bybee, R. W. (2010). Advancing stem education: A 2020 vision. *Technology and Engineering Teacher, 70*(1), 30-35. Retrieved April 23, 2022, from https://doi.org/10.4236/ce.2015.617187

Bybee, R. W. (2013). *The case for stem education: Challenges and opportunities.* Arlington: NSTA press. Retrieved April 18, 2022, from https://doi.org/10.4236/jqis.2013.56051

Cameron, R. (2011). Mixed methods research: The five ps framework. *Electronic journal of business research methods, 9*(2), 96-108. Retrieved March 26, 2022, from www.ejbrm.com

Chiodo, J, and Byford, J. (2004). Do they really dislike social studies? A study of middle school and high school students. The Journal of Social Studies, 28 (1), 16-26. https://www.proquest.com/openview/bdb8456b019d0f03395d591d5d95ef73/1?pqorigsite=gscholar&cbl=48205 adresinden 03.07.2024 tarihinde erişilmiştir.

Creswell, J. W. (2014). *A concise introduction to mixed methods research.* Thousand Oaks, CA: Sage. Retrieved July 3, 2022, from https://www.manaraa.com/upload/d11df289-14cd-482b-a413-54c290668e4b.pdf

Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research (2nd ed.)*. Thousand Oaks, CA: Sage. Retrieved March 17, 2022, from https://doi.org/10.4236/cus.2018.62015

Creswell, J., & Plano Clark, V. L. (2007). Understanding mixed methods research. In J. Creswell (Ed.), *Designing and conducting mixed methods research* (pp. 1-19). Thousand Oaks, CA: Sage. Retrieved April 19, 2022, from https://doi.org/10.1177/1558689809356

Çınar, S., & Kereci, N. (2020). Sınıf öğretmenlerinin mühendislik tasarım uygulamalarının fen bilimleri öğretimine entegrasyonu hakkındaki görüşleri: Ordu Örneği. *Uluslararası Eğitimde Yenilikçi Yaklaşımlar Dergisi, 4*(2), 23-45. https://doi.org/10.29329/ijiape.2020.261.1 adresinden 25.6.2022 tarihinde erişilmiştir.

Çorlu, M. S. (2017). *STEM:* Bütünleşik öğretmenlik çerçevesi. M. S. Çorlu ve E. Çallı (Ed.), *STEM Kuram ve Uygulamalarıyla Fen, Teknoloji, Mühendislik ve Matematik Eğitimi* içinde (ss.1-10). Ankara: Pusula Yayıncılık. https://www.academia.edu/32733083 adresinden 10.6.2021 tarihinde erişilmiştir.

Daugherty, M. K. (2013). The prospect of an "a" in stem education. *Journal of STEM Education: Innovations and Research, 14*(2), 10-14. Retrieved June 8, 2022, from https://www.researchgate.net/publication/286201021

Deveci, H., & Bayram, H. (2022). Sosyal bilgiler öğretimi. Ö., G. Bayır ve T., Selanik Ay (Ed.), *Sosyal Bilgilerin tanımı, kapsamı ve önemi içinde* (ss.12-13). Ankara: Vizitek Yayıncılık

Doğan, H. (2020). *Beşinci sınıf fen bilimleri dersi ünitelerinin bütünleşik stem eğitimi yaklaşımı ile tasarlanması, uygulanması ve değerlendirilmesi*. (Yayın No. 631382) [Yayımlanmamış doktora tezi]. Pamukkale Üniversitesi Eğitim Bilimleri Enstitüsü. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 13.3.2022 tarihinde erişilmiştir.

Duban, N., & Kolsuz, S. (2019). İlkokul öğrencilerinin steam (fen-teknoloji-mühendislik-matematik-sanat) disiplinlerine ilişkin görüşleri. *Information Technologies and Applied Sciences, 14*(2), 227-240. https://doi.org/10.29228/TurkishStudies.22721 adresinden 14.5.2021 tarihinde erişilmiştir.

Dugger, W. E. (2010). *Evolution of stem in the united states. in 6th biennial international conference on technology education research in australia.* Ocak 21, 2023, tarihinde http://www.iteea.org/Resources/PressRoom/AustraliaPaper.pdf adresinden erişildi.

Ecevit, T., Balcı, N., Yıldız, M. ve Sayan, B. (2021). İlkokul Düzeyindeki Araştırma-Sorgulama, Argümantasyon ve STEM Temelli Uygulamalarının Tematik İçerik Analizi. *YYÜ Eğitim Fakültesi Dergisi, 18*(1), 1100-1129. https://doi.org/10.33711/yyuefd.957395 adresinden 11.6.2021 tarihinde erişilmiştir.

Eguchi, A. (2016). RoboCupJunior for promoting stem education, 21st century skills, and technological advancement through robotics competition. *Robotics and Autonomous Systems*, 75, 692-699. Retrieved February 21, 2022, from https://doi.org/10.1016/j.robot.2015.05.013

Elliott, B., Oty, K., Mcarthur, J., & Clark, B. (2001). The effect of an interdisplinary algebra/science course on students' problem-solving skills, critical thinking skills and attitudes towards mathematics. *International Journal of Mathematical Education in Science and Technology, 32*(6), 811-816. Retrieved April 18, 2022, from https://doi.org/10.1080/00207390110053784

Ercan, S. (2014). *Fen eğitiminde mühendislik uygulamalarının kullanımı: tasarım temelli fen eğitimi*. (Yayın No. 372246) [Yayımlanmamış doktora tezi] Marmara Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 23.4.2022 tarihinde erişilmiştir.

Eroğlu, S., & Bektaş, O. (2016). Stem eğitimi almış fen bilimleri öğretmenlerinin stem temelli ders etkinlikleri hakkındaki görüşleri. *Eğitimde Nitel Araştırmalar Dergisi, 4*(3), 43-67. https://doi.org/10.14689/issn.2148-2624.1.4c3s3m adresinden 11.6.2021 tarihinde erişilmiştir.

Etherington, M. B. (2011). Investigative primary science: a problem-based learning approach. *Australian Journal of Teacher Education, 36*(9), 53-74. Retrieved March 18, 2022, from https://doi.org/10.14221/ajte.2011v36n9.2

Farisi, M. (2016). Developing the 21st Century Social Studies Skills Through Technology integration. *Turkish Online Journal of Distance Education, 17*(1), 6-30. Retrieved June 2, 2022, from https://doi.org/10.17718/tojde.47374

Gonzalez, H. B. & Kuenzi, J. J. (2012). *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*. Washington, DC: Congressional Research Service, Library of Congress. Retrieved Fabruary 12, 2022, from https://www.researchgate.net/publication/292937643

Gökçe, T. A., & Yıldırım, D. (2019). Öğretmenlerin stem eğitiminde yaşadığı sorunlar ve çözümler; İçinde *14. Uluslararası Eğitim Yönetimi Kongresi Tam Metin Bildiri Kitabı* 2-4 Mayıs 2019, (ss.45-50), Ankara, Türkiye. https://www.researchgate.net/publication/336922493 adresinden 21.3.2021 tarihinde erişilmiştir.

Gökbayrak, S., & Karışan, D. (2017). Altıncı sınıf öğrencilerinin fetemm temelli etkinlikler hakkındaki görüşlerinin incelenmesi. *Alan Eğitimi Araştırmaları Dergisi, 3*(1), 25-40. https://dergipark.org.tr/tr/pub/aleg/issue/27459/285451 adresinden 22.4.2017 tarihinde erişilmiştir.

Guzey, S. S., Harwell, M., & Moore, T. (2014). Development of an instrument to assess attitudes toward science, technology, engineering, and mathematics (STEM). *School Science and Mathematics*, *114*(6), 271-279. Retrieved May 8, 2022, from https://doi.org/10.1111/ssm.12077

Gül, K. (2019). *Fen bilgisi öğretmen adaylarına yönelik bir stem eğitimi dersinin tasarlanması, uygulanması ve değerlendirilmesi*. (Yayın No. 552171) [Yayımlanmamış doktora tezi]. Gazi Üniversitesi Eğitim Bilimleri Enstitüsü. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 11.2.2022 tarihinde erişilmiştir.

Güleryüz, H., Dilber, R., & Erdoğan, İ. (2020). Stem uygulamalarında öğretmen adaylarının kodlama eğitimi hakkındaki görüşleri. *Ağrı İbrahim Çeçen Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 6*(1), 71-83. https://doi.org/10.31463/aicusbed.610909 adresinden 19.2.2022 tarihinde erişilmiştir.

Gülhan, F. (2016). *Fen-teknoloji-mühendislik-matematik entegrasyonunun (stem) 5. sınıf öğrencilerinin algı, tutum, kavramsal anlama ve bilimsel yaratıcılıklarına etkisi.* (Yayın No. 473101) [Yayımlanmamış doktora tezi]. Marmara Üniversitesi Eğitim Bilimleri Enstitüsü. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 31.3.2022 tarihinde erişilmiştir.

Gülhan, F., & Şahin, F. (2018). Steam (stem+sanat) etkinliklerinin 7. sınıf öğrencilerinin akademik başarı, steam tutum ve bilimsel yaratıcılıklarına etkisi. *Journal of Human Sciences, 15*(3), 1675-1699. https://doi.org/10.14687/jhs.v15i3.543 adresinden 29.5.2022 tarihinde erişilmiştir.

Günhan, B. (2006). *İlköğretim 2. kademede matematik dersinde probleme dayalı öğrenmenin uygulanabilirliği üzerine bir araştırma*. (Yayın No. 206025) [Yayımlanmamış doktora tezi]. Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 1.4.2022 tarihinde erişilmiştir.

Hacıoğlu, Y. & Gülhan, F. (2021). The effects of STEM education on the students' critical thinking skills and STEM perceptions. *Journal of Education in Science Environment and Health, 7*(2), 139-155. Retrieved April 8, 2022, from https://doi.org/10.21891/jeseh.77133

Hartshorne, R., Waring, S. M., & Okraski, H. (2019). Developing well-informed, critically thinking, and active citizens through the connection of modeling & simulation and social studies education. *The Clearıng House, 1*(2), 48–52. Retrieved June 17, 2022, from https://doi.org/10.1080/00098655.2019.1571988

Hebebci, M., T. (2019). *Fen, Teknoloji, Mühendislik ve Matematik Eğitimi Uygulamalarının Ortaokul Öğrencilerinin Akademik Başarı, Bilimsel Yaratıcılık ve Tutumlarına Yönelik Etkisi.* (Yayın No. 556449) [Yayımlanmamış Doktora Tezi]. Necmettin Erbakan Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 10.3.2022 tarihinde erişilmiştir.

Johnson, C. C., & Sondergeld, A. T. (2020). Outcomes of an integrated stem high school: enabling access and achievement for all students. *Urban Education*, 1–27. Retrieved March 23, 2022, from https://doi.org/10.1177/0042085920914368

Kadıoğlu Ateş, H. ve Vatansever Bayraktar, H. (2020). İlkokul Öğrencilerinin Sosyal Bilgiler Dersine Yönelik Tutumunun İncelenmesi. *Jass Studies- The Journal of Academic Social Science Studies*, *13*(83), 41-69. http://dx.doi.org/10.29228/JASSS.46823 adresinden 03.07.2024 tarihinde erişilmiştir.

Kaplan, S., & Yılmaz, F. (2021). The opinions effect of student in disadvantaged classes for stem applications. *Turkish Journal of Qualitative Research, 1*(1), 1-17. Retrieved May 15, 2022, from https://www.nitelarastirma.org

Karahan, E., Canbazoglu-Bilici, S., & Unal, A. (2015). Integration of media design processes in science, technology, engineering, and mathematics (stem) education. *Eurasian Journal of Educational Research, 15*(60), 221-240. Retrieved May 19, 2022, from https://doi.org/10.14689/ejer.2015.60.15

Karakaya, F., Yantırı, H., Yılmaz, G., & Yılmaz M. (2019). İlkokul öğrencilerinin stem etkinlikleri hakkında görüşlerinin belirlenmesi: 4. sınıf örneği. *Uluslararası Türk Eğitim Bilimleri Dergisi, 7*(13), 1-14. https://doi.org/10.46778/goputeb.592351 adresinden 12.4.2022 tarihinde erişilmiştir.

Keçeci, G., Alan, B., & Kırbağ-Zengin, F. (2017). 5. sınıf öğrencileriyle stem eğitimi uygulamaları. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 18*(1),1-17. https://dergipark.org.tr/tr/pub/kefad/issue/59263/851384 adresinden 18.4.2022 tarihinde erişilmiştir.

Kılınç, A. (2007). Probleme dayalı öğrenme. *Kastamonu Eğitim Dergisi, 15*(2), 561-578. https://dergipark.org.tr/tr/pub/kefdergi/issue/49102/626594 adresinden 22.5.2022 tarihinde erişilmiştir.

Kim, D. H., Ko, D. G., & Han, M. J. (2014). The effects of science lessons applying steam education program on the creativity and interest levels of elementary students. *Journal of the Korean Association for Science Education, 34*(1), 43-54. Retrieved Fabruary 20, 2022, from https://doi.org/10.14697/jkase.2014.34.1.1.00043

Kutlu-Demir, Ö. (2018). *21st century learning: integration of web 2. 0 tools in turkish adult language classrooms*. (Yayın No. 505500) [Yayımlanmamış doktora tezi]. Çağ Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 16.4.2022 tarihinde erişilmiştir.

Lacey, T. A., & Wright, B. (2009). Employment Outlook: 2008-18-Occupational Employment Projections to 2018. *Monthly Lab. Rev.*, 132, 82. Retrieved April 28, 2022, from Lacey, T. A. & Wright, B. (2009). Employment Outlook: 2008-18-Occupational Employment Projections to 2018. Monthly Lab. Rev., 132, 82. Retrieved March 12, 2022, from https://www.bls.gov/opub/mlr/2009/11/art5full.pdf

Luo, W., Wei, H. R., Ritzhaupt, A. D., Huggins-Manley, A. C., & Gardner-McCune, C. (2019). Using the s-stem survey to evaluate a middle school robotics learning environment: validity evidence in a different context. *Journal of Science Education and Technology*, *28*(4), 429-443. Retrieved April 19, 2022, from https://doi.org/10.1007/s10956-019-09773-z

Maguth, B. (2012). Defense of the social studies: social studies programs in stem education. *Social Studies Research and Practice*, *7*(2), 65-84. Retrieved March 13, 2022, from https://doi.org/10.1108/SSRP-02-2012-B0005

Millî Eğitim Bakanlığı. (2016). STEM Eğitimi Raporu, http://yegitek.meb.gov.tr/STEM_Egitimi_Raporu.pdf adresinden 30.4.2022 tarihinde erişilmiştir.

Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., Glancy, A. W., & Roehrig, G.H. (2014). Implementation and integration of engineering in k-12 stem education. In S. Purzer, J. Strobel & M. Cardella, (Eds.), *Engineeringi in Precollege Settings: Research into Practice. West Lafayette,* (pp. 35-60). Purdue University Press. Retrieved July 2, 2022, from https://www.researchgate.net/publication/273458545

Murat, A. (2018). *Fen bilgisi öğretmen adaylarının 21. yüzyıl becerileri yeterlik algıları ile stem' e yönelik tutumlarının incelenmesi.* (Yayın No. 515427) [Yayımlanmamış yüksek lisans tezi]. Fırat Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 11.5.2022 tarihinde erişilmiştir.

National Council for the Social Studies, (1993 January;February). *The Social Studies Professional.* Washington DC: National Council for the Social Studies. Retrieved March 15, 2022, from https://www.socialstudies.org/

Noh M. A., & Khairani, Z. A. (2020). Valıdatıng the s-stem among malaysıan pre-unıversıty students. *Jurnal Pendidikan IPA Indonesia, 9*(3), 421-429. Retrieved May 14, 2022, from https://doi.org/10.15294/jpii.v9i3.24109

Orak, S., Çilek, A., & Yılmaz, G., F. (2020). Adaptation of traditional children's games to social studies course: stem course design for teachers. *Cypriot Journal of Educational Science, 15*(6), 1422-1438. Retrieved May 18, 2022, from https://doi.org/10.18844/cjes.v15i6.4318

Ozan, F. (2019). *5. sınıf kuvvetin ölçülmesi ve sürtünme ünitesine yönelik fetemm uygulamalarının etkililiğinin çeşitli değişkenler bağlamında incelenmesi.* (Yayın No. 558663) **[**Yayımlanmamış yüksek lisans tezi]. Amasya Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 16.5.2022 tarihinde erişilmiştir.

Özbilen, G. A. (2018). Stem eğitimine yönelik öğretmen görüşleri ve farkındalıkları. *Scientific Educational Studies, 2*(1), 1-21. https://dergipark.org.tr/tr/pub/ses/issue/37465/414916 adresinden 13.5.2022 tarihinde erişilmiştir.

Özcan, H., & Koca, E. (2019). Stem yaklaşımı ile basınç konusu öğretiminin ortaokul 7. sınıf öğrencilerinin akademik başarılarına ve stem'e yönelik tutumlarına etkisi. *Eğitim ve Bilim, 44*(198), 201-227. http://dx.doi.org/10.15390/EB.2019.7902 adresinden 26.2.2022 tarihinde erişilmiştir.

Özçelik, A., & Akgündüz, D. (2018). Üstün/özel yetenekli öğrencilerle yapılan okul dışı stem eğitiminin değerlendirilmesi. *Trakya Üniversitesi Eğitim Fakültesi Dergisi, 8*(2), 334-351. https://doi.org/10.24315/trkefd.331579 adresinden 21.1.2022 tarihinde erişilmiştir.

Öztürk, D. (2020). *İlkokul 4. sınıf fen bilimleri dersinde stem etkinliklerinin akademik başarıya etkisi*. (Yayın No. 628340) [Yayımlanmamış yüksek lisans tezi]. Ordu Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 21.4.2022 tarihinde erişilmiştir.

Partnership for 21st Century Skills. (2009). *P21 framework definitions.* Ocak 15, 2023, tarihinde http://www.p21.org/storage/documents/P21_Framework_Definitions.pdf adresinden 15.2.2022 tarihinde erişilmiştir.

Pekbay, C. (2017). *Fen Teknoloji Mühendislik ve Matematik Etkinliklerinin Ortaokul Öğrencileri Üzerindeki Etkileri.* (Yayın No. 454935) [Yayımlanmamış Doktora Tezi]. Hacettepe Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 19.3.2022 tarihinde erişilmiştir.

Pryor, C. R., & Kang, R. (2013). Project-based learning: an interdisciplinary approach for integrating social studies with stem. In R. M. Capraro, M. M. Capraro & J. Morgan (Eds.), *STEM Project-based learning: An integrated Science, Technology, Engineering, and Mathematics (STEM)* (pp.129-138). Approach, Brill. Retrieved April 8, 2022, from https://doi.org/10.1007/978-94-6209-143-6_14

Sadler, P. M., Coyle, H. P., & Schwartz, M. (2000). Engineering competitions in the middle school classroom: Key elements in developing effective design challenges. *The Journal of The Learning Sciences, 9*(3), 299-327. Retrieved March 14, 2022, from https://doi.org/10.1207/S15327809JLS0903_3

Schug, M. C., Todd, R. J., & Beery, R. (1982). *Why kids don't like social studies*. National Council for the Social Studies, Boston. Retrieved Fabruary 19, 2022, from https://files.eric.ed.gov/fulltext/ED224765.pdf

Seefeldt, C., Castle, S., & Falconer, R. C. (2015). *Okul öncesi / ilkokul çocukları için sosyal bilgiler öğretimi (Çev: S. Coşkun-Keskin).* Ankara: Nobel Yayıncılık.

Selanik-Ay, T., & Duban, N. (2021). According to primary school teachers' views on s-stem (social studies + stem): A phenomenological research. *Open Journal for Educational Research, 5*(2), 223-244. Retrieved Fabruary 10, 2022, from https://doi.org/10.32591/coas.ojer.0502.08223

Şahin, A. (2019). The role of interdisciplinary project-based learning in integrated stem education. *In STEM Education 2.0*, (pp.93-103). Brill. Retrieved May 23, 2022, from https://doi.org/10.1163/9789004405400_006

Şahin, A., Ayar, M. C., & Adıgüzel, T. (2014). Fen, teknoloji, mühendislik ve matematik içerikli okul sonrası etkinlikler ve öğrenciler üzerindeki etkileri. *Kuram ve Uygulamada Eğitim Bilimleri, 14*(1), 297-322. https://doi.org/10.12738/estp.2014.1.1876 adresinden 7.5.2022 tarihinde erişilmiştir

Tanın, K. (2021). *STEM etkinliklerinin okul öncesi öğretmen adaylarının bilgi işlemsel, eleştirel ve çok boyutlu 21. yüzyıl becerilerine etkisi*. (Yayın No. 677169) [Yayımlanmamış yüksek lisans tezi]. Kastamonu Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 17.4.2022 tarihinde erişilmiştir.

Taş, Mentiş, A. (2007). Yeni sosyal bilgiler ders kitaplarına ilişkin öğretmen görüşlerinin belirlenmesi. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 17, 519-532.

Ulu-Kalın, Ö. ve Topkaya, Y. (2017). İlkokul 4. sınıf için hazırlanan etkileşimli sosyal bilgiler öğrenci çalışma kitabının öğrencilerin kavram algılamalarına etkisi. *Sosyal Bilimler Dergisi, 4*(11), 910-924. https://dergipark.org.tr/tr/pub/mkusbed/issue/44714/555470 adresinden 13.5.2022 tarihinde erişilmiştir.

Wang, H. H., Moore, T. J., Roehrig, G. H., & Park, M. S. (2011). Stem integration: teacher perceptions and practice. *Journal of Pre-College Engineering Education Research (J-PEER), 1*(2), 2. Retrieved June 6, 2022, from https://doi.org/10.5703/1288284314636

Wang, Y., & Main, B., J. (2021). Postdoctoral research training and the attainment of faculty careers in social science and stem fields in the united states. *Studies in Graduate and Postdoctoral Education, 12*(3), 384-402. Retrieved June 8, 2022, from https://doi.org/10.1108/SGPE-04-2020-0025

Yıldırım, B. (2016*). 7. sınıf fen bilimleri dersine entegre edilmiş fen teknoloji mühendislik matematik (stem) uygulamaları ve tam öğrenmenin etkilerinin incelenmesi.* (Yayın No. 429441) **[**Yayımlanmamış doktora tezi]. Gazi Üniversitesi. YÖK Ulusal Tez Merkezi. https://tez.yok.gov.tr/UlusalTezMerkezi/ adresinden 12.2.2022 tarihinde erişilmiştir.

Yıldırım, A., & Şimşek, H. (2018). *Sosyal bilimlerde nitel araştırma yöntemleri (9. Baskı),* Ankara: Seçkin Yayınevi.

Yıldırım, B., & Selvi, M. (2018). Ortaokul öğrencilerinin stem uygulamalarına yönelik görüşlerinin incelenmesi. *Anemon Muş Alparslan Üniversitesi Sosyal Bilimler Dergisi, 6*(18), 47-54. https://doi.org/10.18506/anemon.471037 adresinden 10.4.2022 tarihinde erişilmiştir.

Yıldırım, P. (2018). Fen, teknoloji, mühendislik ve matematik (stem) entegrasyonuna ilişkin nitel bir çalışma. *Atatürk Üniversitesi Kazım Karabekir Eğitim Fakültesi Dergisi,* (35), 31-55. https://dergipark.org.tr/tr/pub/ataunikkefd/issue/33367/351798 adresinden 22.3.2022 tarihinde erişilmiştir.