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Looking for Problem Scenarios with Robotic Coding: Primary School Example in Turkey*

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ABSTRACT

Students can develop their creative thinking processes and problem scenarios with robotic applications. Therefore, the research objective is that robotic applications can solve students' problem scenarios. This study was conducted in Samsun/Turkey in the Ministry of Education for 10 weeks and involved 8 elementary school students.. For this study, we made two things which are the necessary configurations developed by an expert researcher, another one is robotics coding training which other field expert researchers carried out. After studying problem scenarios and robotic coding training, students were provided with the problem scenarios to bring solutions with robotic coding. In this study, it was found that although most of the students proposed different solutions to the given scenario, there were also students who proposed similar solutions. At the end of the study, students had very different approaches to the scenarios and students designed some robots as we can see.

Keywords:
Robotic coding, Problem scenarios, Scenario-based learning, Creative thinking

1. Introduction

It is thought that scenario-based robotic coding training, which is considered among the 21st-century skills, will improve the coding skills of the students, especially by using their high-level thinking skills. The fact that the problems are scenario-based attracts students' attention as they are a situation that they may or may not encounter in daily life, and can bring their creative thoughts to the fore. Scenario-based learning constructs reflection on an existing scenario beyond just a problem situation or daily life. Internalizing the given situation and searching for a solution can be more comprehensive. For this reason, scenario-based teaching was preferred while teaching robotic coding, especially to see and reveal high-level thinking and application skills. According to O'Brien (2004); "*Good scenarios are multidimensional and capture a broad range of uncertain factors. Good scenarios challenge students implicit assumptions about what will not change in their current world and help move their audience beyond it. Engaging scenario titles and narratives are more likely to capture the reader's imagination and thus influence the way they understand how the future may develop*". In scenario-based learning, where the real world is brought to the classroom, students are allowed to think about a problem situation, use their knowledge and skills, realize their insufficiencies, and conduct research to address them. The student working on the given scenario activates high-level thinking processes such as analysis, synthesis, and evaluation (Arabacıoğlu, 2012). Scenario-based learning focuses on Bloom's taxonomy's analysis, synthesis, and application steps. The student should have learned the basics before starting scenario-based learning. For this

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reason, problems and questions within the scenario are prepared based on the information learned by the students (Veznedaroğlu, 2005).

In scenario-based learning, the student assumes more responsibility during the learning activities and organization of the process on product demonstration (Cerrah Özsevgeç and Kocadağ, 2013). SBL is beneficial and effective when instruction is relevant, problem-centered, draws from the learner's experiences, and is conducted in a learning environment that encourages processing and verbalization of thoughts and is supported with immediate feedback (Al Attar, 2019). Scenarios are stories about people's activities. Scenario-based learning is a type of narrative in which the targeted skills are presented implicitly within a certain plan, and which consists of the events or incidents that may occur or may be encountered in daily life (Temur and Turan, 2018). Scenarios are therefore the starting point for students to immerse in a real-world problem and a subsequent solution finding process. During this process students must apply their individual knowledge and cognitive and social abilities to collaboratively solve problems in a safe environment (Erol et al., 2016). Scenarios used as educational tools are fictional series that contain various problems that arouse students' curiosity, raise questions about the cause of those problems, give students clues as they move toward the scenario's goal, and increase and sustain students' urge to continue learning (Cantürk Günhan, 2006).

Problem-solving, forming hypotheses and technical innovation all require a certain form of scientific creativity (Lin, Hu, Adey, and Shen, 2003). Problem solving plays an important and effective role in the formation of creative thinking. Also critical thinking involves the acquisition of information and active learning, problem solving, joint decision making, and the utilization of information (Kim, 2009). According to Gülmez Güngörmez et al. (2016), students try to find solutions by implementing their cognitive processes while producing solutions to problems in scenario-based learning. The most important of these cognitive processes is reflective thinking.

Technologies contribute to engagement and meaningful learning in education sector (Blackburn, 2015). Robotic and coding applications teach students construction of knowledge, algorithmic thinking, creativity and problem solving, programming logic, and engineering design processes (Alimisis and Kynigos, 2009). Robotic coding is the project-based use of robots from simple to complex while programming (Bütüner, 2019). Robotic coding is the integration of a piece of hardware or a large number of hardware with software, which is an abstract concept (Avcı & Başaran, 2021). Block robotic coding is a software language that allows users to create programs by processing graphical elements in the programming language instead of text coding (Lopez and al, 2021).The inclusion of robotics in educational activities promotes popular constructivist understanding as it provides versatility, a wide range of learning experiences, and facilitates learning (Sinap, 2017). Robotics coding applications are becoming more widespread and gaining importance nowadays. Robotics can be used students to engage and develop computational thinking skills (Repenning, Webb & Ioannidou, 2010). It is stated that with such robotic applications, many cognitive and psycho-motor characteristics of students such as creativity, multidimensional thinking, critical and analytical thinking and problem solving can be developed (Benitti, 2012). Different methods are used in the teaching of robotics coding applications. It is thought that robotics coding trainings can be improved if enriched with scenario based learning. Scenario-based learning is a learning model based on interactive scenarios with the goals and behaviors to be realized, in which students take the role of the player and show the goals and behaviors that can solve the problems encountered (Veznedaroğlu, 2005). Robotics applications are an ideal application for engineers to develop their own ideas through trial and error, diversify them, and improve their problem-solving skills (Auerbach and al., 2019).In their study, Cheng and al. (2021) designed a writing system for students consisting of robots and IoT-based toys by creating a scenario-based interactive learning environment.Also, Fernandes and Martins (2018) designed a learning scenario, in which students had the opportunity to participate in a project with robots to explore and make connections between contents from the four disciplines of STEM. In this learning scenario the children worked together with robots. Using this pedagogical approach, students seem to gain a deeper understanding of these scientific concepts and its connections. Smilarly, in Benitti and Spolaor's (2017) study, robots support for STEM education has been successful in different scenarios. The scenario-based approach for designing educational robotics activities are aligned to the curriculum objectives or the development of the 21st century skills such as collaboration, problem-solving, creativity, critical thinking and computational thinking (Komis, Romero & Misirli, 2017).

Based on the literature review, it is seen that scenario-based learning improves advanced thinking skills of individuals such as creative thinking. It is thought that it is important to configure robotic applications, which is one of the technological applications, with scenarios. It is thought that providing scenario-based robotics coding applications will further improve the students' higher thinking and product creation skills. In this context, the study aims to determine the effect of robotics applications on the solution process of students' problem scenarios. The study's problem: How is the effect of robotics applications on students' problem scenarios solution process?

2. Methodology

2.1. Research Model

Single group pretest-posttest model that one of the quantitative research designs and a case study that one of the qualitative research designs were used in this study. The model of this research is mixed model. In the Single group pretest-posttest model, the independent variable is applied to a randomly selected group and its effect on the dependent variable is observed (Karasar, 2005). The case study can be explained as an in-depth description and examination of a particular system (Merriam, 2013).

2.2. Research Sample

The population of this study consists of private schools in the Ilkadım district of Samsun/Turkey. The study group consisted of 8 students studying in a private educational institution in Samsun. The training was carried out in the "Robotic coding club" activity and was designed as 1 lesson hour (40 minutes) per week. The selection of the students was chosen by random sampling method and the researchers trained the first 8 students who joined the club. The students carried out their studies in two groups (4 + 4). The study group, consisting of 9 and 10 years old, 3rd and 4th grade primary school students, consists of 5 girls and 3 boys.

2.3. Data Collection Tools and Procedure

Data was collected by the "Teacher Observation Form" consisting of 32 items and the "Student Self Evaluation Form" consisting of 5 items developed by two researchers who were experts in their fields who developed the item and question pool and received the necessary feedback. While the "Teacher Observation Form" consists of 32 questions on a 5-point Likert scale, the "Student Self-Evaluation Form" consists of 5 open-ended questions.Before starting the research, 8 students in the study group were given block coding training and the robotic coding set they would use was introduced. In addition, scenario-based sample problems were shown and the solutions were evaluated orally. A pilot application was made for the forms. In the data obtained from the student self-evaluation form, which is the qualitative data collection tool of the research, the percentage of agreement of the two encoders was examined.

According to Kabapınar (2003), a consistency of %80 and above between two coders, and a consistency of %70 and above between two coders according to Miles and Huberman (1994), shows that the data analyzes are reliable (cited in Türnüklü, 2000).

The analysis of the quantitative data was done with the SPSS program. The percentage of agreement obtained for this study was determined as %82.05, which demonstrated the reliability of the research data analysis. As a result of the reliability analysis of the teacher observation form, Cronbach's Alpha = ,961.

The data in the observation and self-assessment forms applied to the students were collected on a voluntary basis. These forms were applied to the students every week during the application. In the study conducted by two experts, one of the field experts developed the problem scenarios and made the necessary configurations, and the other field expert performing robotics coding trainings and made the necessary observations. In this study, necessary hardware support was provided to the students and after the robotics coding training, students were asked to produce solutions to problem scenarios with robotics applications. The implementation phase of the study lasted 10 weeks and the researchers then analyzed the data.

In this study, students were given coding training for 3 weeks before being introduced to the application and materials to be used. During the following 10 weeks, robotics coding and problem scenario studies were conducted and the necessary data were collected.The trainings were carried out in the "Robotics Coding Club" activity and are watched as 1 lesson hour (40 minutes) per week.

Sample Scenario

Scenario 1: News of a Newspaper: Landslide in İkizdere closed the road!

In the İkizdere district of Rize, a landslide occurred on the upper part of the highway and the lower part of the house in a neighborhood in the center of the district. At the entrance of İkizdere district center, the pieces of rock that were broken off from the upper side of the highway blocked the highway to transportation. Due to the landslide that occurred within 10 meters in front of the District Police Headquarters building, the Rize-Erzurum highway connection was served from the road in the district center for a while. The road was reopened to traffic after the stones were removed by the teams of the municipality. As seen in the newspaper report above, a landslide occurred as a result of a landslide in Rize in 2009 and the road was closed. It took a lot of effort to open the road, which took a lot of time. Thus, students could not go to school that day. An engineering team was called to solve this situation.

If you were a part of this team of engineers, what kind of robot would you design to open this road that was blocked with stones and earth?

Draw the design of the robot you intend to build below.

Scenario 2: Due to heavy snowfall in a village of Kars that lasted for five straight days, many village roads were blocked, and it became impossible to reach the city. This caused some problems. Coincidentally, Tuelay, a teacher who works in the village of Çamurlu in Kars, went into labor pains, but because of the closure of the roads, no vehicles could reach the village by land. If you were part of the rescue team;

How would you transport the Tülay teacher to a hospital most safely and healthily to deliver her baby?

How would you design a robot for this? Draw the robot you plan to design belew.

2.4. Data Analysis

The data obtained as a result of the research were analyzed by coding. Qualitative research data obtained from content analysis includes the following phases: coding of data, finding themes, organization, and interpretation of codes-themes (Yıldırım & Şimşek, 2008). In addition, the concordance percentage of the two researchers was examined. According to Kabapınar (2003), a concordance of 80% or more between the two codes and according to Miles and Huberman (1994), a concordance of 70% or more indicates that the analyses are reliable (cited by Türnüklü, 2000). In this study, a concordance of 87.5% was found.

2.5. Ethical

For this study, ethics committee approval was obtained from Ondokuz Mayıs University Social and Human Sciences Ethics Committee with the letter dated 23.09.2020 and numbered 2020/570.

3. Findings

3.1. Findings of the student self-evaluation form

3.1.1. Regarding the robots intended to be designed, student self-assessment form findings

In this section, the data related to the question "how would you design a robot according to this scenario" obtained from the research is presented as frequency and percentage distribution.

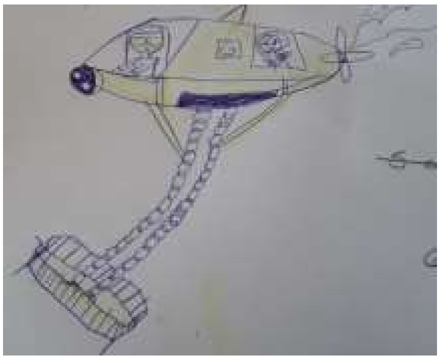
Table 1. *Data from the Study Group on the Question "how would you design a robot according to this scenario."*

Codes	Students	Frequency (f)	Percentage (%)
Balloon	S2,S4,S5	3	37.5
Helicopter	S2,S3,S4,S7	4	50
Flying house	S1,S2,S6,S7	4	50
Spaceship	S3	1	12.5
Ultra duck	S1	1	12.5
Flying hospital	S1, S5, S8	3	37.5

When Table 1 is examined, 37.5% of the students answered balloon, 50% answered helicopter, 50% answered flying house, 12.5% answered spaceship, 12.5% answered ultra duck, and 37.5% answered flying hospital.

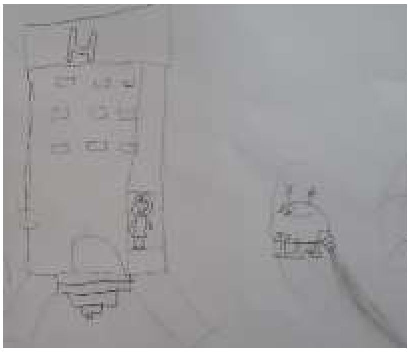
3.1.2. Regarding the drawing of the robots intended to be designed, student self-assessment form findings

In this section, the findings related to the question "please draw the robot you are planning to design based on scenario 2" are presented.



Drawing 1: 1st student's drawing

Here, the student made a robot helicopter, hung a basket down, and thought of reaching the hospital with the robot helicopter they had made

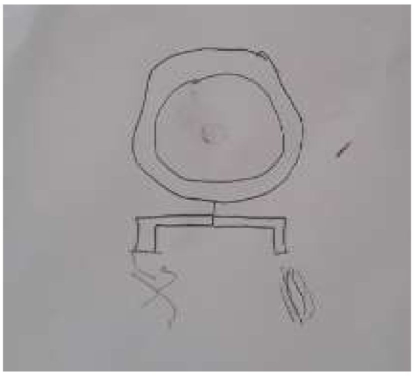


Drawing 2: 2nd student's drawing

The student thought of carrying the patient to the hospital by making a robot that resembles a flying bell. The robot has four legs and two propellers at the top.

Drawing 3: 3rd student's drawing

The student had the idea to bring the patient to the hospital by building a robot in the shape of a glass bell. He/she also designed a route for transportation to the hospital.



Drawing 4: 4th student's drawing

The student thought of carrying the patient by making a robot in the form of a ring with rockets on its feet. It is also seen that a rotation mechanism is considered in one of the legs.

Drawing 5: 5th student's drawing

The student had the idea to transport the patient to the hospital by building a robot resembling a ring and a helicopter. She/He also made details such as

Drawing 6: 6th student's drawing

The student thought of transporting the patient to the hospital by making "ultra duck" robot. It is seen that the robot has a baby room, a comfortable bed for the patient, and a motor on the robot's feet.

lighting, propeller and the sleeping place of the harvest in the robot he made.

Drawing 7: 7th student's drawing

The student thought of transporting the patient to the hospital by making a robot that looks like a flying house. This robot appears to have a foot mechanism and a transport unit.

Drawing 8: 8th student's drawing

The student came up with the idea of transporting the patient to the hospital by building a robot that resembles a space shuttle and a helicopter. When the robot is examined, it is found that there is a mechanism that carries the patient down with a rope-like mechanism and lowers him to the ground with an underbody.

When the drawings were examined, it was seen that each of the students made different drawings. When students examine the drawings, it is seen that they have creative thinking skills such as originality and flexibility.

3.1.3. Student Self-Assessment Form Findings Related to "Today ………. I Think I'm Fine"

In this section, the findings related to the open-ended statement "I think I am good at……………… today." given to the students are presented as frequency and percentage.

Table 2. *Distribution of Answers Given to the Open-Ended Statement "I think I am good at……………… today." on Week 1-10*

	Codes	Students	Frequency (f)	Percentage (%)
Week 1	Assembling parts	S3,S8	2	25
	Coding	S2,S4	2	25
	Drawing	S1,S7	2	25
	Teamwork	S5	1	12.5
Week 2	Assembling parts	S1,S2,S3,S7,S8	5	62.5
	Bringing parts together	S4,S6	2	25
	Teamwork	S5	1	12.5
Week 3	Assembling parts	S2,S6,S8	3	37.5
	Bringing parts together	S5	1	12.5
	Coding	S3	1	12.5
Week 4	Assembling parts	S1,S3,S5,S6,S8	5	62.5
	Teamwork	S2	1	12.5
Week 5	Assembling parts	S1,S6,S8	3	37.5
	Teamwork	S2,S5	2	25
	Coding	S3	1	12.5
Week 6	Assembling parts	S2,S4	2	25
	Teamwork	S5	1	12.5
	Coding	S1,S3,S6,S7	4	50
Week 7	Assembling parts	S6,S7,S8	3	37.5
	Coding	S1,S2,S3	3	37.5
Week 8	Assembling parts	S6,S7	2	25

	Teamwork	S5	1	12.5
	Coding	S1,S2,S4,S8	4	50
Week 9	Assembling parts	S1	1	12.5
	Bringing parts together	S2	1	12.5
	Teamwork	S5	1	12.5
Week 10	Assembling parts	S2,S3,S4,S5	4	50
	Bringing parts together	S6	1	12.5
	Coding	S5	1	12.5

When Table 2 is examined, it can be seen that in Week 1-10, the students especially stated that they were good at assembling parts, coding, teamwork. For example It can be seen that in Week 2, 62.5% of the students stated that they were good at assembling parts. It can be seen that in Week 4, 62.5% of the students stated that they were good at assembling parts. It can be seen that in Week 6, 50% of the students stated that they were good at coding. It can be seen that in Week 7, 37.5% of the students stated that they were good at assembling parts, and 37.5% of the students stated that they were good at coding. In Week 8, 25% of the students stated that they were good at assembling parts, 50% of the students stated that they were good at coding, and 12.5% of the students stated that they were good at teamwork. It can be seen that in Week 10, 50% of the students stated that they were good at assembling parts and 12.5% of the students stated that they were good at coding. When the table is examined; Some of the most repetitive codes and their rates were as follows: "assembling parts" code generally increased over weeks; there was an increase in the "coding code" code rate in the 1st and 7th weeks, at the same rate in the other weeks; ıt is seen that the "teamwork" code is generally expressed at the same rate.

3.1.4. Self-Assessment Form Findings Related to "Today ……I Think I'm Bad"

In this section, the findings related to the open-ended statement "I think I am bad at……………… today." given to the students are presented as frequency and percentage.

Table 3. *Distribution of Answers Given to the Open-Ended Statement "I think I am bad at……………… today." on Week 1-10*

	Codes	Students	Frequency (f)	Percentage (%)
Week 1	Assembling parts	S1,S2,S4,S5	4	50
	Coding	S3	1	12.5
Week 2	Assembling parts	S4,S5,S6	3	37.5
	Bringing parts together	S3	1	12.5
Week 3	Assembling parts	S3	1	12.5
	Team leadership	S2	1	12.5
Week 4	Assembling parts	S2	1	12.5
	Bringing parts together	S6	1	12.5
Week 5	Assembling parts	S2,S3	2	25
	Bringing parts together	S6	1	12.5
Week 6	Coding	S2,S5	2	25
	Bringing parts together	S4,S6	2	25
Week 7	Coding	S2	1	12.5
	Teamwork	S4,S6	2	25
Week 8	Coding	S6	1	12.5
	Assembling parts	S3	1	12.5
Week 9	Bringing parts together	S6	1	12.5
	Assembling parts	S2,S3	2	25
Week 10	Coding	S2	1	12.5
	Assembling parts	S6	1	12.5

When Table 3 is examined, it can be seen that in Week 1-10, 50% of the students especially stated that they were bad at assembling parts, coding, bringing parts together. For example: It can be seen that in Week 1-2-5-10; 50%- 37.5%- 25% -12.5% of the students stated that they were bad at assembling parts. It can be seen that in Week 1-6-10; 12.5%- 25%-12.5% of the students stated that they were bad at coding. Week 1-6-10; 12.5%-25%-12.5% of the students stated that they were bad at coding. Week 2-4-5-6-9; 12.5%-12.5%-12.5%-25%-12.5%

of the students stated that they were bad at bringing parts together. When the table is examined; Some of the most repetitive codes and their rates were as follows: "Assembling parts" code decreased in weeks; the ratio of the "coding code" code is the same; it is seen that the "bringing parts together" code does not exist in some weeks and is expressed at the same rate in other weeks. It was also noted that the students expressed only two codes for this question.

3.1.5. Student Self-Assessment Form Findings Related to "If I Were to Make The Robot Again We Made Today, I Would Make ……….."

In this section, the findings related to the open-ended statement "If I had to rebuild the robot we are building today, I would do this:………………." given to the students are presented as frequency and percentage.

Table 4. *Distribution of answers given to the open-ended statement "If I had to rebuild the robot we are building today; I would do this:………………." on Week 1-10*

	Codes	Students	Frequency (f)	Percentage (%)
Week 1	Add new parts	S2,S4	2	25
Week 2	Add motor instead of wings	S5	1	12.5
	Have ornaments instead of wings	S4	1	12.5
Week 3	Make chains stronger	S2	1	12.5
Week 4	Add a propeller	S5	1	12.5
Week 7	Make it bigger	S2	1	12.5
Week 8	Make it faster and safer	S2	1	12.5
Week 9	Remove the wings	S4	1	12.5

Examination of Table 4 reveals that 25% of students indicated that they would add new parts; 12.5% of students indicated that they would add an engine instead of wings; 12.5% of students indicated that they would have ornaments instead of wings; 12.5% of students indicated that they would make chains stronger; 12.5% of students indicated they would add a propeller; 12.5% of students indicated they would make the robot larger; 12.5% of students indicated they would make the robot faster and safer; 12.5% of students indicated they would remove wingsWhen the table is examined, it is remarkable that different codes are expressed for a total of seven weeks.

3.1.6. Student Self-Evaluation Form Findings Related to "If I Had to Remake The Robot We Made Today, I Would Add: …………."

In this section, the findings related to the open-ended statement "If I had to rebuild the robot we are building today, I would add these:………………." given to the students are presented as frequency and percentage.

Table 5. *Distribution of answers given to the open-ended statement "If I had to rebuild the robot we are building today; I would add these:………………." on Week 1-10*

	Codes	Students	Frequency (f)	Percentage (%)
Week 1	Add a propeller	S2	1	12.5
	Put flowers and a chain on its head	S3	1	12.5
	Add a few propellers to the back	S4	1	12.5
	Add a ring in the middle	S7	1	12.5
	Add a color sensor	S8	1	12.5
Week 2	Add a sensor	S1	1	12.5
	Add LED and eye	S3	1	12.5
Week 3	Add a propeller	S3,S4,S5	3	37.5
	Add a sensor	S6,S8	2	25
Week 4	Add a propeller	S2,S3,S4	3	37.5
	Add wheels	S6	1	12.5
Week 5	Add a propeller	S5	1	12.5
	Add a motion sensor	S4	1	12.5
	Add a sensor	S6,S8	2	25
Week 6	Add a propeller	S4	1	12.5
	Add a color sensor	S6	1	12.5

When Table 5 is examined, it can be especially seen that in Weeks, 12.5%-37.5% of the students stated that they would add a propeller; 25% -12.5% of the students stated that they would add a sensor; 12.5% of the students stated that they would add a color sensor. The students stated that they would put flowers and a chain on its head; a few propellers to the back; a ring in the middle, LED and eye; wheels; a motion sensor. When the table is examined, it is noteworthy that especially "add propeller" and "add sensor" codes increased from time to time in all weeks.

3.1.7. Student Self-Evaluation Form Findings Related to "If I Had to Remake The Robot We Made Today, I Would Infer:……………"

In this section, the findings related to the open-ended statement "If I had to rebuild the robot we are building today, I would remove these:………………" given to the students are presented as frequency and percentage.

Table 6. *Distribution of answers given to the open-ended statement "If I had to rebuild the robot we are building today; I would remove these:………………." on Week 1-10*

	Codes	Students	Frequency (f)	Percentage (%)
Week 1	Carrying apparatus attached to the chains	S2	1	12.5
	Wings	S4	1	12.5
Week 2	Color sensor	S3,S5,S6	3	37.5
	Wings	S4	1	12.5
	Propeller	S2	1	12.5
Week 3	Wheels	S5	1	12.5
Week 5	Color sensor	S4	1	12.5
	Wings	S5	1	12.5
	Wheels	S6	1	12.5

When Table 6 is examined, it can be especially seen that in Weeks, 37.5%- 12.5% of the students stated that they would remove the color sensor. The students stated that they would remove the carrying apparatus attached to the chains, the wings, the propeller, the wheels. When the table was examined, they stated that comments were made for only 4 weeks and would mostly remove the "wings" code.

3.2. Findings Related to the Teacher Observation Form

This section presents observational data related to the students' ability to assemble the appropriate lego pieces as frequency and percentage distribution.

Table 7. *Distribution of the Study Group wth Respect to Bringing the Appropriate Lego Pieces Together*

		Highly Inadequate	Inadequate	Adequate	Highly Adequate
Week 1	Frequency (f)	0	1	7	0
	Percentage (%)	0	12.5	87.5	0
Week 2	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 3	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 4	Frequency (f)	0	0	5	3
	Percentage (%)	0	0	62.5	37.5
Week 5	Frequency (f)	0	0	4	4
	Percentage (%)	0	0	50	50
Week 9	Frequency (f)	0	0	3	5
	Percentage (%)	0	0	37.5	62.5

When Table 7 is examined, it can be seen that 87.5% of the students were adequate and 12.5% were inadequate on Week 1, 100% were adequate on Week 2, 100% were adequate on Week 3, 62.5% were adequate and 37.5% were highly adequate on Week 4, 50% were adequate and 50% were highly adequate on Week 5, and 37.5% were adequate and 62.5% were highly adequate on Week 9.

Table 8. *Distribution of the Study Group With Respect To Assembling The Appropriate Lego Pieces*

		Highly Inadequate	Inadequate	Adequate	Highly Adequate
Week 1	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 2	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 3	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 4	Frequency (f)	0	0	5	3
	Percentage (%)	0	0	62.5	37.5
Week 5	Frequency (f)	0	0	4	4
	Percentage (%)	0	0	50	50
Week 9	Frequency (f)	0	0	3	5
	Percentage (%)	0	0	37.5	62.5

When Table 8 is examined, it can be seen that 100% of the students were adequate on Week 1, 100% were adequate on Week 2, 100% were adequate on Week 3, 62.5% were adequate and 37.5% were highly adequate on Week 4, 50% were adequate and 50% were highly adequate on Week 5, and 37.5% were adequate and 62.5% were highly adequate on Week 9.

Table 9. *Distribution of the Study Group With Respect ro Placing The Code Block At The Appropriate Place*

		Highly Inadequate	Inadequate	Adequate	Highly Adequate
Week 6	Frequency (f)	0	1	7	0
	Percentage (%)	0	12.5	87.5	0
Week 7	Frequency (f)	0	0	8	0
	Percentage (%)	0	0	100	0
Week 8	Frequency (f)	0	0	7	1
	Percentage (%)	0	0	87.5	12.5
Week 10	Frequency (f)	0	0	6	2
	Percentage (%)	0	0	75	25

When Table 9 is examined, it can be seen that 87.5% of the students were adequate and 12.5% were inadequate on Week 6, 100% were adequate on Week 7, 87.5% were adequate and 12.5% were highly adequate on Week 8, and 75% were adequate and 25% were highly adequate on Week 10.

Table 10. *Distribution of the study group with respect to creating a function*

		Highly Inadequate	Inadequate	Adequate	Highly Adequate
Week 6	Frequency (f)	0	2	6	0
	Percentage (%)	0	25	75	0
Week 7	Frequency (f)	0	0	4	4
	Percentage (%)	0	0	50	50
Week 8	Frequency (f)	0	0	2	6
	Percentage (%)	0	0	25	75
Week 10	Frequency (f)	0	0	1	7
	Percentage (%)	0	0	12.5	87.5

When Table 10 is examined, it can be seen that 75% of the students were adequate and 25% were inadequate on Week 6, 50% were adequate and 50% were highly adequate on Week 7, 75% were highly adequate and 25% were adequate on Week 8, and 87.5% were highly adequate and 12.5% were adequate on Week 10

4. Conclusion and Discussion

The scenarios that form the basis of problem-based learning and scenario-based learning create environments in which the individual can feel himself/herself as part of the situation and feels the need to solve a problematic situation. It is thought that creating such environments for students will significantly contribute to the development of students' high-level thinking skills.

It is thought that it is important to enrich robotic coding training with scenario-based learning to increase their quality and make them solution-oriented. In the study conducted by Bakaç (2014), it was found that scenario-based teaching method was effective in increasing student achievement in mathematics course. In another study, Gülmez Güngörmez et al. (2016) found that students' reflective thinking skills developed through scenario-based learning, academic achievement increased, and there was a positive significant correlation between reflective thinking skills and academic achievement. According to a study by Atmatzidou and Demetriadis (2016), robotic learning activities used for educational purposes improved students' cognitive thinking skills. As a result students reach eventually the same level of CT skills development independent of their age and gender; CT skills, in most cases, need time to develop fully.

In the present study, we aimed to determine whether students can develop solutions to problem scenarios using robotic applications. Answers to the following questions were sought in the present study: What kind of solutions did the students propose to the given problem scenario, whether or not they can draw the robot they intend to design according to the given scenario, whether they could make these robots with the given materials, and how well they could do the coding. When the findings obtained in this study were examined, it was found that although most of the students proposed different solutions to the given scenario, there were also students who proposed similar solutions. When the students were asked to make a drawing of the proposed solution, it was seen that each student turned to only one drawing. This can be interpreted as students drawing the robot they found most reasonable, or the robot they could build most comfortably (Table1). When the answers given to the open-ended statement of "I think I am good at .... today" were examined, it was seen that although the students stated different areas, they were good at, they gave similar or the same answers every week (Table2). This can be interpreted as students focusing on one point only or not think flexibly in creating other and original ideas. Furthermore, some students did not answer the same question. This situation can be interpreted as some students leaving the question blank as they did not think they were good in any area that day.

When the answers given to the open-ended statement of "I think I am bad at .... today" were examined, it was seen that most students left this question blank, and those giving an answer gave similar answers (Table3). Most of the students left this question blank because they did not feel bad in any area that day. It can be interpreted that those who answered the question had similar problems. Examination of the responses to the open-ended question "If I had to rebuild the robot we are building today, I would do so: ...." revealed that while very few students answered the question, the responses varied widely and generally suggested different solutions.We found this to be unique and noteworthy (Table4). This can be interpreted as most students being happy with the robots they built, or students having a difficult time in coming up with different solutions. When the responses to the open-ended statement "If I had to rebuild the robot we are building today, I would add the following: ...." were examined, it was found that students gave different responses each week, which drew attention to fluency and originality, particularly in terms of creative thinking, but it was also found that the number of students responding was small (Table5).This situation can be interpreted as the students not wanting to make new additions to the robot they built or having difficulty in creating different ideas. When the answers given to the open-ended statement of "If I had to rebuild the robot we are building today, I would remove these: ...." were examined, it was found that the majority of students left this field blank. This can be interpreted as students being satisfied with the robot they built, or they may be having difficulty criticizing themselves in terms of creative thinking (Table6).

While the students were building their robots within the given scenario, the researchers observed student behaviors. They made observations on certain skill levels and whether there was a change in these skills throughout the 10 weeks. In this regard, in terms of the research group's ability to assemble the appropriate Lego pieces, it was found that the majority of students were at an adequate level, most students reached a very adequate level by the end of the study, and the inadequate students reached an adequate level.This situation can be interpreted as the students becoming accustomed to the materials and thinking and developing ideas for the scenario as the weeks progress and they use the materials much more easily over time (Table7-8). In the observations regarding the research group's ability to place the code block in the appropriate place, it was found that the majority of the students reached an adequate level at the end of the study despite having difficulties in the first weeks. This situation can be interpreted as students improving themselves over time (Table9).

It is thought that robotic coding applications have positive effects on the success of individuals. In the study of Özer Şanal and Erdem (2017), it was found that the problem solving processes of the students who performed coding and robotic applications were much better. In Cappelleri and Vitoroulis (2013) study, a series of project-based robotics labs constituting a Robotic Decathlon for an introductory robotics course have been developed, presented, and implemented. The course assessment showed that the three one-week-long final project tasks turned out to be very successful in allowing the students to keep pace with them.

An interesting finding obtained in this study was that students had difficulty creating a function and that this problem persisted in most of the students at the end of the study. This can be interpreted as students either could not comprehend the logic of functions or could not apply it.

As a result of the research, it was seen that students could approach differently to the scenarios, create different solutions and design their robots. Creativity involves both scientificity and daily life (Farooq, 2008). Blanchard, Freiman and Lirrete-Pitre (2010) conducted several in-class observations and interviews. Two teams were asked to solve one robotics-based task and think explaining what they were doing and why. In this study, it was seen that critical thinking emerged. In the study of Tol (2018), it was found that scenario-based learning method changes students' perceptions of achievement, self-efficacy, and critical thinking tendencies. In the study of Yaman (2005), it was found that scenario-based learning had a positive effect on students' reading comprehension. According to the research conducted Bers, Flannery, Kazakoff, & Sullivan (2014); It demonstrates that kindergartners were both interested in and able to learn many aspects of robotics, programming, and computational thinking with the Tangible K curriculum design. Also according to Chou's (2018) study; It investigated elementary school students' learning performances and behaviors in a maker education program. Students in the maker group received weekly educational robotics lessons. In contrast, those in the nonmaker group only engaged in other after-school learning activities such as homework practice in traditional classrooms. The findings revealed that maker education training significantly improved students' engineering and computer programming content knowledge and improved their problem-solving skills. Also Varnado's (2005) study investigated the effects of a technological (robotic) problem solving activity, specifically 9-14 year old student participants showed significant increases in confidence, overall technological problem solving styles, problem clarification, developing a design, evaluating a design solution, and overall technological problem solving performance in only eight weeks.

As a result of the research, it has been observed that robotics applications positively affect scenario-based problem-solving. In this study, it was found that although most of the students proposed different solutions to the given scenario, there were also students who proposed similar solutions. At the end of the study, students had very different approaches to the scenarios and students designed some robots.

5. Recommendations

Limitation of the study: it could be applied to more students with more Lego pieces. Since our results were obtained through a study in a private school, it is recommended that similar studies be conducted in public schools. More studies should be conducted on problem scenarios with robot coding, and more studies can be conducted on both student profile and teachers.

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