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INVESTIGATION OF THE EFFECT OF ROBOTIC APPLICATIONS IN ELEMENTARY EDUCATION

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ABSTRACT: In this study, it was aimed to investigate the effect of robotic applications of 7th grade students on their attitudes towards Science Process Skills and Science-Technology-Engineering-Mathematics (STEM). The research group of the study consists of a total of 20 7th grade students in the academic year of 2005-2016. In the study, "Science Process Skills Test" and "STEM Attitude Test" and "Personal Information Form" were used to collect data. In the analysis of the data obtained, t-test, analysis of variance, mean and standard deviation calculations were used to evaluate scientific process skill levels of the students and STEM Attitude Test data. The data obtained from the study will be analyzed with SPSS and the results will be discussed.

Key words: Elementary education, robotic, science process skills

INTRODUCTION

Developing science and technology in all areas requires technology to be used in the education system (Özmen, 2004). According to Cameron (2005), considering the science and technology education in the world, there is a new technological area so-called Robotics that can provide great convenience in data acquisition, laboratory observations in especially science and technology education (Koç Şenol, 2012).

Countries providing conscious and systematic training of Robotics use legos. Legos turn building, design and programming development process of students into more fun, educational and collaborative activities (Yalçın, 2012). In this regard, legos are powerful materials that can be used to entertain students and attract their attentions. Therefore, motivation of teachers will be increased with improved success of students (Marulcu and Sungur, 2012). A learning environment supported with lego-logo is found to have very positive effects on the scientific process skills and self-perception of students (Çayır, 2010). In the learning environments created with lego robot kits, students think about problems, formulates the results, reach the information and search for answers of the problems (Özdoğru, 2013).

Considering the literature related to STEM applications, Ricks (2006) states that there is a significant improvement in the attitudes of students towards science after receiving STEM education in the science camp, Yamak, Bulut & Dündar (2014) state that STEM applications positively improve attitudes of 5th grade students towards science, Freeman, Alston & Winborne (2008) indicate that STEM education improves attitudes of undergraduate students towards science and mathematics.

In this study, the following questions are tried to be answered in order to investigate attitudes of 7th grade students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM):

- What is the effect of robotics application on the attitudes of 7th grade students towards Science-Technology-Engineering-Mathematics (STEM)?
- What is the effect of robotics application on the Scientific Process Skills of 7th grade students?

METHOD

The aim of this study was to investigate the effects of robotics applications on the attitudes of 7th grades students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM). The study was carried out as a single group pretest-posttest experimental design. One group pretest-posttest experimental design is one of the weakest experimental designs.

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Scientific Process Skills Test and STEM Attitude Test was administrated on students prior to the study. The study lasted for 20 hours in 3 stages. First, Lego Mindstorms Education EV3 Robotics Education Sets, which will be used in Robotics course and activities along with presentations and videos, were introduced to the students. In the second stage, they were informed about the use of robotic programming interface. In the last stage, teachers were asked to design a robot by using lego parts and perform various activities such as moving robot forward-right and make right-left turns by programming, moving car forward without crashing the obstacles by using some sensors and tracking the black line. At the end of these applications, Scientific Process Skills Test and STEM Attitude Test was administrated on students as the post-test.

Sample

In this study, it was aimed to investigate the effects of robotics applications on the attitudes of 7^{th} grades students towards Scientific Process Skills and Science-Technology-Engineering-Mathematics (STEM). The study group consists of a total of 20 7^{th} grade students including 10 girls and 10 boys in the academic year of 2015-2016.

Instrument

In the study, "Scientific Process Skills Test", which was developed by Okey, Wise and Burns (1985) and translated into Turkish by Özkan, Aşkar and Geban (1992) and "STEM Attitude Test", which was developed by Faber et al. (2013) and translated into Turkish by Yıldırım and Selvi (2015) and "Personal Information Form" were used to collect the data.

Data Analysis

The data obtained in this study were analyzed by using SPSS (Statistical Package for Social Sciences) for Windows 22.0. Mean and standard deviation were used as descriptive statistical methods in the evaluation of data. Wilcoxon signed rank test was used to determine the difference between the pre-test and post-test results. Spearman correlation analysis was performed between continuous variables of the study. The findings obtained were evaluated with a confidence interval of 95% and significance level of 5%.

FINDINGS

In this section, statistical operations on the data obtained from the data collection instruments used in the study were performed and the results are given in tables.

Table 1. Wilcoxon test results related to test pretest and posttest scores of students received from scientific process skills test

	Mean	N	Std. Deviation	z	p
Pretest	13,2	20	2,44	-3,52	0,00
Posttest	17,25	20	2,26		

As it can be seen in Table 1, there is a significant difference between pretest and posttest scores of students received from scientific process skills test ($z = -3.52$, $p = 0.00 < 0.05$). The average pretest score of students was found to be 13.2, while the average posttest score was 17.25, respectively. Therefore, it can be suggested that robotics activities contribute positively to the scientific process skills of students.

Table 2. Wilcoxon test results related to test pretest and posttest scores of students received from STEM attitude test

Sub-Dimensions of the Test	Pretest		Posttest		N	Z	p
	Mean	Sd	Mean	Sd			
Mathematics	4,19	0,83	4,54	0,55	20	-2,57	0,01
Science	4,27	0,56	4,44	0,63	20	-2,28	0,02
Engineering	4,44	0,47	4,47	0,86	20	-1,85	0,06
Skills of 21^{st} Century	4,51	0,48	4,46	0,74	20	-0,32	0,75

As it can be seen in Table 2, the difference between average scores received from pretest-posttest of mathematics sub-dimension was found to be statistically significant ($Z = -2.57$, $p = 0.01 < 0.05$). The average pretest score is ($x = 4.19$) smaller than the average posttest score ($x = 4.54$). In the science sub-dimension, the difference between average scores received from pretest-posttest was found to be statistically significant ($Z = -2.28$, $p = 0.02 < 0.05$). The average pretest score is ($x = 4.27$) smaller than the average posttest score ($x = 4.44$). In this

context, it can be said that robotics activities have a positive impact on the attitudes of students towards mathematics and science. The difference between average scores received from pretest-posttest of engineering and skills of 21st century sub-dimensions was found to be statistically significant (p>0.05).

Table 3. Spearman's rho correlations coefficients between scientific process skills test (SPS) and STEM attitude test

		SPS-Pretest	SPS-Posttest
Mathematics-Pretest	r	-0,122	0,661**
	p	0,608	0,002
Mathematics-Posttest	r	0,015	0,612**
	p	0,950	0,004
Science- Pretest	r	-0,010	0,502*
	p	0,966	0,024
Science-Posttest	r	-0,063	0,520**
	p	0,791	0,019
Engineering-Pretest	r	-0,237	0,303
	p	0,314	0,194
Engineering-Posttest	r	-0,165	0,280
	p	0,486	0,232
21st Cen. Skills-Pretest	r	-0,130	0,349
	p	0,585	0,132
21st Cen. Skills-Posttest	r	-0,076	0,427
	p	0,752	0,060
SPS-Pretest	r	1,000	0,032
	p		0,894
SPS-Posttest	r	0,032	1,000
	p	0,894	
*p<0,05			

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension pre-test results of students (r=0.661, p=0.002 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension post-test results of students (r=0.612, p=0.004 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and science sub-dimension pre-test results of students (r=0.502, p=0.024 <0.05).

There is a moderate level, positive and significant relationship between SPS posttest results and science sub-dimension post-test results of students (r=0.520, p=0.019 <0.05).

CONCLUSION

In this study, which was conducted to investigate the effects of robotics applications on the attitudes of 7th grades students towards Science Process Skills and Science-Technology-Engineering-Mathematics (STEM), the data analyzed show that robotic applications have positive effects on the scientific process skills of students (z=-3.52, p=0.00<0.05). These results are consistent with results of (Sullivan, 2008; Çayır, (2010); Çavaş et al. (2012); Koç Şenol (2012); Koç Şenol and Büyük, (2013)) the earlier studies in the literature.

In the study, attitudes of students receiving robotics applications education towards mathematics and science were found to be significantly improved. This result is consistent with earlier studies about development of attitudes of students towards mathematics in the literature (Saad, (2014); Freeman, Alston and Winborne, (2008); Naizer, Hawthorne and Henley, (2014); Gülhan and Şahin (2016); Vollstedt, (2005)), while the attitude development of students towards science is consistent with the results of (Naizer, Hawthorne and Henley, (2014); Ricks, (2006); Yamak, Bulut and Dündar, (2014); Freeman, Alston and Winborne, (2008)) in the literature. According to the data analyses, no significant improvement was observed in the sub-dimensions of engineering and 21st century skills.

There is a moderate level, positive and significant relationship between SPS posttest results and mathematics sub-dimension pre-test results (r=0.661, p=0.002 <0.05), mathematics sub-dimension post-test results (r=0.612,

p=0.004 <0.05), science sub-dimension pre-test results (r=0.502, p=0.024 <0.05) and science sub-dimension post-test results of students (r=0.520, p=0.019 <0.05).

As a result, since robotics applications have positive effects on the scientific process skills and attitudes of students towards mathematics and science, schools should provide activities related to robotics applications.

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