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The Effect Of Robotic Coding Training Given In Private Schools On The Self-Efficacy Perceptions Of Students' Computational Thinking Skills

Agâh Tuğrul KORUCU
Necmettin Erbakan University, Ahmet Keleşoğlu Faculty of Education, Computer and Instructional Education Department,

akorucu@erbakan.edu.tr

ORCID: https://orcid.org/0000- 0002-8334-1526

Mine ÜNÜVAR
Necmettin Erbakan University, Ahmet Keleşoğlu Faculty of Education, Computer and Instructional Education Department,

mine.unuvarr@gmail.com

ORCID: https://orcid.org/0000-0001-5624-1055

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ABSTRACT

This research aimed to determine the self-efficacy perceptions of computational thinking skills of the students studying in private school. In the study, a quantitative research method was adopted and the descriptive survey model was used. The study group consists of 223 students from two different private schools that continue their education in Konya in the fall semester of the 2019-2020 academic year. "The Perception Scale of Self-Efficacy for Computational Thinking Skill" adapted to Turkish by Gülbahar, Kert, and Kalelioğlu (2019) was used to gather personal information as a data collection tool, to demonstrate the demographic information form developed by the researchers and the computational thinking skills of the study group in the research." Descriptive statistics were used to analyze the data and t-test was used for unrelated samples. In line with the data obtained from the research, it was found that there was no significant difference in the self-efficacy perception of computational thinking skill in terms of gender, having a computer at home, and having internet access, while there was a significant difference between the self-efficacy perception of computational thinking and robotic coding lesson. Besides, it was concluded that there was a significant difference among the opinions regarding robotic coding education increasing the success level in other courses.

Introduction

In the development of individual talents, which is also called the 21st century talents that the digital world expects from individuals along with the developing technology, the biggest task that falls in the education and training field is the acceleration of compliance to the integration process of developing technologies and the development of knowledge, skill and attitude levels of technological literacy, information processing thinking skills and technology usage in the individuals' integration process (Ananiadou & Claro, 2009). It is aimed for individuals to learn to use other technological tools effectively together with computers in computer lessons starting from primary school age (Çelik, 2019).

In the 21st century, students must be individuals with problem solving, analytical and critical thinking, production, and high communication skills (Akpınar & Altun, 2014). However, the fact that traditional education methods are book-based, teacher-centered, and students are reluctant to learn abstract subjects cause less participation and less motivation in class (Çelik, 2019).Therefore, education should be carried out in environments where students can participate actively and learn by living by doing. It is thought that robotic coding trainings given in schools provide students with many 21st century features such as problem solving, reflective and creative thinking, collaborative work (Grout & Houlden, 2014; Konyaoğlu, 2019).

The concept of coding is educationally based on 50-60 years ago (Tağci, 2019). Countries that want to keep up with rapidly developing technology are also increasing their studies on developing computer science curriculum so that the growing generation can progress with this awareness (Angeli, Voogt, Fluck, Webb, Cox, Malyn-Smith & Zagami, 2016). Countries such as the UK, Canada, Ireland allocate high budgets to teach computer science, Japan, Argentina, Malaysia, Ireland, South Korea and Sweden offer programming training for the entire K12 level. Many countries, especially Australia, Estonia, Finland, Greece, Ireland, Israel, Lithuania, New Zealand, Romania, South Korea, England and Vietnam, provide coding education for all students at primary level within the scope of computer education (Code.org, 2017). In our country, curriculum arrangements are made and developed for primary and secondary schools (Code.org, 2017). In our country, 5th and 6th graders take Information Technologies and Software lessons twice a week (Talim ve Terbiye Board, 2018). In total, there is a Problem Solving and Programming unit that will last 18 weeks in a 37-week education and training period. This situation shows that students are aimed to develop their problem solving skills by taking coding training along with basic computer knowledge, to approach problems from different perspectives, and to gain creative and critical thinking skills (Yükseltürk & Altıok, 2015).

In our country, tools such as "Alice", "Scratch", "Code.org" are used in robotic coding education. In these tools, the code line can be created with drag and drop methods and the coding logic is shown to the student with simple steps (Konyaoğlu, 2019). Visual coding programs such as Scratch also help to think in computers (Brennan & Resnick, 2012). These block-based tools enable even individuals who do not have programming knowledge to develop programming and increase the interest in programming (Al-Jarrah, 2016).

Robotic coding education in schools basically allows students to code themselves and develop their own games and animations without the need to learn complex program language structures in detail (Resnick et al., 2009). Robotic coding sets; With its features such as improving visual programming, being inexpensive and having a clear technology (distance, sound, light, contact sensors etc.), is important among educational tools that can be used in the classroom environment (Çelik, 2019). By using robotic sets, coding ability can be provided to students from preschool age (Tekinarslan & Çetin, 2018). While robotic kits reached high costs in the first years of use, they have become more convenient and accessible tools today (Çelik, 2019). Developed by Lego Wedo, Lego Mindstorms, Makeblock, mBot is among the widely used robotic kits (Çelik, 2019). In the literature review, it was seen that in the trainings given with robotic kits, students actively participate in the learning process by seeing the kits as toys and this situation increases the scientific creativity and scientific process skills of the students, improves their problem solving skills, and positively develops their thoughts about the robot-human and society (Alimisis, 2012; Cavas et al, 2012; Mauch, 2001).

Robotic coding education and robotic kits are not only limited to computers and informatics, but are also related to different disciplines. Robot parts (engine, sensor, coding) are also related to different disciplines such as engineering and electronics (Ebelt, 2012). The 21st century, in which young people also have information processing thinking skills to use informatics and information and communication technologies with such professions. skills should also be available (Tutulmaz, 2019). Computational thinking skills are also among the 21st century skills.

Computational thinking skill is defined as the ability to understand how computers are used to solve problems, organize and analyze data, and use computers to produce effective solutions (Computer Science Teachers Association, 2011). Computational thinking skills are generally accepted as problem solving skills or higher level thinking skills that are accepted as its lower step (Üzümcü, 2019). In addition, computing thinking skills can be used to solve problems in social and physical sciences, mathematics and all other fields besides computer applications (Education, 2019).

When the studies on computational thinking skill and robotic coding are examined in the literature, many studies are encountered. In his doctoral thesis study, Yolcu (2018) investigated the effect of robotics use on computing thinking in programming. He conducted his research with a mixed method and 47 students studying in 6th grade in a 14-week period. At the end of the process, it has been reached that programming education increases students' computing thinking skills. In addition, data were obtained that robotic coding had no effect on computational thinking skills. In another master's thesis, the effects of trainings given by scratch application and robotics application on computational thinking and academic success were compared (Şimşek, 2018). According to the data obtained as a result of the research, no significant difference was found between the effects of the two forms of education. Konyaoğlu (2019), in his master's thesis, investigated the effect of robotics education on problem solving skills of middle school students and their opinions on robotic activities. 26 students participated in the study, which was carried out using a mixed method. As a result of the research, it was seen that robotics education had a positive effect on students' problem solving skills. In addition, it was concluded that students developed positive thoughts about robotics as a result of the activities. Most of the research involves secondary school students studying at public schools and qualitative measurement research tools are used along with quantitative measurement tools. In this research, the current situation in private schools will be investigated by using descriptive screening model, which is one of the quantitative research methods.

Therefore, the purpose of this study is to investigate the effect of robotic coding education given in private schools on students' computational thinking skills. In this context, the sub-research questions that direct this research are:

1. Are the students' computational thinking skills self-efficacy perceptions meaningful by gender?
2. Are the students' computing thinking skills self-efficacy perceptions meaningful according to the availability of computers at home?
3. Do the students' computational thinking skills self-efficacy perceptions make sense according to their internet access status?
4. Do the students' computational thinking skills self-efficacy perceptions make sense according to their robotic coding education?
5. Is there a significant relationship between the thoughts of robotic coding education to increase students' success levels in other courses?

Method

In this research, descriptive scanning method, one of the quantitative research methods, was used. The studies carried out to describe the characteristics of the phenomenon studied are descriptive studies (Fraenkel, Wallen & Hyun, 2012). In screening models, researchers are interested in how thoughts and features are distributed to individuals rather than why they occur (Fraenkel et al, 2012).

Study Group

The study group of the study consisted of 176 students in the 5th and 6th grades studying in a private school that provides robotic coding training and 47 students in the 5th and 6th grades in a private school that does not teach robotic coding. In the study in which 223 students participated in total, data on students' gender, computer availability at home, internet availability, robotic coding education status, and their interest in robotic coding outside school are given in Table 1.

Table 1. Students' demographic information (n = 223)

Variable	Group	Frequency	%
Gender	Female	108	48,4
	Male	115	51,6
	Total	223	100
Computer availability at home	Yes	177	79,4
	No	46	20,6
	Total	223	100
Internet availability	Yes	213	95,5
	No	10	4,5
	Total	223	100
Robotic coding training status	Yes	176	78,9
	No	47	21,1
	Total	223	100

When Table 1 is analyzed, it is seen that 22.4 students in total participated in the study, 48.4% (n = 108) were female students, 51.6% (n = 115) were male students. It is seen that 79.4% (n = 177) of the students have a computer at home and 20.6% (n = 46) do not have a computer. It is seen that 95.5% (n = 213) of the students have internet access and 4.5% (n = 10) do not have internet access. While 78.9% (n = 176) of the students receive robotic coding training, 21.1% (n = 47) do not receive robotic coding training.

Data Collection Tools and Analysis

In accordance with the objectives of the research, the "Self-Efficacy Perception for Computing Thinking" scale, which was adapted according to the Turkish education system by Gülbahar, Kert and Kalelioğlu (2019), was used for secondary school students. The scale consists of 36 questions developed as 3-point Likert (1-Yes, 2-Partially, 3-No) type in order to be suitable for the students' level of development. It consists of 5 sub-sections as algorithm design competence (9 items), problem solving ability (10 items), data processing competency (7 items), basic programming competence (5 items), self-confidence (5 items). The total reliability coefficient of the scale was .943. Kaiser Meyer Olkin coefficient was .966 and Bartlett test significance level was found as <.05.Correlation matrix values above .30 were reached.

In addition, personal information form was used to reach demographic information of the students in the study group. In the personal information form, questions were asked and demographic information was obtained to determine what students think about gender, whether they have computers at home, internet access, and whether robotic coding improves success in other courses.

Data Analysis

In the research, an investigation was made on the collected forms. As a result of the examinations, no missing or inaccurate scale was found and transferred to the computer before analysis. The data transferred to the computer was analyzed with the statistical program. In the analysis of the data, the level of significance was accepted as .05. Demographic data obtained from students were explained using frequencies in descriptive statistics methods. T-test was used for unrelated samples to determine whether students' gender, computer ownership, internet possession, and robotic coding activities showed a significant difference.

Findings

The results of the participants' computing thinking skills self-efficacy perceptions by gender variable are given in Table 2.

Table 2. Students' computational thinking skills self-efficacy perceptions t-test results by gender

Gender	N	$\bar{X}$	s	sd	t	p
Female	108	61,6389	15,70312	221	,442	,562
Male	115	60,6696	16,95387			

When Table 2 is examined, there is no significant difference between the students' self-efficacy perceptions and gender in computing thinking (t (221) =, 442, p> .05). The average of perceptions of female students' computing thinking skills self-efficacy is $\bar{X}$ = 61.63, and the average of perceptions of male students' computing thinking skills self-efficacy is $\bar{X}$ = 60.66. Considering this, it can be said that the perceptions of female students' and male students' computing thinking skills self-efficacy are close to each other.

The results of the participants' perceptions of computing thinking self-efficacy according to their ownership of computers at home are given in Table 3.

Table 3. Students' computational thinking skills self-efficacy perceptions t-test results according to having a computer at home

Having a computer	N	$\bar{X}$	s	sd	t	p
Yes	177	60,0000	16,66924	221	-2,058	,368
No	46	65,5217	14,28867			

When Table 3 is examined, there is no significant difference between students' computing thinking skills self-efficacy perceptions and having a computer at home (t (221) = -2.058, p> .05). The average of computing thinking self-efficacy perceptions of students who have a computer at home is

$\bar{X}$ = 60.00, and the average of computing thinking self-efficacy perceptions of students who do not have a computer at home is $\bar{X}$ = 65.52. Considering this, it can be said that the computing thinking skills self-efficacy perceptions of students who have a computer and those who do not have a computer are close to each other.

The results of the participants' computing thinking skills self-efficacy perceptions according to their internet access status are given in Table 4.

Table 4. Students' computational thinking skills self-efficacy perceptions t-test results according to their internet access status

Having internet access	N	$\bar{X}$	s	sd	t	p
Yes	213	60,9390	16,38370	221	-,844	,974
No	10	65,4000	15,30577			

When Table 4 is examined, there is no significant difference between students' perceptions of computing thinking self-efficacy and having internet access (t (221) = -, 844, p> .05). The average of computing thinking self-efficacy perceptions of students with internet access is $\bar{X}$ = 60.93, the average of computing thinking self-efficacy perceptions of students without internet access is $\bar{X}$ = 65.40. Considering this, it can be said that the computing thinking skills self-efficacy perceptions of students who have a computer and those who do not have a computer are close to each other.

The results of the participants' perceptions of information processing thinking skills self-efficacy according to their robotic coding training are given in Table 5.

Table 5. T test results according to the students' robotic coding education perceptions of their self-efficacy perceptions of information processing thinking skills

Getting robotic coding training	N	$\bar{X}$	s	sd	t	p
Yes	176	73,9574	17,57092	221	-6,615	,034
No	47	57,7159	14,18607			

When Table 5 is examined, it can be said that there is a significant difference between students' perceptions of computational thinking skills self-efficacy and robotic coding education. (t (221) = -6.615, p> .05). The average of computing thinking skills self-efficacy perceptions of students who have received robotic coding training is $\bar{X}$ = 73.95, and the average of computing thinking self-efficacy perceptions of students who do not have robotic coding training is $\bar{X}$ = 57.71. Considering this, it can be said that the computational thinking skills self-efficacy perceptions of students who have received robotic coding training are higher than the computing thinking skills self-efficacy perceptions of students who do not have robotic coding training.

The results of the participants according to their thinking status towards increasing the level of success of robotic coding training in other courses are given in Table 6.

Table 6. T test results of student views on increasing the level of success of robotic coding education in other courses.

Robotic coding training increases success in other courses	N	$\bar{X}$	s	sd	t	p
Yes	109	67,0439	16,66398	221	-5,932	,026
No	104	54,9633	13,50372			

When Table 6 is analyzed, it can be said that there is a significant difference between students' thoughts towards increasing the level of success of robotic coding education in other courses. (t (221) = -5.932, p <.05). The average of the students who think that the robotic coding education increases the success level in other courses is **X** =67,04, and the average of the students who do not think that the robotic coding education increases the level of success in other courses is **X** = 54,96.Considering this, it can be said that students who think that robotic coding education increases their success in other courses are higher than students who do not think that robotic coding education increases their success level in other courses.

Discussion and Conclusion

The aim of the research is to measure the self-efficacy perceptions of the students who are educated in private school about their computational thinking skills by gender, having a computer at home, having internet access, getting robotic coding education and determining the effect of the robotic coding education on the level of success in other courses. This study was attended by 223 students studying at a private school. The findings obtained as a result of the research were discussed and interpreted.

According to the results obtained in the research, it is stated that students' computing thinking skills self-efficacy perceptions do not show a significant difference according to gender. According to this information, it can be said that self-efficacy perceptions of female students towards computational thinking skills and self-efficacy perceptions of male students' computational thinking skills are close to each other. In parallel with this result, there was no significant relationship between the levels of computational thinking skills and gender (Werner, Denner, Campe & Kawamoto, 2012). In a study conducted with 8th grade students of secondary school, it was found that their perceptions of computing thinking skills self-efficacy differed by gender (Kuleli, 2019). In the study, the average of self-efficacy scores of female students for computational thinking skills was found 80,39, and male students were found to be 79,61 and it was stated that they differed in favor of female students with a low difference (Kuleli, 2019). In another study, it was concluded that women are more skilled in acquiring computational thinking skills (Prottsman, 2011). In addition, a study with students studying between 5th and 12th grades found that computing thinking skills favored male students by gender (Román-González, Pérez-González & Jiménez-Fernández, 2017).

According to the results of this research, it is seen that there is no significant difference between the students' computing thinking skills self-efficacy perceptions and having a computer at home. According to this information, it can be said that the students who have a computer at home and those who do not have a computer have close computing skills and self-efficacy perceptions. According to a study, students' tablet ownership and computing thinking skills self-efficacy perceptions were examined and no significant difference was found (Kuleli, 2019).

According to this research, it was found that there was no significant difference between the students' computing thinking skills self-efficacy perceptions and their internet access status. According to this information, the computing thinking skills self-efficacy perceptions of students who have internet access and the computing thinking skills self-efficacy perceptions of students who do not have internet access can be said to be close to each other.

According to the results of the research, it is seen that there is a significant difference between the students' computing thinking skills self-efficacy perceptions and robotic coding education. According to this result, it can be said that the computational thinking skills self-efficacy perceptions of students who have received robotic coding education are higher than the computational thinking skills self-efficacy perceptions of students who do not have robotic coding education. It is stated that block-based robotic coding education positively contributes to problem solving, self-efficacy perception and computational thinking skills (Yukselturk & Altıok, 2016).

According to the results of the research, it is seen that the opinions of the students about the robotic coding education to increase their success levels in other courses differ significantly. It is seen that students who think that robotic coding education increases the success in other courses are more than students who do not think that robotic coding education increases the success in other courses. In a master's thesis research, it has been stated that robotic coding education also benefits other courses (Kök, 2019). Uslu (2018) stated in his research that programming did not improve computational thinking skills, but the students stated that it was beneficial for science courses (cited in: Kök, 2019). A relationship is determined between self-efficacy perceptions of computing thinking skills and mathematics, science and technology, English and T.C. Revolution History and Kemalism course scores (Kuleli, 2019). The fact that the computational thinking skill, which is accepted as the lower step of the robotic coding education, increases the level of success in other courses, can indirectly give the result that robotic coding education has a positive effect on the level of success in other courses.

Suggestions

According to the results of this research, where the effect of robotic coding education on students' computational thinking skills self-efficacy perceptions is examined, some suggestions can be offered to practitioners and researchers interested in the subject. It is concluded that robotic coding has a positive effect on computational thinking skill self-efficacy perception. In line with this information, parents and teachers can be made conscious of students' basic robotic education. Students can be directed to participate in robotic coding activities outside of school. Robotic coding competitions between schools can be increased, and efforts to increase students' desire to participate in these competitions can be organized and motivation enhancing gifts can be given as a result of the competition. Conducting descriptive, experimental or mixed studies in which the relationship between computing thinking skill and different disciplines is investigated will contribute to the field. Conducting mixed studies investigating the effects of robotic coding education on students' creative thinking, critical thinking and reflective thinking skills will contribute to the literature.

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