

# **INVESTIGATION OF VIEWS OF MIDDLE SCHOOL STUDENTS, PRESERVICE SCIENCE TEACHERS AND SCIENCE TEACHERS TOWARDS ROBOTIC APPLICATIONS**

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**ABSTRACT:** In this study, it was aimed to determine views of middle school students, preservice science teachers and science teachers about robotic applications. This study aims to present views and knowledge levels of middle school students, preservice science teachers and science teachers about robotic applications. In the study one group pretest-posttest experimental design was used. The study group of study consists of a total of 60 people including 20 middle school students, 20 preservice science teachers and 20 science teachers. In the study, the “Robotics Pre-Test”, which was developed by Riberio (2006) and translated into Turkish by Koç Şenol (2012), as well as "Robotics Satisfaction Test", which was developed by Silva (2008) and Gibbon (2007) and translated into Turkish by Koç Şenol (2012), and “Personal Information form" and a semi-structured interview form developed by the researcher after reviewing the relevant literature were used to collect the data. The study lasted for 60 hours in 3 stages. Middle school students were trained about robotics in the first stage, preservice science teachers were trained in the second stage and science teachers were trained in the third stage, respectively. In the first stage of the study, the Robotics and Lego Mindstorms Education EV3 Training Kits that will be used in the activities were introduced along with presentations and videos to the participants; in the second stage, they were informed about the use of Robotics program interface; and in the last stage, they designed a sample robot by using lego parts and performed some activities with programming. Descriptive statistics (frequency and percentage distribution) were used in the analysis of the data obtained from the study and inductive content analysis was applied in the analysis of the interview data. In the light of this study, views and knowledge levels of middle school students, preservice science teachers and science teachers about robotic applications as well as how they see the use of robotics as a method were determined.

**Keywords:** middle school student, preservice teacher, teacher, robotics

## **INTRODUCTION**

Although needs and life perspectives of communities have been changed with changing living conditions, the idea that this change and development can be achieved by education has not been changed and the necessity for education has become compulsory (Açışlı, 2010). This situation caused by rapid changes in information and technology, requires people to adapt to innovation (Yamak, Bulut and Dündar, 2014). There is a close relationship between technology, society and education (Fidan, 2008). Education system has to be constantly innovating to keep pace with changing and emerging technologies (Balci, 2007). Countries require students to use technology effectively, have skills such as problem solving, critical thinking, willing to take responsibility and being part of a team as well as being science and technology-literate as education gains importance every passing day (Özdoğru, 2013).

The use of new methods and teaching materials has become obligatory in order to improve the quality of science education, make students more interested in the course and establish the relationship between everyday life and scientific subjects (Sungur, 2013). In this context, it should be noted that robots are actively used in the science and technology courses in many educational programs (Özdoğru, 2013). According to Wood (2003), the purpose of studies conducted about the use of robotics in education should be providing a robotics education program integrated with science and technology to instructors and more meaningful and lasting learning by performing robotics and advanced technology applications in the education (Cited by Koç Şenol, 2012).

Many countries began to use robot kits in science and technology education in addition to robotics education (Fidan and Yalçın, 2012). According to Costa & Fernandes (2004), robotics is a significant area in the science and technology education. Because, as a result of robot design, robot contents and robot project applications held in science and technology education, students gain many skills such as problem solving, finding practical solutions, critical thinking, being aware of their own abilities, gaining first-hand experience, improved technology use and being more disposed to use technology (Cited by Koç Şenol and Büyük, 2013).

Considering the studies conducted on robotics in the literature; Cavas and Çavaş (2005) states that Legos play an important role in the development of abstract learning skills of middle school students such as computer-assisted

robot programming; Çayır (2010) suggests that a learning environment supported by legos has positive impacts on scientific process skills of students; Tse (2009) states that Lego training sets have positive effects on the success of students; Koç Şenol (2012) states that students have positive thoughts about robotics and robotic applications improve scientific process skills of students; McWhorter (2008) states that robotic activities increase student interest in computer programming; Riberio (2006) says that robotics provide discipline and high level of motivation in students; Barker and Ansoorge (2007) state that students have more fun and active learning process with the use of Lego Mindstorms robotics sets; Wei, Hung, Lee and Chen (2011) state that students using robotics have more fun and their motivation for learning is increased.

In science education, pre-service teachers and teachers should be trained with new methods in order to apply them effectively (Marulcu and Sungur, 2012). Considering that robotics is a very promising technology, studies to be conducted in this field become more important (Koç Şenol and Büyük, 2013). In this context, in this study, it was aimed to determine thoughts and knowledge level of middle school students, pre-service science teachers and science teachers about robotics.

## **METHOD**

In this study, it was aimed to determine thoughts and knowledge level of middle school students, pre-service science teachers and science teachers about robotics. In the study, single group pretest-posttest experimental design was used.

The study lasted for 60 hours in 3 stages. Middle school students received robotics training in the first stage, while pre-service teachers received in the second stage and finally science teachers received robotics training in the third stage, respectively. In the first phase of training sessions, Mindstorms Education EV3 Robotics Education Sets, which will be used in activities along with presentations and videos, were introduced to the participants. In the second phase, they were informed about the use of robotic programming interface. In the last stage, participants of the study were asked to design a robot by using Lego parts and perform various activities.

### **Sample**

The study group consists of 20 science teachers including 11 women and 9 men; 20 7<sup>th</sup> grade middle school students including 10 girls and 10 boys and 20 pre-service science teachers including 12 men and 8 women, respectively.

### **Instrument**

In the present study, the "Robotics Pre-Test", which was developed by Riberio (2006) and translated into Turkish by Koç Şenol (2012), as well as "Robotics Satisfaction Test", which was developed by Silva (2008) and Gibbon (2007) and translated into Turkish by Koç Şenol (2012) were used to collect the data. In addition a "Personal Information form" and a semi-structured interview form developed by the researcher after reviewing the relevant literature were used. "Robotics Pre-Test" was administrated on students, pre-service science teachers and science teachers prior to the study in order to receive their opinions about robotics. "Robotics Satisfaction Test" was administrated after the application.

### **Data Analysis**

In the study, descriptive statistics (frequency and percentage distribution) were used to analyze the data obtained from Robotics Pre-Test and Robotics Satisfaction Test and inductive content analysis was used for the analysis of the interview data.

## **FINDINGS**

The answers of middle school students, pre-service science teachers and science teachers in response to both "Robotics Pre-test" and "Robotics Satisfaction Test" are presented in the tables below.

**Table 1.** Frequency and percentage distributions of 1<sup>st</sup> and 2<sup>nd</sup> questions of robotics pre-test

		Yes		No	
		f	%	f	%
<b>Question 1:</b> Have you ever used Lego parts before?	Student	17	85	3	15
	Pre-Service Teacher	10	50	10	50
	Teacher	7	35	13	65
<b>Question 2:</b> Do you have any information about Lego Mindstorms Robotic System?	Student	3	15	17	85
	Pre-Service Teacher	2	10	18	90
	Teacher	4	20	16	80

As it can be seen in Table 1, 85% of the middle school students said yes and 15% them said no, while 50% of pre-service teachers said yes and 50% of them said no and 35% of the teachers said yes and 65% of them said no in response to the question “Have you ever used Lego parts before?”

On the other hand, 15% of the students, 10% of pre-service teachers and 20% of teachers said that they have information about Lego Mindstorms Robotic System and 85% of middle students, 90% of pre-service teachers and 80% of the teachers said that they have no information about the System.

**Table 2.** Frequency and percentage distributions of 4<sup>th</sup> and 5<sup>th</sup> questions of robotics pre-test and robotics satisfaction test

		Yes		I Haven't Decided Yet				No					
		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
		f	%	f	%	f	%	f	%	f	%	f	%
<b>Question 4:</b> Do you think that you can teach/learn science and technology and other courses by using computers and robots?	Student	15	75	18	90	4	20	0	0	1	5	2	10
	Pre-Service Teacher	18	90	20	100	2	10	0	0	0	0	0	0
	Teacher	18	90	20	100	2	10	0	0	0	0	0	0
<b>Question 5:</b> Do you think that you can design appropriate robots for future activities?	Student	17	85	19	95	3	15	0	0	0	0	1	5
	Pre-Service Teacher	14	70	18	90	6	30	2	10	0	0	0	0
	Teacher	12	60	19	95	8	40	1	5	0	0	0	0

As it can be seen in Table 2, 75% of the middle students participated in the pre-test said yes, 20% said I haven't decided yet and the remaining 5% said no in response to the question “Do you think that you can teach/learn science and technology and other courses by using computers and robots?” and 90% of them said yes and 10% said I haven't decided yet in response to this question in the post-test. On the other hand, 90% of the teachers and pre-service teachers participated in the pre-test said yes and the remaining 10% teachers said I haven't decided yet in response to the same question and 100% of them participated in the post-test said yes in response to this question.

85% of the students participated in the pre-test said yes and the remaining 15% said that they haven't decided yet in response to the question “Do you think that you can design appropriate robots for future activities?” and 95% of the students participated in the post-test stated that they can design the appropriate robots and the remaining 5% said no to the question. On the other hand, 70 of pre-service teachers said yes, and the remaining 30% said they haven't decided yet in response to the question in the pre-test and 90% of them said yes and 10% said I haven't decided yet in the post test. 60% of the teachers participated in the pre-test said yes and the remaining 40% of the teachers said that they haven't decided yet in response to the question “Do you think that you can design appropriate robots for future activities?” and 95% of the teachers participated in the post-test stated that they can design the appropriate robots and the remaining 5% said they haven't decided yet.

**Table 3.** Frequency and percentage distributions of 6th, 7<sup>th</sup> and 8<sup>th</sup> questions of robotics pre-test and robotics satisfaction test

		Partly Difficult				I haven't decided yet				Easy			
		Pre-test		Post-test		Pre-test		Post-test		Pre-test		Post-test	
		f	%	f	%	f	%	f	%	f	%	f	%
<b>Question 6:</b> What do you think about the use of computers in the activities that you perform/will perform?	Student	1	5	0	0	4	20	2	10	15	75	18	90
	Pre-Service Teacher	3	15	0	0	2	10	0	0	15	75	20	100
	Teacher	1	5	3	15	3	15	0	0	16	80	17	85
<b>Question 7:</b> What do you think about the use of robots in the activities that you perform/will perform?	Student	5	25	2	10	3	15	0	0	12	60	18	90
	Pre-Service Teacher	2	10	0	0	10	50	0	0	8	40	20	100
	Teacher	0	0	0	0	14	70	2	10	6	30	18	90
<b>Question 8:</b> What do you think about programming robots in the activities that you perform/will perform?	Student	4	20	1	5	4	20	2	10	12	60	17	85
	Pre-Service Teacher	9	45	4	20	4	20	0	0	7	35	16	80
	Teacher	4	20	4	20	8	40	1	5	8	40	15	75

As shown in Table 3, 5% of the students participated in the pre-test said it would be partly difficult for them, while 20% of them said that they haven't decided yet and the remaining 75% said that it would be easy in response to the question "What do you think about the use of computers in the activities that you will perform?" and 10% of the students participated in the post-test said that they haven't decided yet, while 90% of them said that it was easy, respectively. In the pre-test, 15% of the pre-service teachers said it would be partly difficult for them, while 10% of them said that they haven't decided yet and the remaining 75% said that it would be easy in response to the same question and 15% of the pre-service teachers participated in the post-test said that it was partly difficult for them while 85% of them said that it was easy. 5% of the teachers participated in the pre-test said it would be partly difficult for them, while 15% of them said that they haven't decided yet and the remaining 80% said that it would be easy in response to the question "What do you think about the use of computers in the activities that you will perform?" and 15% of the teachers participated in the post-test said that it was partly difficult for them, while 85% of them said that it was easy, respectively.

25% of the students participated in the pre-test said that they it would be partly difficult for them, while 15% said that they haven't decided yet and the remaining 60% said that would be easy for them in response to the question "What do you think about the use of robots in the activities that you perform/will perform?" and 10% of the students participated in the post-test said that they haven't decided yet and the remaining 90% said that it was easy, respectively. On the other hand, 10% of the pre-service teachers participated in the pre-test said that it would be partly difficult for them, 50% said that they haven't decided yet and the remaining 40% said it would be easy. 100% of pre-service teachers participated in the post-test said that it was easy for them. 70% of the teachers participated in the pre-test said that they haven't decided yet and 40% of them said that it would be easy in response to the same question and 35% of the teachers participated in the post-test said that it was partly difficult, 10% said that they haven't decided yet and the remaining 55% said that said that it was easy, respectively.

20 of the students participated in the pre-test said that it would be partly difficult, 20% of them said that they haven't decided yet and the remaining 60% said that it would be easy in response to the question "What do you think about programming robots in the activities that you perform/will perform?", while 5% of the students participated in the post-test said that it was partly difficult, 10% of them said that they haven't decided yet and 85% of the students said that it was easy, respectively. On the other hand, 45% of the pre-service teachers participated in the pre-test said that it would be partly difficult for them, 20% said that they haven't decided yet and the remaining 35% said it would be easy. 20% of pre-service teachers participated in the post-test said that they had difficulties while the remaining 80% said it was easy. 20% of the teachers participated in the pre-test said that it would be partly difficult, 40% of them said that they haven't decided yet and the remaining 40% said that it

would be easy in response to the same question, while 20% of the teachers participated in the post-test said that it was partly difficult, 5% of them said that they haven't decided yet and 75% of the teachers said that it was easy, respectively.

**Table 4.** Frequency and percentage distributions of 1<sup>st</sup> question of robotics satisfaction test

	Not Satisfied		Satisfied		Very Satisfied		
	f	%	f	%	f	%	
<b>Question 1:</b> Are you interested in robotic applications?	Student	0	0	1	5	19	95
	Pre-Service Teacher	0	0	1	5	19	95
	Teacher	0	0	2	10	18	90

As seen in Table 4, 5% of the students and pre-service teachers said that they are satisfied and the remaining 95% said that they are very satisfied in response to the question "Are you interested in robotic applications?" On the other hand, 10% of the teachers said they are satisfied and the remaining 90% said that they are very satisfied in response to the same question.

In the Robotics Satisfaction Test, 100% of the students, pre-service teachers and teachers said that they are more interested in response to the question "How you are interested in robotics currently when compared to your previous thoughts before the project?".

100% of the students, pre-service teachers and teachers said yes in response to the questions "Would you recommend your colleagues to use robotic?", "Once you start using robotics, would you follow innovations about it?", and "Do you think you would use robotics in your future courses?".

The answers of some students, pre-service teachers and teachers in response to the questions during interviews are given without any revisions in order to present the current situation. Students were coded as S-1, S-2, S-3,.... while pre-service teachers were coded as P.T-1, P.T-2, P.T-3,.... and teachers were coded as T-1, T-2, T-3,....

Some of the answers of teachers and pre-service teachers in response to the questions "Does the use of robotics affect professional development of the teacher? How?" are as follows:

**T-1:** "Learning new technologies and broadening their horizon contributes to the professional development of teachers."

**T-2:** "It would have positive impacts. It encourages them to use different teaching methods. Furthermore, the classroom management becomes easier since it will attract attention of students."

**T-3:** "Yes, it affects. Students don't like and pay attention to the lectures without using any materials in my class. Using robotics in the class develops a positive attitude towards both the course and technology."

**T-4:** "It allows teachers to be informed about today's technologies robots. Professional development becomes necessary."

**T-5:** "Yes, it affects. Students respect their teachers and pay attention to the course as long as teachers are well-equipped and improved in their subjects."

**P.T-1:** "Yes it affects, it brings participation level of students in the course to the maximum level and the use of robotics keeps you one step ahead of your colleagues. In addition, the use of robots while doing some experiments minimizes the margin of error."

**P.T-2:** "Yes it affects, using robots requires a specific knowledge. This gives extra points to teachers to improve themselves."

**P.T-3:** "Yes it affects, because it is an enjoyable learning material for both teachers and students. In addition, teachers become happy and think multidimensionally when they develop projects frothier students and work with them."

**P.T-4:** "Technology is progressing every passing day and traditional methods don't draw attention of students. Therefore, using a technological tool increases interest of students in the course and students learn better. In this way, teacher's academic standing also increases."

**P.T-5:** "Yes it affects, because technology is advancing and there are robots everywhere and in every area. Using robots positively affects professional development of teachers."

Some of the answers of middle school students, pre-service teachers and teachers given in response to the questions "What kind of advantages are provided with the use of robotics in the class?" are as follows:

**T-1:** "I think it will increase the attention of the students and facilitate the learning process."

**T-2:** "It will provide a student-centered classroom environment with applications."

**T-3:** "It may pave the way for efficient, effective and lasting learning."

**T-4:** "I think it will increase the attention of students for the course."

**T-5:** "Students' responses will make me happy. My class will be more fun."

**P.T-1:** "Using robotics in the classroom provides permanent learning for students."

**P.T-2:** "Courses become more interesting and fun. In addition, students don't get bored in the classroom."

**P.T-3:** "I think my class becomes more fun if I use robotics and students learn in an easier way."

**P.T-4:** "The course becomes more fun and the information taught becomes more permanent and students become more interested in the course."

**P.T-5:** "I think students will learn the concepts better and they will have fun at school."

**S-1:** "What we learn remains in our mind. It provides an easy and effective learning."

**S-2:** "It is effective in choosing the future profession and allows students to be more knowledgeable compared to their peers."

**S-3:** "I think the use of robotics in schools creates curiosity in children and the number of future engineers increases."

**S-4:** "Students like schools more with the help of robotic applications and they become more excited about school. Thus, we have a fun learning process and I think we better understand the lesson."

**S-5:** "I think it allows us to use our mind better and we can go from part to whole in the events that we cannot resolve."

Some of the answers of middle school students, pre-service teachers and teachers in response to the questions "What are the positive effects of using robotics on students when they are used in the classroom?" are as follows:

**T-1:** "I think it will improve efforts of students because it will attract their interest to the course. It will also improve their intellectual development and self-confidence because they will conduct their own studies by themselves after learning the program."

**T-2:** "It may be very useful because one of the best learning methods is trial-and-error method and it allows students to experience real experiments and it is fun like a game. In this way, students will want to learn new thing with the use of robotics."

**T-3:** "Producing new products is very important for self-confidence of students and they may gain new perspectives by trial-and-error methods. Creativity, finding solutions to different events and get rid of the shallow thinking."

**T-4:** "The use of robotics in the classroom make students participate in the class more willingly and happily. It may result in more permanent learning since it appeals to senses."

**T-5:** "It will be very useful for my students. They will have a robot made of legos and they will be able to give commands to the robot. They will experience the happiness of building a robot, and thus they will make use of their spare times by thinking about more possibilities."

**T-6:** "They will not forget this knowledge since they will learn by experiencing and practicing. They adapt to new technologies. Students work together by sharing the workload. It allows learning to be permanent."

**S-1:** "They come to school willingly."

**S-2:** "They like school more and they become more excited about the course."

**S-3:** "I think Legos are the best tools to build something in a way that we want."

**S-4:** "They learn through fun."

**S-5:** "They perform more efficient learning."

**P.T-1:** "It improves the intelligence, creates curiosity, draws attention and facilitates learning."

**P.T-2:** "Learning becomes more permanent. Makes it difficult to forget. Courses become more enjoyable and fun."

**P.T-3:** "It provides a more effective learning since it appeals to more senses."

**P.T-4:** "Students participate in the class more actively because they are encouraged to learn by experiencing. They become more interested in the course and eager to go to school."

**P.T-5:** "Their imagination can improve and they can produce alternative solutions to problems."

**P.T-6:** "I think they will like the course and will have fun in the class, and their dexterity skills will also develop."

Some of the answers of middle school students, pre-service teachers and teachers in response to the questions “What are the possible negative impacts of using robotics on students when they are used in the classroom?” are as follows:

**T-1 and T-2:** “There may be problems about the time. Time problems may be the biggest drawback.”

**T-3:** “It may be difficult to use in crowded classrooms. In addition, the cost of materials can be another problem and it may be expensive to apply on all students.”

**T-4:** “The only problem is that each student will want to have his/her own robot. I don’t see any other possible problem.”

**P.T-1:** “It cannot be used in every lesson. Students with poor dexterity skills may experience some difficulties.”

**P.T-2:** “Limited time can be a problem.”

**P.T-3:** “All contents of the course cannot be covered due to the limited time.”

**P.T-4:** “Every student should take advantage of these applications. However, it will be a problem to get a sufficient number of them since they are expensive. The course can be disrupted since it will take time to educate all students with a limited number of robots.”

100% of the middle school students participated in the study stated that they don’t think using robotics would have any negative effects on the course.

Finally, all participants said yes in response to the question “Would you like to use robotics in the classroom?”

## DISCUSSION AND CONCLUSION

In this study, views of middle school students, pre-service science teachers and science teachers in regard with robotics were investigated. Prior to the study, opinions of middle school students, pre-service science teachers and science teachers participated in the study about robotics were determined. According to the results of the study, 85% of the middle school students, 90% of the pre-service science teachers and 80% of the science teachers stated that they have no information about Lego Mindstorms Robotic System. However, 85% of the middle school students, 50% of the pre-service science teachers and 35% of the science teachers stated they have used lego parts before. In this context, since a large portion of the participants don’t have any prior information about Lego Mindstorms Robotic System, they would be more curious and willing about robotic applications and they wouldn’t have difficulties since they have used lego parts for different purposes. In addition, according to the results of post-test, 95% of the middle school students, 90% of the pre-service science teachers and 95% of the science teachers stated that they can design the appropriate robots for future activities.

The participants were asked “How often do you use a computer?” since the use of computers is required for the applications and 65% of all participants said that they use a computer on a daily basis. In this context, it is thought that they won’t have too much difficulty in robotic programming. Considering the results obtained in this context, 87% of all participants find it easy to use of computer programming in the applications.

According to the results of the study, 51% of the participants participated in the pre-test stated that it would be easy to use robots, whereas 93% of the participants participated in the post-test stated that the use of robots in the applications is easy, respectively. Similarly, in the pre-test, 45% of the participants said that programming robots would be easy, whereas this rate is increased up to 80% in the post-test. This result shows that the participants were afraid to fail in the use of robots and programming these robots since they have never tried such applications before.

According to the results obtained, 97% of the participants think that they can learn/teach science and technology courses by using computers and robots. In addition, 5% of the students and pre-service teachers said that they are satisfied and the remaining 95% said that they are very satisfied about the robotic applications. On the other hand, 10% of the teachers said that they are satisfied and 90% of them said they are very satisfied about robotic applications. In the Robotics Satisfaction Test, 100% of the students, pre-service teachers and teachers said that they are more interested in response to the question “How you are interested in robotics currently when compared to your previous thoughts before the project?”. In addition, 100% of the students, pre-service teachers and teachers said yes in response to the questions “Would you recommend your colleagues to use robotic?”, “Once you start using robotics, would you follow innovations about it?”, and “Do you think you would use robotics in your future courses?”.

According to the results of the study, in which views of middle school students, pre-service science teachers and science teachers in regard with robotics were investigated; it was determined that middle school students, pre-service science teachers and science teachers were very satisfied about robotic applications performed, they had fun while learning, their motivation for learning was increased. Considering all these positive impacts, various courses and activities should be organized about robotics, which is the technology of our age, for teachers and students.

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