Attitudes of Secondary School Students towards Robotics and Coding in STEM Education with Tinkercad

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Abstract

The aim of the research is to investigate the attitudes of middle school students towards robotics and coding in STEM education with Tinkercad. A total of 32 secondary school students (12 girls and 20 boys) participated in the 6-week study. The research lasted 8 weeks. Quantitative research method was used in this study. Two scales were used in the study. Robotic attitude scale for middle school students and attitude scale for coding for middle school students were applied. The research is a single group experimental study. It was done in the form of pre-test and post-test. Analyzes were made by applying the t test for paired samples. According to the data obtained from the findings, it is seen that there is a positive significant difference in the robotic attitude scale for secondary school students and the attitude scale for coding for secondary school students. Arduino IDE program was used over Tinkercad portal. In the research, 4 applications were made and their knowledge was reinforced. Robotic coding applications prepared in accordance with STEM education were prepared. It has increased the interest of secondary school students in STEM education. This study is important in terms of transforming theoretical knowledge into products and acquiring 21st century skills.

Keywords: *STEM education, robotics and coding, tinkercad*

Tinkercad ile STEM Eğitiminde Ortaokul Öğrencilerin Robotik ve Kodlamaya Yönelik Tutumları

Öz

Araştırmanın amacı, Tinkercad ile STEM eğitiminde ortaokul öğrencilerin robotik ve kodlama yönelik tutumları araştırmaktır. 6 hafta süren Araştırmaya (12 kız ve 20 erkek) toplamda 32 ortaokul öğrencisi katılmıştır. Araştırma 8 hafta sürmüştür. Bu çalışmada nicel araştırma yöntemi kullanılmıştır. Araştırmada 2 ölçek kullanılmıştır. Ortaokul öğrencilere yönelik robotik tutum ölçeği ve Ortaokul öğrenciler için kodlamaya yönelik tutum ölçeği uygulanmıştır. Araştırma tek grup deneysel bir çalışmadır. Ön test ve son test şeklinde yapılmıştır. Bağımlı örneklemler için t testi uygulanarak analizler yapılmıştır.

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Bulgulardan çıkan verilere göre, ortaokul öğrencilere yönelik robotik tutum ölçeği ve ortaokul öğrenciler için kodlamaya yönelik tutum ölçeğinde pozitif yönde anlamlı bir fark çıktığı görülmektedir. Tinkercad portalı üzerinden Arduino İDE programı kullanılmıştır. Araştırmada 4 uygulama yapılarak bilgileri pekiştirilmiştir. STEM eğitimine uygun hazırlanmış robotik kodlama uygulamaları hazırlanmıştır. Ortaokul öğrencilerin STEM eğitimine olan ilgilerinin artmasını sağlamıştır. Teorik bilgilerin ürüne dönüştürülmesi ve 21. yüzyıl becerilerinin kazanılması açısından bu çalışma önem arz etmektedir.

Anahtar Kelimeler: *STEM eğitimi, robotik ve kodlama, tinkercad*

Introduction

The field of communication and information technologies is getting stronger and developing day by day. Continuous developments and changes in this field also affect the education and training processes. The use of technology in education facilitates the realization of permanent learning. Changes in learning approaches with the development of technology necessitated restructuring learning activities and environments in accordance with this developing technology. The use of educational technologies in the creation of these environments has now emerged as a necessity rather than an alternative (Şişman & Küçük, 2017). The use of technology in education has enabled the application of technology-supported modern teaching methods as well as traditional teaching. The use of modern teaching methods and approaches such as flipped learning method (transformed classroom), blended learning, learning by gamification, and cooperative learning in teaching environments is becoming more common day by day (Talan, 2020). It is expected from every individual who steps into education life, that is, from kindergarten to high school, to have a certain level of knowledge about computer science (Smith, 2016). In the 21st century, coding skill is seen as one of the basic skills that every individual should acquire. Because societies no longer need a consuming generation, but a producing generation. 21st century skills are the skills that have been emphasized and brought to the agenda with the changes that have occurred in the century we live in. In other words, some of these skills have existed before and have become important again (Silva, 2009).

STEM education is one of the most important and modern education approaches of the 21st century, which ensures that the information given piece by piece in today's programs becomes permanent by associating it with each other. While STEM education enables students to understand the world they live in, it also enables individuals to find solutions to the problems they will encounter in real life and to find alternative and practical solutions to them. STEM (science, technology, engineering and mathematics) was formed by the combination of four different disciplines (Güleryüz and Dilber, 2022b; Güleryüz, 2020).

Coding, one of the most important technological developments of the last century, seems to be included in the 21st century skills (Seferoğlu, 2021). Coding has a structure that allows students to learn by doing and experiencing,

and also provides support for metacognitive development, providing the opportunity to solve the problems they encounter. The lexical meaning of coding, which is also expressed as programming, can be expressed as block-based programming, which is formed by combining the planned operations according to a certain rule and order. In addition, coding can also be expressed as a part or all of the sequence of commands written to make any computer, electronic circuit or mechanisms made of a mechanical system operate (Genç & Karakuş, 2011).

Coding and robotics education supports the development of 21st century skills. Coding and robotics education strengthens its place in today's conditions for future generations by creating the infrastructure of technological developments. It will be an important investment for the future to instill the technologies of the future in our students, who are the technology developers of the future, and to support their tendency towards scientific research with robotics and coding technologies (Göksoy & Yılmaz, 2018).

Depending on the technological developments, coding teaching had to renew itself in parallel with the developing technologies. The adaptation of coding education to the changing technological developments is its transformation into robotic coding. While robotic coding provides students with coding-related skills, it also allows students to learn many abstract concepts and processes by embodying them (Korkmaz, Altun, Usta, & Özkaya, 2014).

Robotic coding is a type of coding that individuals come up with by combining coding and mechanics. It enables students to produce a concrete and moving object with the codes they have created. In other words, the student moves the robots with the codes they have created. In this way, education becomes both fun and interesting for the student (Güleryüz & Dilber, 2022b). Thanks to robotics and coding, while students have fun, they also develop scientific methods, engineering design processes, creativity skills, coding logic, collaborative work, mathematical thinking process skills and problem solving skills (Eguchi, 2014).

The development of students at all levels of education and training should be supported by STEM education, robotics and coding training. STEM is an education model in which science, technology, engineering and mathematics disciplines are combined. In today's world of technology revolutions, knowing STEM and coding is of great importance (Güleryüz, Dilber & Erdoğan, 2019).Therefore, the fact that secondary school students receive both STEM education, robotics and coding education is of great importance for the future of countries.

Purpose and Importance of the Research

The aim of this research is to create a learning environment designed in accordance with STEM education, where secondary school students can

participate in robotics and coding activities efficiently within the framework of STEM education, and to determine the effect of this environment on students' attitudes towards robotics and coding. Raising students with 21st century skills in STEM education, robotics and coding is among the goals of our education system. It is seen that STEM Education, robotics and coding education, where interdisciplinary bonds are best provided, are essential for raising students with 21st century skills. The aim of this study is to determine the effects of robotics and coding activities prepared in accordance with STEM education on secondary school students' attitudes towards robotics and coding. In addition, these subjects are encouraged by the Ministry of National Education and it is seen that they are planned to be disseminated in schools.

Research Problem

In STEM education with Tinkercad, it aims to investigate middle school students' attitudes towards robotics and coding.

Research Questions

What are the attitudes of middle school students towards robotics and coding in STEM Education?

Method

Quantitative research method was used in this study. Quantitative research method is to objectively measure the social behavior of individuals through experimentation, observation and testing and to explain them with numerical data. Research that is reproducible and objectively demonstrated by observation and measurement is known as quantitative research. In the quantitative research, t-test was applied for paired samples. The t-test for paired samples tests whether the means from two related groups or measures differ significantly from each other. The research was conducted in the form of a single group pre and post-test.

Sample

A total of 32 secondary school students, 12 girls and 20 boys, participated in the research.

Data Collection Tools

Middle School Students' Robotic Attitude Scale;

The original version of the robotic attitude scale of middle school students Cross et al. (2016) was developed. Fat et al. (2018) conducted a validity and reliability study. The aim is an appropriate measurement tool that can be used to determine the attitudes of secondary school students towards educational robotics activities. Within the scope of the study, a valid and reliable scale was obtained, which was

collected under four factors with 24 items. The scale form consisting of 24 items was 5-point Likert 5: Strongly; 4: Agree; 3: Undecided; 2:Disagree Agree; 1:Strongly Disagree;

Attitude Scale towards Coding For Secondary School Students;

Attitude scale towards coding for middle school students, Akkuş et al. (2019) was developed by. The aim is an appropriate measurement tool that can be used to determine the attitudes of students who have received coding education. Within the scope of the study, a reliable and valid scale with 10 items collected in a single factor was revealed. The 10-item scale form is 5-point Likert 5: Totally Agree, 4; Agree, 3; Partially Agree; 2: Disagree; 1:Totally Disagree.

Data Analysis

The data of this research, in which the Robotic Attitude Scale towards Secondary School Students and the Attitude Scale towards Coding for Secondary School Students were used as data collection tools, were analyzed with SPSS 21, a computer-aided statistical package program. In order to test the problem situation in the research, the standard deviations of the scores and the significant difference between the averages of these scores were examined. It was observed that the scores showed a normal distribution. Because of this situation, t-test was applied for paired samples from parametric tests. It was seen that the data obtained showed a statistically significant difference between the pre and post-test.

Application

In this study, an educational program, which was prepared for secondary school students and made the education-teaching process fun, simple and efficient, was implemented using robotic and coding activities made with Tinkercad. The content of this program lasted for 8 weeks and a total of 32 hours (2+2) hours per week. Tinkercad and Arduino IDE programs were taught in robotics and coding activities with Tinkercad. This application was made in the form of pre and post-test. A brief summary of the activities carried out is shown below and the work schedule is given in Table 1.

A Brief Summary of the Event:

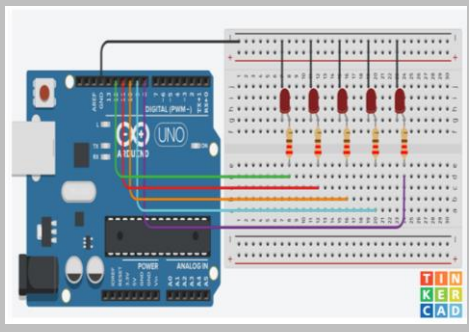
- ✓ Pre-tests of both scales were given to middle school students in the first week.
- ✓ In the second and third weeks, secondary school students were granted membership on the Tinkercad page. Then Tinkercad and Arduino programs were taught.
- ✓ Tinkercad 1st application was made in the fourth week. Sequential Led Application was made with robotics and coding.
- ✓ Tinkercad 2nd application was made in the fifth week. Traffic light application was made with robotics and coding.

- ✓ Tinkercad 3rd application was made in the sixth week. Controlling Led Brightness with Potentiometer with robotics and coding has been applied.
- ✓ Tinkercad 4th application was made in the seventh week. Motion (PIR) sensor application was made with robotics and coding.
- ✓ In the eighth week, the post-tests of both scales were given to the secondary school students.

Table 1.
Weekly Schedule of Robotic Coding Applications with Tinkercad

Week	Subject
Week 1	Pre-tests of both scales were performed.
Week 2	Introduction of Tinkercad Program
Week 3	Introduction of Tinkercad Program
Week 4	Tinkercad 1. Application: Robotic and Coding Sequential Led Application
Week 5	Tinkercad 2. Application: Robotic and Coding Traffic Light Application
Week 6	Tinkercad 3. Application: Controlling Led Brightness With Robotic and Coding Potentiometer Application
Week 7	Tinkercad 4. Application: Robotic and Coding Motion (PIR) Sensor Application
Week 8	Post-tests of both scales were performed

Tinkercad Robotics and Coding 1st Application

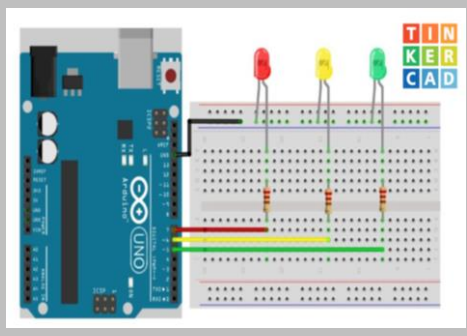


```
Metin
1  void setup()
2  {pinMode(12, OUTPUT);
3    pinMode(11, OUTPUT);
4    pinMode(10, OUTPUT);
5    pinMode(9, OUTPUT);
6    pinMode(8, OUTPUT);}
7
8  void loop()
9  {for(;;)
10   {digitalWrite(12, HIGH);
11   delay(1000);
12   digitalWrite(11, HIGH);
13   delay(1000);
14   digitalWrite(10, HIGH);
15   delay(1000);
16   digitalWrite(9, HIGH);
17   delay(1000);
18   digitalWrite(8, HIGH);
19   delay(1000);
20    digitalWrite(12, LOW);
21    digitalWrite(11, LOW);
22    digitalWrite(10, LOW);
23    digitalWrite(9, LOW);
24    digitalWrite(8, LOW);
25   delay(1000);}}
```

Figure 1. Sequential led application

In the first application of robotics and coding made with Tinkercad, sequential led application was made with Arduino IDE. Figure 1 shows the circuit diagram and codes of the led application.

Tinkercad Robotics and Coding 2nd Application

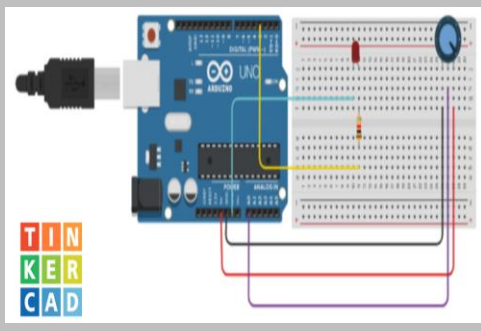


```
Metin
1  void setup()
2  { pinMode(7, OUTPUT);
3    pinMode(6, OUTPUT);
4    pinMode(5, OUTPUT);}
5  void loop()
6  { digitalWrite(7, HIGH);
7    delay(3000);
8    digitalWrite(7, LOW);
9    digitalWrite(6, HIGH);
10   delay(1000);
11   digitalWrite(6, LOW);
12   digitalWrite(5, HIGH);
13   delay(5000);
14   digitalWrite(5, LOW);
15   digitalWrite(7, HIGH);
16   digitalWrite(6, HIGH);
17   delay(1000);
18   digitalWrite(7, LOW);
19   digitalWrite(6, LOW);}
```

Figure 2. Traffic light application

In the second application of robotics and coding made with Tinkercad, a traffic light application was made with Arduino IDE. Figure 2 shows the circuit diagram and codes of the traffic light application.

Tinkercad Robotics and Coding 3rd Application

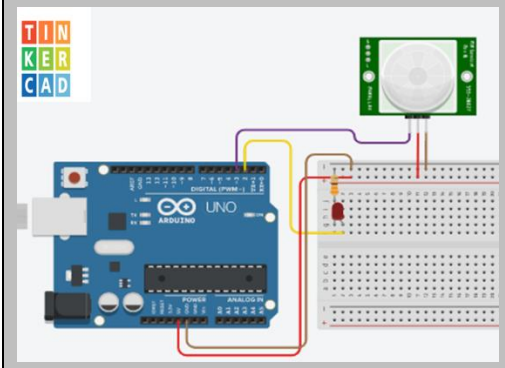


```
Metin
1  long deger;
2
3  void setup()
4
5  { pinMode(3, OUTPUT);
6    pinMode(A0,INPUT);
7  }
8
9  void loop()
10
11 { deger=analogRead(A0)/4;
12   analogWrite(3,deger); }
```

Figure 3. Controlling led brightness with potentiometer

In the third application of robotics and coding made with Tinkercad, Controlling Led Brightness with Potentiometer with Arduino IDE was applied. Figure 3. The circuit diagram and codes of the application of Controlling Led Brightness with a Potentiometer are included.

Tinkercad Robotics and Coding 4th Application



```
int hareket_sensor = 3;
int led_pini = 2;

void setup()
{ pinMode(hareket_sensor, INPUT);
  pinMode(led_pini, OUTPUT);}

void loop()
{if (digitalRead(hareket_sensor) == HIGH)

{digitalWrite(led_pini, HIGH); }

 else {digitalWrite(led_pini, LOW); }
    }
```

Figure 4. Motion (PIR) sensor application

In the fourth application of robotics and coding made with Tinkercad, Temperature Sensor Application was made with Arduino IDE. Figure 4. Circuit diagram and codes of the Temperature Sensor application are included.

Findings

In this research, there are analyzes of middle school students' attitudes towards robotics and coding in STEM education with Tinkercad.

Robotic Attitude Analysis of Middle School Students

Table 2.

Numerical Data Showing the Sample

S	F
Female	12
Male	20
Total	32

When Table 2 is examined, 12 female and 20 male secondary school students participated in the study.

Table 3.
Robotic Attitude Paired Samples T-Test of Secondary School Students

	$\bar{x}$	n	ss	sh_x
PRETEST	62.24	32	6.33	.92
POSTTEST	72.43	32	6.39	.94

When Table 3 is examined, when the results of secondary school students' robotic attitudes in STEM education with Tinkercad are examined, it is seen that there is an increase in the averages of $\bar{X}$pretest = 62.24 and $\bar{X}$posttest = 72.43. It is seen that the results support the post-test average scores.

Table 4.
Robotic Attitude Paired Samples Test of Secondary School Students

	$\bar{x}$	ss	sh_x	Lower	Upper	t	df	p
PRETEST POSTTEST	-8.19	6.11	0.87	-8.59	-6.35	-8.13	32	0.000

When Table 4 is examined, it is seen that there is a statistically significant increase in the pre-test and post-test results of secondary school students' attitudes towards robotic attitudes in STEM education with Tinkercad as a result of the paired samples t-test analysis. ($t(32) = -8.13$, $p = 0.00$). Based on this finding, it is seen that STEM education with Tinkercad positively affects the attitudes of secondary school students towards robotic attitudes.

Attitude Analysis Towards Coding for Secondary School Students

Table 5.
Attitudes Towards Coding Paired Samples T-Test for Secondary School Students

	$\bar{x}$	n	ss	sh_x
PRETEST	63.99	32	6.44	.87
POSTTEST	72.77	32	6.59	.93

When Table 5 is examined, when the results about the attitudes of secondary school students towards coding in STEM education with Tinkercad are examined, it is seen that there is an increase in the averages of $\bar{X}$pretest = 63.99 and $\bar{X}$posttest = 72.77. In the results, it is seen that the post-test average scores are supported.

Table 6.
Attitude Paired Samples Test towards Coding

	$\bar{x}$	ss	shx	Lower	Upper	t	df	p
PRETEST POSTTEST	-8.29	6.19	0.88	-8.59	-6.43	-7.98	32	0.000

When Table 6 is examined, it is seen that there is a statistically significant increase in the pre and post-test results of secondary school students' attitudes towards coding in STEM education conducted with Tinkercad, as a result of the paired samples t-test analysis. ($t(32) = -7.98$, $p = 0.00$). Based on this finding, it is seen that STEM education with Tinkercad positively affects secondary school students' attitudes towards coding.

Discussion and Conclusion

In the results of the analysis carried out to determine the robotic attitudes of middle school students and their attitudes towards coding for middle school students in STEM education with Tinkercad, it is seen that there is a positive and significant change in both the robotic attitudes of middle school students and their scores on coding for middle school students. With the STEM education applications, the students exhibited a positive attitude towards robotics and coding.

When we do a literature review, it is seen that it shows parallelism with similar studies. Güleryüz (2022b) Similar results were obtained as the robotic coding applications made with Tinkercad measured the robotic attitudes of the students and it was a single group experimental study. Öz Doğru (2005) determined that robotic activities affect students' attitudes positively and these activities are instructive. Khanlari (2013) stated that STEM education, which includes robotic activities, is an effective tool to develop students' 21st century skills such as teamwork, cooperation, social responsibility and communication. De Silva & Ekanayake (2008) stated in his study on the use of robotic applications in physics teaching that there are important developments in terms of motivation and participation for students who have difficulty concentrating in physics subjects.

Kececi (2017) stated that there was a significant increase in students' attitudes towards coding learning supported by educational computer games in their research to determine the effects of STEM education practices on the attitudes of 5th grade students towards coding learning. Güleryüz, Dilber, and Erdoğan (2020) gave positive feedback about the coding education of the students in their study named Opinions of students about coding education in STEM applications. In the research conducted by Gülbahar and Kalelioğlu (2018), teachers need to learn something about robotic coding with their own efforts. Güleryüz, (2020); Güleryüz & Dilber (2022b) in their study named the effect of robotic coding and 3D printer applications on teacher candidates' 21st century skills, STEM awareness and STEM self-efficacy; Robotic coding and 3D printing activities prepared within the scope of STEM education helped students to have a positive attitude.

In the study of examining the place of coding education as a 21st century skill in education policies, Sayın & Seferoğlu (2016) included coding in the

curriculum in order to improve students' logical thinking and problem solving skills. In addition, they have obtained similar results in studies in the fields of robotics and coding education. (Güleryüz, Dilber 2022a Güleryüz, 2022a; Gültepe, 2018; Şenol & Demirer, 2017; Şenol & Büyük, 2015; Datteri, et al. 2013; Welch & Huffman, 2011; Sullıvan, 2008).

As a result, it was determined that robotics and coding activities designed in accordance with STEM education contributed positively to students' attitudes towards robotics and coding. The fact that robotics and coding-related skills, which are among the 21st century skills, were supported in STEM education, contributed to the increase of students' interest in STEM education as well as gaining these skills. Students showed a positive attitude in robotics and coding activities designed in accordance with STEM education. It also increases their interest in STEM education. Robotic education, which is one of the most important paradigms in the world in the 21st century, is of great importance for coding education and STEM education in terms of transforming theoretical knowledge into products and acquiring 21st century skills. Today, where 21st century skills are very important, supporting the development of these skills with robotics and coding activities within the scope of STEM education will be an important investment in the future by placing our students, who are the developers of the future, on solid foundations.

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Genişletilmiş Özet

Teknolojinin gelişmesiyle birlikte öğrenme yaklaşımlarında meydana gelen değişimler, öğrenme etkinliklerini ve ortamlarını gelişen bu teknolojiye uygun olarak yeniden yapılandırmayı gerektirmiştir. Bu ortamların oluşturulmasında eğitim teknolojilerinin kullanılması artık bir alternatiften çok gereklilik olarak ortaya çıkmıştır. Eğitimde teknoloji kullanımı geleneksel öğretimin yanında teknoloji destekli çağdaş öğretim yöntemlerinin de uygulanmasına olanak sağlamıştır. 21. yüzyılda robotik ve kodlama becerisi her bireyin kazanması gereken temel becerilerden biri olarak görülmektedir. Çünkü toplumlar artık tüketen değil üreten nesle ihtiyaç duymaktadır. 21. yy. becerileri yaşadığımız yüzyıl içinde meydana gelen değişimlerle önemi tekrar vurgulanan ve gündeme gelen becerilerdir. Yani bu becerilerin bir kısmı önceden de var olup yeniden önemli hale gelmiştir.

STEM eğitimi, günümüzde uygulanan programlarda parça parça verilen bilgilerin birbirleri ile ilişkilendirerek kalıcı hale gelmesini sağlayan 21. yüzyılın en önemli ve modern eğitim yaklaşımlarından birisidir. STEM eğitimi öğrencilerin içinde bulundukları dünyayı anlamalarını sağlarken diğer yandan da gerçek hayatta bireylerin karşılaşacakları problem karşısında çözümler bulmasını ve bunlara alternatif ve pratik çözümler bulmasını sağlar. STEM (fen, teknoloji, mühendislik ve matematik) dört farklı disiplinin bir araya gelmesi ile oluşmuştur.

Kodlama ve robotik eğitimi, 21. yüzyıl becerilerinin gelişimini desteklemektedir. Kodlama ve robotik eğitimi gelecek nesiller açısından günümüz koşullarındaki yerini teknolojik gelişmelerin alt yapısını meydana getirerek iyi bir biçimde sağlamlaştırmaktadır. Geleceğin teknoloji geliştiricisi olan öğrencilerimize, geleceğin teknolojilerini şimdiden aşılamak ve onların bilimsel araştırmalara yönelik eğilimini robotik ve kodlama teknolojileri ile desteklemek geleceğe yapılacak önemli bir yatırım olacaktır.

Eğitim ve öğretimin her kademesindeki öğrencilerin gelişiminin STEM eğitimi, robotik ve kodlama eğitimleriyle desteklenmesi gerekmektedir. STEM fen, teknoloji, mühendislik ve matematik disiplinlerinin bir arada verildiği bir eğitim modelidir. Teknoloji devrimlerinin yaşandığı günümüzde STEM ve kodlama bilmek büyük bir önem arz eder. Bundan dolayı ortaokul öğrencilerin hem STEM eğitimi hem robotik hem de kodlama eğitimlerini şimdiden almaları ülkelerin geleceği açısından son derece büyük bir önem arz ettiğini ifade etmektedir.

Bu araştırmada nicel araştırma yöntemi kullanılmıştır. Nicel araştırma yöntemi, Bireylerin toplumsal davranışlarını deney, gözlem ve test yolu ile nesnel bir şekilde ölçmek ve sayısal veriler ile açıklamaktır. Gözlem ve ölçüm ile tekrarlanabilir olan ve objektif olarak ortaya konan araştırma niceliksel yani "sayısal" araştırma olarak bilinir. Nicel araştırmada bağımlı örneklemler için t testi uygulanmıştır. Bağımlı örneklemler için t testi, İki ilişkili grup veya ölçümden elde edilen ortalamaların birbirlerinden anlamlı bir şekilde farklılık gösterip göstermediğini test eder. Araştırma tek grup halinde ön test son test şeklinde yapılmıştır. Araştırmaya 12 kız ve 20 erkek olmak üzere toplamda 32 ortaokul öğrencisi katılmıştır. Veri toplama aracı olarak Ortaokul öğrencilerin robotik tutum ölçeği ve Ortaokul öğrenciler için kodlamaya yönelik tutum ölçeği uygulanmıştır. Ortaokul öğrencilerin robotik tutum ölçeğinin orijinal hali Cross vd. (2016) geliştirilmiştir. Şişman vd. (2018) tarafından geçerlik ve güvenirlik çalışması yapmıştır. Amaç, Eğitsel robotik etkinliklerine ilişkin ortaokul öğrencilerinin tutumlarını belirlemede kullanılabilecek uygun bir ölçme aracıdır. Çalışma kapsamında 24 maddeye sahip olan dört faktör altında toplanan geçerli ve güvenilir bir ölçek elde edilmiştir.24 maddeden oluşan ölçek formu 5'li likert 1: Kesinlikle Katılmıyorum, 2: Katılmıyorum, 3: Kararsızım, 4: Katılıyorum, 5: Kesinlikle Katılıyorum şeklindedir. Ortaokul öğrenciler için kodlamaya yönelik tutum ölçeği, Akkuş vd. (2019) tarafından geliştirilmiştir. Amaç, kodlama eğitimi almış öğrencilerin tutumlarını belirlemede kullanılabilecek uygun bir

ölçme aracıdır. Çalışma kapsamında tek faktörde toplanan 10 maddelik güvenilir ve geçerli bir ölçek ortaya çıkarılmıştır. 10 maddeden oluşan ölçek formu 5'li likert 1: Tamamen Katılmıyorum, 2: Katılmıyorum, 3: Kısmen katılıyorum, 4: Katılıyorum, 5: Tamamen Katılıyorum şeklindedir. Tinkercad ile yapılan robotik ve kodlama etkinliklerin kullanıldığı bir eğitim programı uygulanmıştır. Hazırlanan bu programın içeriği 6 hafta ve her hafta (2+2) saat olmak üzere toplam 24 saat sürmüştür. Tinkercad ile yapılan robotik ve kodlama etkinliklerinde, Tinkercad ve Arduino IDE programları öğretilmiştir. Yapılan bu uygulama ön test ve son test şeklinde yapılmıştır.

Tinkercad ile yapılan STEM eğitiminde ortaokul öğrencilerin robotik tutumlarını ve ortaokul öğrencileri için kodlamaya yönelik tutmlarını tespit etmek amacıyla yapılan analiz sonuçlarında hem ortaokul öğrencilerin robotik tutumlarında hem de ortaokul öğrencileri için kodlamaya yönelik tutumları puanlarında pozitif yönde anlamlı değişim meydana geldiği görülmektedir. Yapılan STEM eğitimi uygulamalarıyla öğrencilerin robotik ve kodlamaya yönelik olarak olumlu bir tutumlar sergilemişlerdir.

Sonuç olarak, STEM eğitimine uygun tasarlanmış robotik ve kodlama etkinliklerinin öğrencilerin robotik ve kodlamaya yönelik tutumuna olumlu yönde katkı yaptığı belirlenmiştir. STEM eğitimine uygun tasarlanmış robotik ve kodlama etkinliklerinde öğrencilerin olumlu yönde tutum sergilemiştir. STEM eğitimine olan ilgilerinin artmasını da sağlamaktadır. Teorik bilgilerin ürüne dönüştürülmesi ve 21. yüzyıl becerilerinin kazanılması açısından 21. yüzyılda dünyadaki en önemli paradigmalardan birisi olan robotik eğitim, kodlama eğitimi ve STEM eğitimine büyük önem teşkil etmektedir. 21. yüzyıl becerilerinin oldukça önem arz ettiği günümüzde bu becerilerin gelişimini STEM eğitimi kapsamında robotik ve kodlama etkinlikleriyle desteklemek geleceğin geliştiricisi olan öğrencilerimizi sağlam temeller üzerine oturtarak geleceğe yapılacak önemli bir yatırım olacaktır. Çalışmanın önemini ortaya koymaktadır.