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Research Article

The Effect of Robotic Coding (Mblock - Arduino) Activities on Students' Self-efficacy and Attitudes

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Abstract

The purpose of this study is to determine the effect of robotic activities (mblock - arduino) on students' attitudes towards coding and their self-efficacy. Within the scope of the study, 14-week robotic coding activities were planned, followed by 43 8th grade students. Qualitative research method was used in this study. In order to collect the research data, self-proficiency perception scale for block-based programming and robotics attitude scale were applied as pre-test and post-test. For dependent samples, t-test was applied and analyses were performed. According to the findings of the study, there was a significant increase in students' positive attitudes towards coding, and students' self-efficacy for coding. Robotic coding (mblock- Arduino) trainings were given and activities were made within the scope of these trainings. 5 activities related to robotic coding were performed. mBlock- Arduino for robotic coding and Fritzing programs for circuit diagram were taught. According to the findings of the research, after teaching programming with robotic coding activities, there was a significant increase in students' positive attitudes towards coding, students' self-efficacy for coding, and students' permanent learning.

Keywords: Robotic Coding Activities; mBlock-Arduino; Robotic Coding Efficacy; Robotic Attitude

Introduction

Interest in robotics and coding in education and industry has increased quite rapidly over the past few years. Societies that want to produce high-tech products are planning investments in the field of robotics and coding. Undoubtedly, education investments for children, who are the future of societies, come first among these investments. In this direction, it is seen that various robotic coding activities are getting popular in educational environments [6]. There are increasing attempts to develop an educational system aimed at educating individuals with 21st century skills. STEM (Science (S), Technology (T), Engineering (E) and Mathematics (M), which embodies education initiatives with real interdisciplinary concrete practical activities to find solutions to daily life problems (in different disciplines, coding, robotic coding and smart device design activity examples are encountered in various sizes) can be given an example. In developed countries, efforts are made to start programming education at an early age in order to make children love coding. Many states require coding education when children come to school [9,10,12,13]. Thanks to STEM-based educational programs, children are becoming more interested in these areas while developing their analytical thinking abilities. According to the results of a study, it was found that there is a significant positive correlation between creative problem solving skills and performance scores of students engaged in robotic coding [4,11,13].

The changes that Industry 4.0 brings determine the skills that individuals should have in the 21st century society. Predictions about rapidly changing world lead to an increase in studies on the skills of 21st century. The lack of studies and projects on robotic

coding education in Turkey indicates that Turkey needs to increase its efforts to strength its position in robotic coding education and academic research [1,14,22].

Robotic coding activities enable students to observe how the code they have written can work with hardware. Therefore, many educators prefer the way to diversify the teaching of programming with such hardware supports. Thanks to robotic coding activities, a teaching environment is offered in which the working logic of both smart devices and the internet of things can be understood. Block-based visual programming environments have been developed by many organizations and institutions in order to minimize these negativities and to facilitate programming learning. The benefit of Mblok Arduino logic is that students can focus only on design and production without having to remember command names or codes, without encountering code typos [12,14].

Robotic coding with mBlock

Thanks to its block-based structure, it provides the ability to Decode blocks of code by drag-and-drop and develop simple games without knowing any programming languages. Nowadays, when coding training starts from kindergarten, the Scratch-based mBlock program, which allows you to code like combining Legos with a drag-and-drop method, is one of the most preferred programs for STEM education. Various games and animations can be done with the mBlock program, as well as Makeblock kits and Arduino cards can be encoded. Arduino, on the other hand, is a low-cost electronic board that visualizes the algorithm we design in our minds and on the computer. It is possible to realize many projects with the Arduino board, which is highly popular and quite easy to use. Programming with Arduino is an ideal method to understand the working principle before transitioning to robotic applications. Students program with block-based or text-based visual programming tools when coding robotics. During programming, robots are enabled to interact with the environment by using various sensors such as sound, color, touch, infrared. Thus, students can also develop original robotic coding projects that can perform different functions in accordance with the goals they have set. According to the literature, robotic coding activities benefit students ' creative thinking, critical thinking, teamwork, problem solving, scientific process, decision-making and self-confidence [5,7,18,19]. It is the ones raised by the Mblock Arduino to be grown at younger ages and to be straightened, to explain the obtained groupings and to be disseminated. Mblock Arduino, which brings together education and training plans and information technology experts, reveals to reveal a policy evaluation in accordance with pedagogical foundations of education in Turkey as well as all over the world.

Research problem

How is there a change in students' perception of self-efficacy related to coding with robotic coding (Mblock Arduino) training? How is there a change in the attitude of students about robotic coding (Mblock Arduino) training? How are the students' experiences related to robotic coding (Mblock Arduino) activities?

Research questions

- Is there a significant change in students' self-efficacy perceptions of robotic coding after robotic coding (Mblock Arduino) activities?
- Is there a significant change in the attitude of students to robotic coding after robotic coding (Mblock Arduino) activities?

Methods

In this study, quantitative research method was used. Quantitative research method; Quantitative research is a type of research that can objectify the events and phenomena, make them observable, measure, and express them numerically. For quantitative data, T-Test was applied for dependent samples. The dependent t test is a parametric technique used to test the significance of the difference between two averages obtained from two related samples.

Sampling

43 students from 8th grade participated in the research.

Data collection tools

Self-proficiency perception scale for block-based programming

The scale was developed by Kasalak [15]. The scale consists of 12 items. The aim of the scale is to determine whether robotic coding activities at secondary school level has any significant effect on students' self-efficacy perceptions. Responders specify their level of agreement to a statement in five points: (1) Strongly untrustful; (2) Untrustful; (3) Neutral; (4) Trustful; (5) Strongly trustful.

Robotics attitude scale

Robotics attitude scale was developed by Şişman and Küçük [21]. The scale consists of 24 items. The aim of the scale is to determine secondary school students' attitudes towards robotics. Responders specify their level of agreement to a statement in five points: (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree.

Analysis of the data

In terms of data analysis, paired sample t-test was used in the SPSS 21 program. Histogram graphs and the Kolmogorov-Smirnov value were evaluated to determine whether the data show a normal distribution. It was determined that the scale scores provided the normal distribution. Then, the means and standard deviations were evaluated. In the statistical evaluation of the study, paired samples t-test was used. In the statistical evaluation of the study, paired samples t-test was used. According to pre-test and post-test results, there was a significant difference in intra-group. According to pre-test and post-test results, there was a significant difference in intra-group.

Application

In this study, a STEM-based education program using robotic coding activities which make the educational process fun, simple and efficient were implemented. The content of this prepared program lasted for a total of 56 hours, including 14 weeks and (2 +2) hours every week. In the robotic coding activities conducted within the scope of STEM-Based education, Mblock Arduino and Fritzing programs were taught. In this study, a pretest, posttest single-group (without a control group) experimental research design was used. A brief summary of the application on STEM activities with robotics programming is given below and the work schedule is shown in table 1.

A brief summary of the application

- The level of readiness of students about STEM-based education and robotic coding was measured. Detailed information about STEM-based training on Mblock Arduino activities was given.
- The Mblock Arduino program, which will be used in STEM-based activities with robotic coding, has been explained to students in detail in the second and third week.
- In the fourth week, the Friztzing program for drawing the circuit diagram of the activity made with Mblock Arduino was explained to the students in detail.
- Then five activities were made. In two weeks, 5 activities related to Mblock Arduino and 5 activities related to Fritzing program were made.

Week	Subject
1. Week	STEM Based Education
2. Week	Robotic Coding; Introduction of Mblock Arduino Program
3. Week	Robotic Coding; Introduction of Mblock Arduino Program
4. Week	Robotic Coding Circuit diagram; Introduction of Fritzing Program
5. Week	Robotic Coding Mblock Arduino First Application; Led Lighting
6. Week	Fritzing First Application; Led Lighting
7. Week	Robotic Coding Mblock Arduino Second Application; Buzzer (sound) production with button
8. Week	Fritzing Second Application; Buzzer (sound) production with button
9. Week	Robotic Coding Mblock Arduino Third Application; Distance measurement with HC SR04 distance sensor
10. Week	Fritzing Third Application; Distance measurement with HC SR04 distance sensor
11. Week	Robotic Coding Mblock Arduino Fourth Application; Starting servo motor with potentiometer
12. Week	Fritzing Fourth Application; Starting servo motor with potentiometer
13. Week	Robotic Coding Mblock Arduino Fifth Application; Temperature measurement with LM35
14. Week	Fritzing Fifth Application; Temperature measurement with LM35

Table 1: The Weekly Program of Robotic Coding Activity.

Figure 1: Led lighting.

Figure 2: Buzzer (sound) production with button.

Figure 3: Distance measurement with HC SR04 distance sensor.

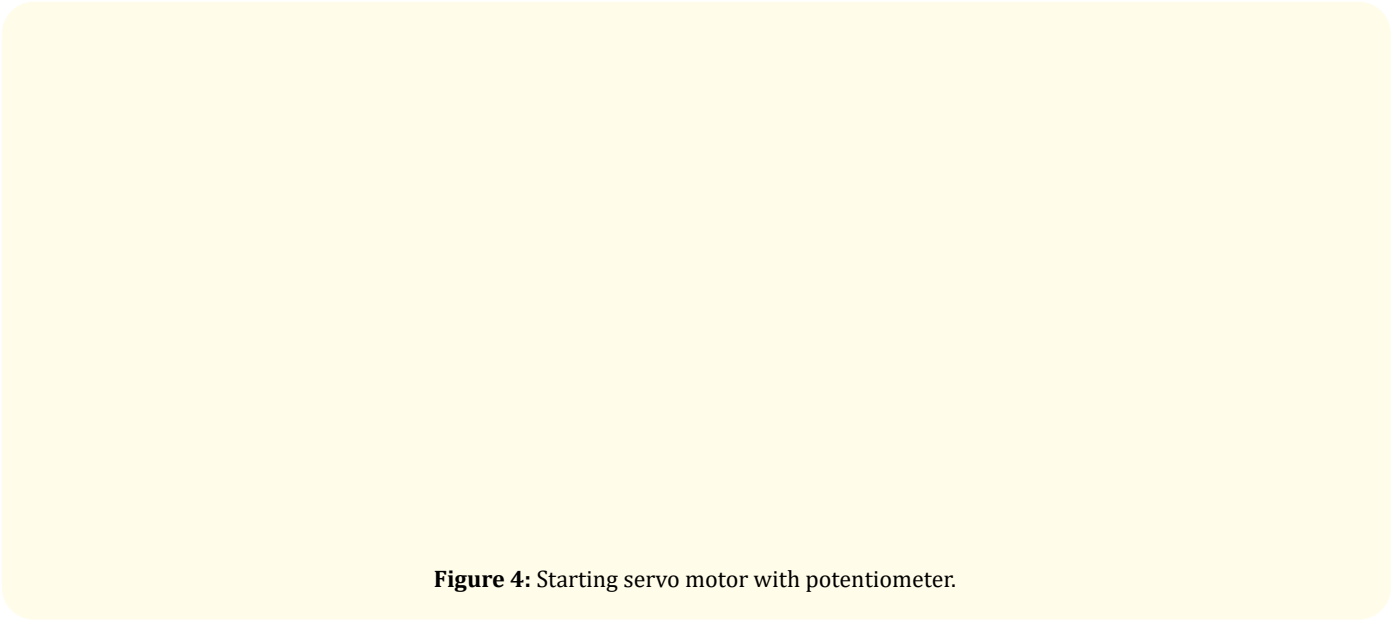

Figure 4: Starting servo motor with potentiometer.

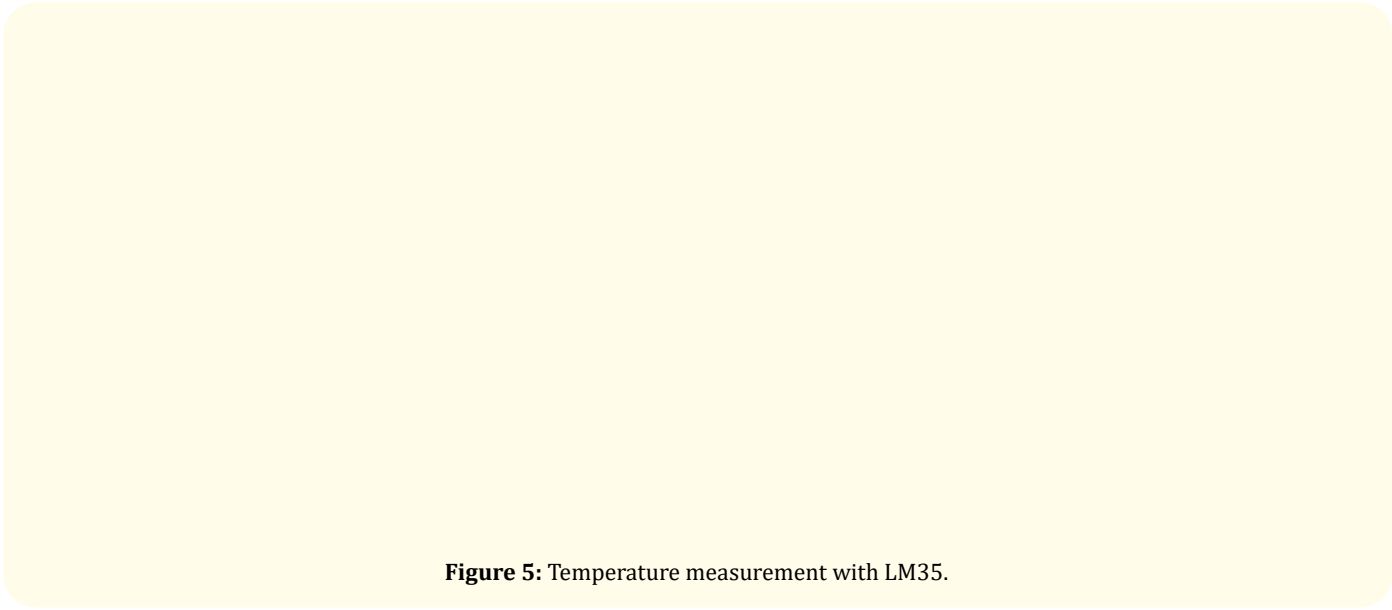

Figure 5: Temperature measurement with LM35.

Findings

In this study, the effect of robotic activities (mblock – arduino) on students' attitudes towards coding and their self-efficacy was analyzed.

	$\bar{x}$	n	ss	sh_x
Pretest	61.13	43	6.13	.88
Posttest	73.52	43	6.36	.94

Table 2: Students' Self-Efficacy (Dependent Samples T-Test).

According to table 2, it is seen that there is a difference between pretest and posttest scores ($\bar{X}_{pretest}$ = 61.13 ve $\bar{X}_{posttest}$ = 73.52) in favour of protest score.

As a result of the dependent samples t-test analysis in table 3, there is a statistically significant increase in the students' self-efficacy; t(43) = -9.64, p = 0,00). Based on the findings, it can be concluded that robotic coding (mblock – arduino) activities have a positive effect on the students' attitudes.

	$\bar{x}$	ss	sh_x	Lower	Upper	t	df	p
Pretest-Posttest	-9.21	6.23	0.94	-9.97	-7.52	-9.64	43	0.000

Table 3: Students' Self-Efficacy (Dependent Samples Test).

	$\bar{x}$	n	ss	sh_x
Pretest	70.11	43	6.32	.85
Posttest	83.22	43	6.47	.94

Table 4: Robotic Attitude (Dependent Samples T-Test).

According to table 4, it is seen that there is a difference between pretest and posttest scores ($\bar{X}_{pretest}$ = 70.11 ve $\bar{X}_{posttest}$ = 83.22) in favour of protest score.

	$\bar{x}$	ss	sh_x	Lower	Upper	t	df	p
Pretest-Posttest	-9.37	6.46	0.94	-9.95	-5.32	-9.64	43	0.000

Table 5: Robotic Attitude (Dependent Samples Test).

As a result of the dependent samples t-test analysis in table 5, there is a statistically significant increase in the students' robotic attitude; t(43) = -9.64, p = 0,00). Based on the findings, it can be concluded that robotic coding (mblock – arduino) activities have a positive effect on the students' attitudes.

Discussion

After the robotic coding activities, according to pre-test and post-test paired samples t-test results of the students, there was a significant change in the self-efficacy perception scores of block-based programming in positive direction. This result is similar to the findings of Kasalak [15]. According to the pre-test data analysis findings, the self-efficacy perception test scores of the students related to block-based programming were found that no significant difference was observed according to computer ownership at home, Internet connection ownership at home and the possibility to study mblock Arduino program out of course. The findings indicate that there is no significant difference in the pre-test scores of the individuals in the research group according to various variables. According to these findings, it can be determined that students' readiness levels were similar and did not have a detrimental effect to lead further changes in the self-efficacy perceptions related to block-based programming. The results of this study are similar to the findings of Rusk [20].

According to the results of the analysis, it was determined that there was a significant change in the self-efficacy perception scores of block-based programming in positive direction. Korucu and Taşdöndüren [17] revealed that the attitudes of secondary school students towards robotic coding change in positive direction. Similarly, Kırkan [16] found that robotic coding education positively improves the attitudes of gifted middle school students. Şişman and Küçük [21] obtained similar results. In the study, it is seen that the robotic attitude levels of middle school students increase together with robotic coding activities. Accordingly, it was found that the anxiety of middle school students about robotic coding decreased. Participants had a fun time thanks to robotic coding activities. Yang, Wong and Dawes [23] stated that robotic coding helps students develop a positive attitude. On the other hand, it has been stated that robotic coding activities are fun and interesting for students and that they show a positive attitude towards coding activities Kasalak [15], Baz [2], Göksoy and Yılmaz [8].

Conclusions

As a result, in this study, the effect of robotic coding (Mblock-Ardunio) activities on secondary school students' self-efficacy perceptions and robotic attitudes was examined and it was concluded that students' anxiety about robotic coding decreased and that students' self-confidence increased when their time was productive and enjoyable. Thanks to robotic coding, students can learn easily, and their desire to learn increases. According to these results, it can be said that robotic coding activities will contribute to the development of students in many ways. In addition, the

effect of robotic coding teaching on students' problem solving, entrepreneurial skills and creativity in an environment designed in future studies can be tested experimentally. Students can easily use the mblock arduino program in any robotic coding project designed. It is seen in the results that the students have reached this level.

Suggestions

- The widespread use of robotic coding applications in different teaching programs
- It is thought that robotic coding can be effective on students' scientific thinking skills, as they will be realized with different disciplines.
- Teaching robotic coding to students in this age category will have a great impact on future career choices in the field of information technologies.
- Making interdisciplinary robotic supported education projects using different robotic technologies.
- Developing algorithmic, creative and versatile thinking skills of students taking the robotics and coding course.

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