Opinions of Middle School Students on the Concept of Science and the Use of Robotic Systems

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Abstract

In this research, in the "Artvin gets Color with Science and Robotics-2"project, which was supported with the Project number 121B899 within the scope of the 2020/1 call period launched in the 15thyear of the Scientific and Technological Research Council of Turkey (TÜBİTAK) 4004-Nature Education and Science Schools Support Program, students were taught in science, robotics, artificial intelligence, It is aimed to examine his views on the concept of science and the use of robotic systems after active learning and by doing different scientific activities in the fields of astronomy and nature. The Project was carried out with the participation of 30 secondary school 6th and 7th grade students. Student personal information form, robotic pre-questionnaire, robotic satisfaction test, "What do you think is science?" and "If you were a scientist, what would you like to invent?" were used as data collection tools in the research. A two-question questionnaire and a semi-structured form for robotics activities were used. Quantitative data obtained from the research were analyzed according to the content analysis method in qualitative data by giving frequency and percentage values. From the analysis of the data obtained, it was determined that the project made a positive contribution to the students' perspectives on science and robotics. As a result of the study, students' defined science as the effort to improve people's living conditions, to investigate unknown events in the universe and the world, to research, discover, produce and develop new things, and to change the World and people in which we live.

Introduction

The characteristics that a person should have in accordance with the new age can only be obtained by raising people who are aware of how to live in a changing age and technological environment. With the approach of contemporary science understanding, it has become necessary for individuals to access the most accurate information by following developments in science and technology, to analyze the most accurate information obtained, and adapt it to the necessary places by making it ready and appropriate for the use of science, that is, technology in their daily lives. A student who has acquired these skills will be able to develop and apply scientific knowledge in subsequent educational steps (Kara & Akarsu, 2013; Taner et al., 2017; Yalçın & Şişman, 2018).

In light of the above, the Scientific and Technological Research Council of Turkey (TÜBİTAK) implements a variety of support programs and projects in order to contribute to the training and education of scientists in our country. In this context, education and training provided outside of the classroom, in addition to education provided in schools, is particularly effective in enabling students to become scientifically literate scientists and to emulate the scientist's problem-solving processes (Keçeci, 2017). Our new generations, who are qualified, self-assured, and equipped with our national and spiritual values, are our greatest source of strength in our efforts to turn our country's dreams of reaching the level of contemporary civilizations and beyond into goals and these goals into reality as soon as possible (*MEB*, 2021).

With the advancement of technology on a daily basis, the current situations in many fields in our country have changed, developed, and thus progressed. The benefits of information technologies, which are rapidly advancing and will continue to do so, have made themselves felt, proven, and spread to every industry, particularly since the 2000s. When considered in this context, the technologies created and developed for individuals have started to have a transformative effect, making everyday living easier. Due to their diverse functionality and educational qualities, technology and robotic coding-based applications have become a widely demanded application in education (Subakan & Koç, 2019).

TÜBİTAK supports the development of students' problem-solving, analytical, positive, and critical thinking skills through a variety of support programs and projects. It also has planned and intended objectives, such as collaborating with peer groups and sharing the knowledge and expertise obtained (Özel & Akyol, 2016). Students' critical questioning abilities, active engagement in activities, and friendships are all enhanced by this support program and projects. Students continue their activities in these projects by asking questions, locating resources, conducting resource research, planning their research and process with their peers, collecting and analyzing data, estimating and sharing predictions and results, thinking like scientists, and learning scientific approaches (Matson & Parsons, 2006; Tüzün, 2006). The activities carried out within the scope of TÜBİTAK 4004-Nature Education and Science Schools Support Program positively increased primary school students' attitudes toward science class, their scientific process skills, their perceptions of thinking like a scientist, and their motivation towards the class (Durmaz et al., 2017; Yıldırım, 2018). It has been determined that students' involvement in experiments and practical activities, as well as the design of a research project, improves their interest in the class and research, particularly in science classes. It is known that such activities facilitate learning and have a longer lasting effect on the mind Aydoğdu & Ergin, (2009); Kaya & Böyük, (2011); Yeşilyurt et al., (2005). Scientific curiosity, questioning, knowledge development, and linking existing information with science are all well-established methods of transferring science and social relations or knowledge to social layers.

Starting from the primary school years in which they began their education, it is critical for students to acquire scientific skills such as data collection, data evaluation, establishing a cause-effect relationship between the obtained information, and making decisions in light of these results, in order to establish the foundation of scientific studies. TÜBİTAK's scientific activities are a key step toward realizing all of these goals (TÜBİTAK, 2018). TÜBTAK4004-Nature Education and Science Schools Support Program seeks to introduce and

communicate knowledge with students as much as possible by visualizing the material as much as possible, interactively and in an intelligible fashion with peer group applications. In the projects within the scope of the program, it is aimed to encourage the sense of curiosity, research, inquiry and learning desire by enabling the participants to realize scientific concepts and phenomena (TÜBİTAK, 2021). The fundamental goal of these programs is to instill a love of science in students. The programs are designed to help our students develop their scientific abilities of observation, discovery, questioning, hypothesis formation, hypothesis testing, problem solving, and model creation. It is hoped that our students would internalize these abilities via practice, learn how to collaborate across disciplines, and solve problems in everyday life using scientific procedures, as well as become aware of them through activities. Furthermore, during the project, several studies and educational activities are planned to develop our students' bonds with science, as well as the humanities and arts. One of the most important points in these projects is to ensure that our students enjoy while performing all these activities (TUBİTAK, 2015).

In this context, TUBİTAK supported secondary school students' participation in the "Artvin gets Color with Science and Robotics 2" project as part of the 4004-Nature Education and Science Schools Support Program. The opinions of the students participating in this activity on the projects and other activities carried out were investigated. Information is attempted to be delivered to students in an intelligible manner through the use of interactive and experimental applications in this project. Students are expected to discover scientific facts by noticing them, develop their sense of curiosity, become interested in science and robots, in addition to researching, questioning, thinking, being highly motivated and willing to learn, gaining problem-solving skills, and, most importantly, gaining the ability to understand the problem.

The goal of the “Artvin gets Color with Science and Robotics-2” project is to evaluate students' perspectives on science and robotics following active learning through doing and experiencing various scientific activities in the disciplines of science, robotics, artificial intelligence, astronomy, and nature. It's intended to help them gather and organize information in a meaningful way. Each student was expected to participate actively in the activities and was encouraged to communicate and connect with their peers as well as share information. In this context, with an interdisciplinary approach, the project aims to activate the sense of curiosity of secondary school 6th and 7thgrade students and transfer their knowledge and experiences to new disciplines, through workshops, nature education, robotic coding, augmented reality, computational science applications, artificial intelligence, sports, and astronomy. and renewable energy resources activities, and to raise individuals who can follow today's scientific technologies, know the environment they live in and the plant and living species living in it, have a conscious perspective towards protecting nature and a sustainable nature consciousness.

Similar results were obtained in previous studies similar to this one. Akay, (2013) stated that the 6th, 7th and 8th grade students participating in the “I Do and I Learn Summer Science School” project carried out in Mersin within the scope of TÜBİTAK 4004-Nature Education and Science Schools Support Program showed a positive change in their perspectives towards science at the end of the project, and that the activities that the students did in the project were effective on what they wanted to do in the name of science in their lives. As a result of the findings of the study, it was concluded that the activities and practices carried out in the summer science camp

were effective in recognizing the six characteristics of the students regarding the nature of science. Tuncel, (2012) investigated whether children's views about scientific research change with summer science camp practices. In this context, activities were carried out for one week in a summer science camp supported by TÜBİTAK. 23 students in the 6th and 7th grades participated in the science camp. As a result, it was determined that the summer science camp practices positively affected the behaviors and thoughts of the students towards the scientific research process. Abik, (2017) aimed to develop students' views on the nature of scientific research in the summer science camp. The research was supported by TÜBİTAK 4004-Nature Education and Science Schools Support Program.24 students who completed the 6th and 7th grades participated in the research. When the research findings were examined, it was determined that the camp activities contributed to the formation of the idea that scientific research may be done in a variety of ways, as well as the summer science camp practices and the kids' perspectives on science. The effect of nature education practices on the biophilia levels of teacher candidates studying in the science department was explored in a study conducted by (Sefalı, 2019). When the research findings were examined, it was determined that the nature education applications had a substantial impact on the biophilia levels of science teacher candidates in favor of the experimental group. According to the studies of Acisli & Kumandaş Öztürk, (2019), it was determined that the students found the robotic coding activity to be 97% successful and gave positive answers at the level of I strongly agree with the Artvin gets Color with Science and Robotics Project. The students' evaluations of the activities were generally at a high level and I strongly agree. Students especially showed more interest in robotics and technological applications.

Method

“Artvin gets Color with Science and Robotics-2” project was carried out in Artvin within the scope of TÜBİTAK 4004-Nature Education and Science Schools Support Program. The diaries of the secondary school students who took part in the project and their evaluations about the project and its activities were examined. In addition, on the project's last day, students were interviewed to learn about their perspectives on the project and their activities.

Research Model

The research is a descriptive study using the survey model. Survey models are appropriate for research that aims to characterize a previous or current situation in its current state (Karasar, 1999). In this context, all participants are expected to participate in each event under the same conditions. Since the project was shaped according to the criteria of TÜBİTAK 4004-Nature Education and Science Schools Support Program, it was not a research project, and experimental and control groups could not be established, the study was designed as a single-group pre-test-post-test experimental model without a control group. In this design, the effect of the experimental approach is tested on a single research group. When certain predictions are produced on any subject, this experimental model is used to test the accuracy of these predictions (Büyüköztürk et al., 2018). Document review was used in the study to better understand the students' achievements and to increase the validity of the research. Document review in qualitative research includes the examination of written materials containing information about the event or phenomena being researched (Yıldırım & Şimşek, 2011).

Study Group

The research group consisted of 30 secondary school students in grades 6 and 7 who took part in the "Artvin gets Color with Science and Robotics 2" project, which was funded under the 2020/1 call period and began in the 15th year of the TUBİTAK 4004-Nature Education and Science Schools Support Program. 14 students are in 6th grade and 16 are in 7th grade, with 16girls and 14 boys among the participants.

Data Collection Tools

In the research, the personal information form of the students and information about their personal information were collected, and a two-question survey prepared by Akay, (2013) including the questions “What do you think science is?” and “If you were a scientist, what would you like to invent?” was applied to determine their thoughts, the robotic pre-questionnaire and robotic satisfaction test prepared by Koç Şenol, (2012) and a semi-structured form were used to determine the students' views on robotic activities. The content analysis method was used to evaluate qualitative data, whereas frequencies and percentages were used to assess quantitative data.

Analysis of Data

The open-ended questions obtained in the research were evaluated using the descriptive analysis method. In the descriptive analysis, the data obtained are summarized and interpreted by the researcher according to the previously determined themes. Quotations from studies created directly by individuals are included in this study to reflect their perspectives. The goal of this form of analysis is to display the collected data and findings in a logical and understandable manner. The descriptions are interpreted using the criteria established, the cause-effect correlations are investigated, and conclusions are drawn (Yıldırım & Şimşek, 2011). The data obtained in the study were examined using descriptive analysis in the form of the stages used in determining the project topics, the problems encountered during the activities, the difficulties encountered during the project preparation, the benefits of TÜBİTAK 4004-Nature Education and Science Schools Support Program, and general opinions about the project.

Findings

The findings regarding the views of the students who participated in the “Artvin gets Color with Science and Robotics-2” project are given in Table 1. Following that, examples of the answers given by the students to the question of “What is science?” are presented. Table 1 shows that the students describe science as follows; it is an attempt to better people's living conditions (f=8), investigating unknown events in the universe and the world (f=7), an accumulation of knowledge based on experimentation and research (f=6), researching, discovering, producing and developing new things. (f=6) and everything that alters the world we live in and the people who inhabit it (f=3). (Abdioğlu et al., 2020; Akay, 2013; Güler & Akman, 2006; Tatlı & Eroğlu, 2021)also tried to find an answer to the question of “What is science?” in their studies. Following these findings, the answers given by the students to the question of “What is science?” were examined.

Table 1. Students" Definitions of Science

Students' definitions of science	**f**
Everything that alters the world we live in and the people who inhabit it.	3
Researching, discovering, producing and developing new things.	6
It is an attempt to better people's living conditions.	8
It is an accumulation of knowledge based on experimentation and research.	6
Its mission is investigating unknown events in the universe and the world.	7
Total	**30**

Some of the answers given by the students to the question "What is science?" are as follows:

"Science is a hobby. It's about making people's life easier or finding solutions to their questions."

"Science is what allows us to live more comfortably in our everyday lives and in the future."

"Science is proposing new ideas based on existing knowledge for the benefit and happiness of humanity."

"Science is the effort people make to learn what they don't know."

"Science is the process of people conducting study, learning, and attempting to improve diverse fields" (physics, chemistry, biology...).

"Science is the explanation of everything, it is human intelligence and research that people do about the past and the future, so science encompasses everything."

"I believe science is the process of logically exploring and discovering the answer to an unfamiliar subject."

The findings regarding the opinions of the students participating in the "Artvin gets Color with Science and Robotics 2" project about what they want to invent are given in Table 2 as frequency. The following are some examples of their responses to this question "What would you invent if you were a scientist?" The things wanted to be invented under the health category are as follows; a vaccine that ends the cancer disease (f=1), ray glasses for blind people (f=1) and portable disease display device (f=1). The things wanted to be invented under the category of environment are as follows; a robot that extinguishes forest fires (f=2), a machine that converts carbon dioxide to oxygen (f=1), a sensor that detects plastics that are harmful to the environment (f=1), and abottle made of plastic that is not harmful to the environment (f=1). The things wanted to be invented under the category of space are as follows; a teleportation machine (f=8), a rocket traveling to mars (f=1) and a telescope showing all space (f=1). The things wanted to be invented under the category of transportation are as follows; vehicles powered by wind energy (f=1) and a vehicle that can travel by land, air, sea and rail (f=1). The things wanted to be invented under the category of technology are as follows; a robot that will make life easier (f=6), technology that overcomes the problem of charging (f=2) and a machine powered by magnet (f=1). What was intended to be invented under the category for other purposes was in the form of a powder (f=1) that would provide peace all over the world. The ones most wanted to be invented by students are respectively; a teleportation machine (f=8), a robot that will make life easier (f=6), technology that solves the charging problem (f=2) and a robot that extinguishes forest fires (f=2).

Table 2. What Students Want to Invent

Category	Things to be invented	f	Σf
Health	Vaccine that ends the cancer disease	1	3
	Ray glasses for blind people	1	
	Portable disease display device	1	
Environment	Robot that extinguishes forest fires	2	5
	Machine that converts carbon dioxide to oxygen	1	
	Sensor that detects plastics that are harmful to the environment	1	
	Bottle made of plastic that is not harmful to the environment	1	
Space	Teleportation machine	8	10
	Rocket traveling to mars	1	
	Telescope showing all space	1	
Transportation	Vehicles powered by wind energy	1	2
	Vehicle that can travel by land, air, sea and rail	1	
Technology	Robot that will make life easier	6	9
	Technology that overcomes the problem of charging	2	
	Machine powered by magnet	1	
For other purposes	Powder that will bring peace to the whole world	1	1
	Total	**30**	

Some of the answers given by the students to the question "If you were a scientist, what would you like to invent?" are as follows:

"If I were a scientist, I'd create a ray-glass that allows blind people to see life."

"If I were a scientist, I'd like to discover and distribute a powder that would bring world peace."

"If I were a scientist, I'd create a vaccination that entirely eliminates cancer cells. The goal of this vaccine, which I intend to develop specifically for youngsters, is to save people who have only recently begun their lives and ensure that they enjoy a healthy life like everyone else."

"If I were a scientist, I would build a big machine that takes carbon dioxide from nature and turns it into oxygen. I would have this machine do the job that tree and leaves do in burning forests."

"If I were a scientist, I'd like to be able to teleport and produce environmentally friendly plastic bottles."

"If I were a scientist, I would want to make a robot, because its fun and you can do whatever you want."

The findings regarding the frequency and percentage distributions of robotics pre-questionnaire questions 1 and 2 given by the students participating in the "Artvin gets Color with Science and Robotics-2" project are presented in Table 3. As seen in Table 3, 53.3% of the students who participated in the study answered yes to the question "Have you ever used Lego pieces before?" and the remaining 46.7% answered no to the question. 90% of the students stated that they did not know anything about the Lego Mindstorms Robotic System, and 10% stated that they did.

Table 3.Frequency and Percentage Distributions of Robotic Pre-Questionnaire Questions 1 and 2

	Yes		No	
	f	%	f	%
Have you ever used Lego pieces before?	16	53.3	14	46.7
Do you have any information about the Lego Mindstorms Robotic System?	3	10	27	90

The findings regarding the frequency and percentage distributions of question 3 of the robotic pre-survey and robotic satisfaction survey by the students participating in the "Artvin gets Color with Science and Robotics 2" project are given in Table 4.

Table 4. Frequency and Percentage Distributions of Robotic Preliminary Survey and Robotic Satisfaction Survey Question 3

	I think it will be difficult		It was difficult		Not Decided				I think it would be easy		It was easy	
	Pre test		Post test		Pre test		Post test		Pre test		Post test	
	f	%	f	%	f	%	f	%	f	%	f	%
What do you think about the use of Legos in the activities you will/are doing?	1	3.33	5	16.7	10	33.3	-	-	19	63.3	25	83.3
What do you think about programming robots in the activities you will/are doing?	17	56.7	3	10	9	30	-	-	4	13.3	27	90

As seen in Table 4, in the pre-test to the question “What do you think about the use of Legos in the activities you will/are doing?”, 33.3% of the students stated that they were undecided about the use of Legos in the activities they would do, 63.3% of them stated that it would be easy to use them, and 3.33% said that they would have difficulty. On the other hand, in the post-test, 16.7% of the students stated that they had difficulty and 83.3% stated that it was easy. In the pre-test to the question “What do you think about the programming of robots in the activities you will/are doing?”, 56.7% of the students thought that they would have difficulty, while 30% were undecided and 13.3% thought it would be easy. In the post-test, 10% of the students stated that it was difficult and 90% stated that it was easy. In addition, 100% of the students stated that they were satisfied in response to the question “Are you satisfied with the activities you did?” in the post-test.

The findings regarding the frequency and percentage distributions of question 4 of the robotics pre-questionnaire by the students participating in the "Artvin gets Color with Science and Robotics 2" project are presented in Table 5.

Table 5.Frequency and Percentage Distributions of Robotic Pre-Questionnaire Question 4

	Alone		With group	
	f	%	f	%
How would you prefer to do your robotic activities?	4	13.33	26	86.7

As seen in Table 5, 13.33% of students said they prefer to do their robotic activities alone, while 86.7% of the students stated that they prefer to do them with a group.

Discussion and Conclusion

According to the data obtained from the research in which the opinions of the secondary school6th and 7th grade students who participated in the Nature Education and Science Schools Support Program and the project activities of the "Artvin gets Color with Science and Robotics 2" project supported within the scope of TÜBİTAK 4004-Nature Education and Science Schools Support Program, they found most of the activities entertaining and instructive, that they would like to participate again and would recommend them to their friends. Students who recognized the relevance of nature and the relationship between nature and science appreciated the project's learning environment because it made learning pleasurable. Students learnt scientific material while having fun in everyday life, and this strategy was discovered to be more permanent. It has been observed that similar studies conducted have reached results close to the ones obtained in this study (Göloğlu Demir & Yılmaz, 2018; Marulcu et al., 2014; Tekbıyık et al., 2013; Yalçın et al., 2014; M. Yıldırım et al., 2016).

Many students throughout the universe recognize the importance of science and acquire scientific knowledge. When the students' views on science were examined, it was determined that their interest and willingness to learn had improved, and that all of the students had good feelings toward science. It has been stated that students' responsibilities, self-confidence and desire to learn increased during and after the project. According to the findings, practically all of the students talked with their group mates, shared ideas, and sought advice from their course teachers when deciding on project topics (Ayvacı & Çoruhlu, 2010; Çavuş et al., 2018; Çetin & Şengezer, 2013; Özel & Akyol, 2016; Sözer, 2017; Tortop, 2013). Some of the problems experienced by the teachers and students working on the project during the activities can be listed as the lack of material support, the inadequacy of financial support, the lack of physical opportunities, the lack of in-service training on the subject and the lack of a project course in the curriculum (Okuyucu & Demir, 2019). Teachers in charge of the project noted that the activities taught students how to cope with and struggle with challenges they experience in everyday life, and that the tasks they conducted helped them strengthen their manual skills (Tortop, 2013). In this study, in which the opinions of the students about the activities conducted in the project were determined, it was discovered that, in addition to the cognitive advantages acquired by the students, the project boosted their interest in school and the class, and improved their self-confidence in a favorable way. Given the scientific value, importance, and contribution of TÜBİTAK 4004 projects to students, it was determined that completing and continuing the financial and other inadequacies would be more useful (Atalmış et al., 2018).

In the context of the above-mentioned, the majority of the students who participated in the "Artvin gets Color with Science and Robotics 2" project on the definition of science said, "It is an endeavor to better people's living conditions." Some of them responded, "It is to search for undiscovered events in the cosmos and the world," "It is to explore, find, generate, and develop new things," and "It is the entirety of knowledge based on experimentation and investigation," all of which were close to this answer. A few students said in a brief definition: "Everything that transforms the world and the people we live in." Secondary school students classified science as a discipline that is regarded as a source of knowledge and studied while having fun, according to Akay, (2013) and the reason for this is that students learn all of the activities in the project by doing and experiencing them themselves. Güler & Akman, (2006) stated that as a result of their studies in which they investigated the views of preschool children on science, they defined science as something unknown, knowing everything, formulas, compounds, technology and inventions, experimenting, researching, and examining, while some of the children defined science with the names of professions such as engineering and medicine. Abdioğlu et al., (2020) stated that the number of concepts produced by the eighth-grade students in the post-test regarding the concept of "Science" due to their activities in the TÜBİTAK 4004: “Let's Meet; Let's Make Science and Mathematics Fun!”project is significantly higher than in the pre-test. Tatlı & Eroğlu, (2021) stated that as a result of their study, in which they investigated the opinions of 20 secondary school students, who participated in TÜBİTAK 4004: “Burdur “7/24 Science” Camp” project, about the science camp and the activities carried out in the camp, the perspectives of the students who stated that they liked the project very much, changed positively after the camp.

In the study, the two most notable answers given by students in response to the question “What is science?” are as follows: "Science is to put forth new ideas on what exists for the benefit and happiness of humanity.” “Science is the explanation of everything. It is the research of human intelligence about the past and future, so science is everything.” Students generally gave logical and positive answers to this question.

As a result of the experts' evaluations, the things that the secondary school students participating in the project wanted to invent were examined under six categories: health, environment, space, transportation, technology, and other purposes. “A vaccine that ends cancer disease”, “ray glasses for blind people”, and “a portable display device for diseases” are all examples of those intended to be invented under the health category with equal frequency. Those that are intended to be invented under the category of "environment" are also of equal frequency, which are “a robot that extinguishes forest fires”, “a machine that converts carbon dioxide into oxygen”, “a sensor that locates plastics that harm the environment”, and “a plastic bottle that is not harmful to the environment”. The things that were wanted to be invented under the space category were mostly “a teleportation machine”, then “a rocket traveling to Mars”, and “a telescope showing the whole space”. The ones that are intended to be invented under the transportation category are of equal frequency, which are "vehicles running on wind energy" and “a vehicle that can travel by land, air, sea and railway”. The things that were wanted to be invented within the category of technology are generally in the form of “a robot that will make life easier”, “technology that solves the charging problem”, and last but not least, “a machine that works with magnet power”. On the other hand, “a powder that will provide peace in the whole world” is intended to be invented under the category for other purposes. As a result, teleportation machines, robots that make life easier,

technology that solves the charging problem, and a robot that extinguishes forest fires are among the most desired inventions by students. Considering the ideas that are most wanted to be invented here, the students want to invent things that make their lives easier and they want inventions that protect the environment by being sensitive.

When the findings are examined, it is possible to say that robotic, astronomy, science, and environmental activities have an influence on the ideas of students who want to invent robots that extinguish forest fires, a machine that converts carbon dioxide into oxygen, a sensor that determines the location of plastics that harm nature, a rocket that travels to Mars, and a telescope that shows the entire universe. Similarly, in the study of Akay (2013), the secondary school 6th, 7th and 8th grade students who participated in the "I'm Doing and Learning Summer Science School" project stated that they wanted to invent a time machine, a robot that makes life easier, a pill that prevents diseases, a car that runs on water or air, a robot for the disabled, a space travel vehicle, and a food capsule, and it was also stated that the activities they did had an effect on these thoughts.

The following are the two most important responses given by students to the question: "If you were a scientist, what would you like to invent?"

> *"If I were a scientist, I would like to teleport and produce things like plastic bottles that do not harm the environment (nature)."*
>
> *"If I were a scientist, I would want to develop a robot, because its fun and you can do whatever you want."*

These responses demonstrated the students' concern for the environment (nature) as well as the inventions that make their life easier and more enjoyable.

More than half of the students who participated in the research said yes to the question "Have you ever used LEGO pieces before?", which is the 1st question of the robotic pre-questionnaire, while the others said no. According to this finding, the students dealt with previously new and technologically developed materials, even if they were toys, by adapting to the emerging and improving technology. Almost all of the students who participated in the research stated that they did not know anything about the Lego Mindstorms robotic system in response to the question "Do you know anything about the Lego Mindstorms robotic system?", which is the 2nd question, and very few of them stated that they did. Although more than half of the students use Lego pieces, almost all of them do not use the Lego Mindstorms robotic system and state that they do not have any knowledge, showing that robotic systems have not reached the secondary school level yet due to the cost. It has been concluded that the inability to use developing and advancing technology at the secondary school level negatively affects practical and permanent education and training.

While a few of the students in the pre-test stated that they were undecided about the use of Legos in the activities they would do in response to the question "What do you think about the use of Legos in the activities you will/are doing?", which is the 3rd question of the Robotic Preliminary Questionnaire and Robotic Satisfaction Questionnaire, most of them said that it would be easy to use them, and very few of them said it would be difficult. In the post-test, very few of the students stated that they had difficulties, and most of them

said it was easy. While less than half of the students said that they would have difficulty in the pre-test in response to the question "What do you think about the programming of robots in the activities you will/do?", very few said that they were undecided and very few said that it would be easy. In the post-test, very few of the students stated that it was difficult, and the majority of them stated that it was easy. Furthermore, all of the students stated that they were satisfied in response to the question "Are you satisfied with the activities you did?" in the post-test. According to these findings, while students stated that they would be more prejudiced or indecisive in the use of blocks and robots in education and training before the activities, they did not have nearly as much difficulty using the blocks and robots after the activities. On the contrary, they easily used them in education and training, and they carried out a more permanent and effective education.

According to the answers of the students in response to the question “How would you prefer to do your robotic activities?”, which is the 4th question of the Robotics Pre-Questionnaire, very few of the students wanted to do them alone, while many more stated that they wanted to do them with a group. This result demonstrates that conducting activities together in cooperation and sharing knowledge boosts students' sense of achievement as a group, which is more fun and instructional.

Furthermore, students stated that the project was advantageous since it allowed them to engage in active learning. They highlighted the importance of learning by doing and experiencing. As a result of the analysis, it was discovered that students volunteered to engage in the activities in general, and their volunteering status climbed to the maximum level at the end of the activity. Almost all of the students made an effort to complete the exercises on time and expressed satisfaction with the results. All of the students responded that they would like to participate in the project again and that they would tell their peers about it. In addition to these findings, other students requested that the experiment be extended. According to Su (2019), students gained social benefits from this project, including self-expression, increased feelings of self-confidence and sensitivity, improved knowledge, skills, and experience levels, increased communication through socialization, setting goals and acting more systematically, working together, sharing, patience and tolerance.

In recent years, robotic applications have gained a lot of attention. Primary and secondary school applications, in particular, capture students’ attention and help them focus on studies for longer periods of time. Robotic applications, in addition to these capabilities, necessitate the acquisition of additional skills such as software knowledge, coding, and technical applications. These applications also require a serious financial budget. Because robotic application kits are costly, they can place a significant financial burden on educators when used with a large number of students. For this reason, it is suggested that researchers considering robotic applications take advantage of TÜBİTAK support programs, design their courses in collaboration with competent informatics educators, receive additional robotics training, and design activities appropriate for student levels in process-product-oriented studies.

The findings of the study revealed that secondary school students in 6th and 7th grades who took part in the project had positive attitudes about robotic scientific activities. Again, it was determined that the students who participated in this project developed problem solving skills, started to think within the scope of scientific

process skills, started to analyze the data obtained in the activities, interpreted the results reached and presented them to the relevant people, conveyed them in information, and started to interpret the results of the research with the audience in a constructive and positive way within the scope of critical thinking. The results of this study are in agreement with the results of the studies conducted by Keçeci et al., (2017, 2018). In the study, it was discovered that the students participating in the project felt more confident, and this conclusion was found in the study of (Soyuçok, 2018).

According to the findings of the study, it is considered that in-service trainings for teachers would be beneficial in informing them about the process of designing and maintaining the TÜBİTAK 4004-Nature Education and Science Schools Support Program. Furthermore, it should be ensured that these applications are used in all classes, not only science ones. All courses' curriculums should include explanations, photos, and videos of sample applications for the program. These additions are thought to be critical in terms of increasing science literacy and encouraging students to ask questions. The scientific activities prepared in the projects should be documented electronically, uploaded to a website established by the Ministry of National Education, and made available to all teachers and students in order for them to be implemented in schools. Further dissemination of these programs to enable students to learn by doing and living will enable our students to think more scientifically, to speak preparedly and unprepared in front of the community, and to make numerous contributions such as defending their views within the framework of scientific rules, having the opportunity to discuss the results, and developing arguments.

Considering the achievements and outcomes of the projects organized within the scope of TÜBİTAK 4004-Nature Education and Science Schools Support Program, which was designed specifically for secondary school students to engage in scientific activities and give their hearts to scientific activities, it should be expanded to include all students across our country. Some projects selected from all the projects carried out in the same year can be evaluated by a scientific committee to be created in competitions in their own fields and among themselves. These competitions are expected to be extremely beneficial in the development of students' creativity, entrepreneurship and innovative perspectives. In this way, the projects are not only carried out, but can be used as a result of scientific evaluations by making them more useful by participating in the application areas, especially in the education and training processes within the scope of the project subjects.

Note

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