Journal of Social Sciences of Mus Alparslan University

anemon

Derginin ana sayfası: http://dergipark.gov.tr/anemon

Araştırma Makalesi ● Research Article

Special Issue on *International Conference on Applied Economics and Finance (ICOAEF' 19), 9-11 April, 2019, Kyrenia, T.R.N.C.*

Effects of Robots on Engineering Students' Attitude

Robotların Mühendislik Öğrencilerinin Tutumlarına Etkisi

Nilcan Çiftçi Özüorçun*

Dr. Öğretim Üyesi Lefke Avrupa Üniversitesi, Yönetim Bilişim Sistemleri Bölümü Lefke/KKTC

ORCID: 0000-0001-7625-6959

MAKALE BİLGİSİ

Makale Geçmişi:
Başvuru tarihi: 13 Haziran 2019
Düzeltme tarihi: 28 Temmuz 2019
Kabul tarihi: 01 Kasım 2019

Anahtar Kelimeler:
Bilgisayar Mühendisliği
Mühendis Eğitimi
Programlama
Robotik Öğrenme

ÖZ

Robotik, mühendislik öğrencilerinin çalışırken analiz, tasarım ve uygulama yapmalarını sağlar. Robotik'in mühendislik eğitimi için kullanımı, öğrencilerin gerçek uygulamalarla anlamalarını arttırmayı amaçlar. Bilgisayar programlama dersi mühendislik fakültesinin ana dersidir. Genel olarak, öğrenciler programlama dersinin mantığını anlamakta zorluk çekerler ve bu ders hakkında olumsuz bir önyargıya sahiptirler. Bu çalışma, programlama dersinde robotların öğrencilerin tutumları üzerindeki etkisini incelemeye çalışmaktadır. Bu amaç doğrultusunda yüz öğrenci deney ve kontrol grubu olmak üzere iki gruba ayrılmıştır. Deney grubundaki öğrenciler bilgisayar, robot ve kontrol grubundaki öğrencileri bilgisayar kullandılar. Öğrencilerin tutumlarını belirlemek için her iki gruba da Bilgisayar Programlama Tutum Ölçeği uygulanmıştır. İstatistiksel sonuçlar, robot kullanımının deney grubundaki öğrencilerin bilgisayar programlama dersindeki tutumunu olumlu yönde etkilediğini göstermiştir.

ARTICLEINFO

Article history:
Received 13 June 2019
Received in revised form 28 July 2019
Accepted 01 November 2019

Keywords:
Computer Engineering
Engineering Education
Programming
Robotic Learning

ABSTRACT

Robotic allows engineering students to understand to do analysis, design, and implementation while working. The usage of robotic for engineering education aims to increase student understanding with real practices. The Computer programming course is the main course of engineering faculty. Generally, students get difficulties to understand the logic of programming course and they have a negative bias about that course. This study attempts to examine the effect of the robots on students' attitude in the programming course. With this aim, a hundred students are divided into two groups as experimental and control groups. Students who are in the experimental group used computer and robots and control group students used a computer. Computer Programming Attitude Scale was applied to both groups to determine students' attitudes. The statistical results showed that robot usage has affected positively the experimental group of students' attitude in the computer programming course.

1. Introduction

Rapid developments in the age of technology affect every aspect of human life. According to technological development, new technologies take place in teaching and new technological materials are needed for educations (Uzunboylu&Tugun,2016). Many studies about the introduction to programming course identify factors for success or failure. The cognitive prerequisites are important factors to learn programming such as mathematical ability, analogical, conditional, temporal reasoning and procedural thinking (Wilson&Shrock,2001). Students' computer background affects their approaches and attitudes to introduction to programming course. The educational studies find out students have a variety of learning styles and variety

* Sorumlu yazar/*Corresponding author*.
e-posta: nciftci@eul.edu.tr

http://dx.doi.org/10.18506/anemon.577920

of prepared course material and technology usage in the classroom help to increase understanding of the course. The Lego robot is the good material used in the introduction to programming course because it has a programmable brick. Moreover, it is the way of getting the attraction of students to the course. The Lego robot encourages students to write code.

The introduction to programming course is a basic course of engineering faculty and it has practice hours in the computer laboratory. The Lego robot is the favorite educational robot set used in education. The Lego robot set useful for engineering education because, it suits to learn with practices(Gura,2011). At the university, introduction to programming course is a compulsory course at an undergraduate level in Engineering Faculty. It is a first-year course and the course teaching as two sessions such as class hours and computer laboratory hours. At the class hours' students learned theory and at the computer laboratory, hours' students write code on a compiler. This paper tried to find an answer for students' attitudes depend on the usage of Lego robots at the laboratory sessions with computer programming attitude scale (CPAS) which was developed assessing university students' attitudes towards computer programming course (Cetin&Ozden,2014). A hundred of the undergraduate level of enrolled students were different engineering departments and they divided into two groups; control and experimental. The experimental group of students used a Lego robot at the laboratory hours. At the results of the study, students' attitudes analyzed with CPAS using before and after tests for both groups. And the statistical result of the study showed that, how do robots affect engineering students' attitudes to programming course?

1.1. Engineering Education with Robot

Technological improvement is changed required skills from 21. Century engineers such as an ability to be a creative, an innovative, have leadership skills, ability to work in a team. The usage of robotics has been expanding day-by-day in education areas and it is to be an important element in education (Koç, Böyük 2013). The robotic studies are done in engineering areas, such as programming, artificial intelligence and mechatronics projects. Engineering education should be exciting, creative, demanding, rigorous and empowered with technology. The study by Cruz, Fernandez, Galindo Gonzales, Stockmans and Blanco (2012) was about teaching data acquisition, control system engineering, and real-time systems for undergraduate students with robots obtained the students' point of view and their results showed that the students wanted to use the robots because they were like a toy, which motivated the students. Another study done with undergraduate engineering students in Turkey, Aras (2009) used the Lego Mindstorm set to design a robot and wrote programming code to find a wanted ball and carried the ball to a defined destination. Garcia, Gomez, Fernandez, Mandow, Munoz, Vidal, and Janschek (2008) argued that they achieved positive results using Lego robot in the summer school to teach mechatronic issues, which consisted of a combination of Mechanical and Electronics subjects. Another study done in 2006 by Kim and Jeon, they used the Lego RCX 2.0 model for teaching the C programming language. They stated that the students learned the programming language with their robotic applications and also contributed to the learning of robot programming.

2. The Purpose

The primary purpose of this research was to investigate how robot usage affects engineering students' attitude in the computer programming course. This research was performed in the introduction to computer programming course during the Fall semester of 2016-2017 academic year at the European University of Lefke with a hundred of the undergraduate level of engineering students. The introduction to programming is the main course for Engineering Faculty departments at the European University of Lefke. The introduction to computer programming course covers programming logic, principles and design to teach C language. The C is a computer programming language and it used to create an instruction for a computer to follow. The Engineering students who registered in the introduction to programming they have had difficulties to pass the course. According to 2013-2014 and 2014-2015 fall semesters, course results showed that students unsuccessful in the introduction to programming course. While determining the purpose of this study unsuccessful results were a reason. In the introduction to programming course, there were different characteristics of students and typical class and laboratory hours weren't attracting students' attention to the course. The educational robots are attractive and intelligent tools for a programming course. On the other hand, using robots in the programming course has positive and negative effects on student motivation, because in the classroom there are different characteristics of students (Mcgill, 2012). This study aimed to investigate how the Lego robot affects the attitude of students in the computer programming course.

3. Research Method

The determination of university students' attitudes to computer programming algorithm course the quantitative analysis method was used. This study conducted with one hundred students from the Engineering Faculty departments, which were from the Computer Engineering, Electric-Electronic, Electronic Communication, Software, and Civil Engineering departments.

Table1. Experimental group of student gender by student countries

	Male	Female
Zimbabwe	5	3
Turkey	14	4
Nigeria	6	6
Uganda	1	0
Pakistan	8	0
Mongolia	2	0
Tajikistan	1	0

The research is done in two groups: control and experiment groups. Both groups had fifty engineering students and both groups had approximately the same number of students according to gender and countries. The course is done in two parts as theoretical and laboratory sessions. In the laboratory hours, the pedagogical methods of learning by doing educational model were used.

Table2. Control group of student gender by student countries

	Male	Female
Zimbabwe	9	2
Turkey	13	3
Nigeria	6	5
Uganda	0	0
Pakistan	9	1
Mongolia	1	0
Tajikistan	1	0

At the beginning of the course, students answered Computer Programming Attitude Scale (CPAS) questionnaire, and then at the end of the six weeks, the same questionnaire was answered again by the same students. According to the CPAS questionnaire, the study found out how the Lego robot affected students' attitude to introduction to computer programming course.

3.1. Research Question:

Is there a significant difference between the students' attitude before and after using the Lego robot in the programming course?

3.2. Research Design

This study applied to 100 of students enrolled in computer programming course during the 2016-2017 Fall semester at the European University of Lefke. The research was done as pre-test and post-test for control and experimental groups. The experimental group of students has used the Lego robot in laboratory hours. The control group of students didn't use Lego robot and they continued to do practice on computers. According to the departments of the Engineering Faculty, introduction to computer programming course is available as three or four credits. The course content starts with problem-solving concepts for computers (constants, variables, data types, and functions); then continue with planning the solution (communication with computers, using tools, software development cycles). After that coding chapter starts with the introduction to programming structure; algorithm instruction, flowchart symbols, conditions (if/else, nested/if, while, repeat, until) and problem-solving with decisions (multiple if/then/else). The experimental group of students used a Lego robot and C compiler computer together. On the other hand, the control group of students at the laboratory hour they used C compiler on a computer. The Lego robot components are convenient with a computer and also a programming algorithm course. The well-prepared lab exercises made the course more attractive with a Lego robot. While in the laboratory hours, students learned how the Lego robotic set would be used in programming and they tried to understand algorithm logic within the learning by doing education model framework. The Lego robot set was used for six weeks in the laboratory hours and end of the four weeks CPAS questionnaire completed by students to find out if there were any changes in students' attitudes to the course.

3.3. Data Collection and Analysis

The students responded to a questionnaire (Computer Programming Attitude Scale (CPAS)). The attitude scale of university students, which was developed by Çetin and Özden (2014), consists of 18 items and 3 dimensions in total. The 6 items of the dimension named "affection "dimension; 6 items in the "cognitive" dimension; there are 6 items in the "behavioral" dimension. The Cronbach's Alpha value of the Attitude scale was 0.90, the Cronbach's alpha value of the cognitive dimension was 0.80, and the Cronbach's alpha value of the behavioral dimension was 0.90. The Cronbach's alpha value of the overall scale was 0.93, indicating the reliability of the scale (Çetin & Özden, 2014). To collect data with Computer Programming Attitude Scale:

- Firstly, CPAS questionnaire were answered by students who were enrolled in the introduction to computer programming course.
- Secondly, groups were separated as control and experimental groups.
- Lastly, the end of the six weeks both groups of students completed CPAS questionnaire again.

To prove the study's reliability, three experts checked all the data. After the quantitative data was collected, it was entered into SPSS 22.0 software and the result of the mean scores was obtained.

4. Results

The analysis focused on how Lego robot affects students' attitude in the introductory computer programming course. The survey was done with 100 of engineering faculty students at the European University of Lefke in Cyprus in 2016-2017 Fall semester. To measure students' attitude to the course, the CPAS questionnaire used which has 18 items and three dimensions such as affection, cognition, and behavior.

The questions, results and some conclusions are shown as following.

Table3. Experimental Group Before and After Affection Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeAffection - AfterAffection	,6900	,58613	,08289	,52342	,85658	8,324	49	0,00

Figure 1. CPAS' Affection dimension questions.

Cohen's d calculation was used in this study to find a standardized difference between before and after means and the alpha value used was 0.05 for all statistical analyses. The Pair-Samples T-test was used in Table 3 to show descriptive statistics for pre and post-test scores of the experimental group of students, and the two-tailed significance was less

than 0.05. The data in the experimental group shows that students attitude positively change according to affection dimension. At Table 4, shows control group students whose are continue lecture without Lego robot and according to affection dimension students' attitude negatively changed. The p-value is greater than 0.05.

1. I find programming frustrating.
3. I think program-writing is unnecessary.
6. Program-writing is boring.
11. Programming-related activities make me nervous.
13. I get really bored when I start writing a program.
16. The very idea of code-writing makes me nervous.

5. I always strive to write a better program.
8. If I encounter a problem that I cannot solve in the short term while writing a program, I don't give up until I solve it.
10. I take part in programming projects if I get the change.
12. I do research in order to be a good programmer.
15. Once I start working on a computer program, I try to finish it before anything else.
18. I follow the developments in programming.

Table4. Control Group Before and After Affection Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeAffection - AfterAffection	-,08696	,45371	,06690	-,22169	,04778	-1,300	45	,200

Another dimension for attitude measurement is cognition. The experimental group of student answers' calculation about p-value is less than 0.05 (Table 5). On the other hand, control group student answers' calculation about p-value is equal to 0.08 (Table 6) and it is greater than alpha value.

Table5. Experimental Group Before and After Cognition Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeCognition - AfterCognition	-,27667	,62869	,08891	-,45534	-,09800	-3,112	49	,003

The cognitive include, transfer of preliminary information and strict structured being presented more flexible (Yucel&Karahoca&Karahoca,2016).

Table6. Control Group Before and After Cognition Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeCognition - AfterCognition	-,15163	,37179	,05423	-,26079	-,04247	-2,796	46	,08

Figure2. CPAS' Cognition dimension questions.

Table 7 shows the statistical results of the before and after

2. Programming is a distinguishing skill.
4. Programming has no significance in daily life.
7. Programming makes human life easier.
9. I feel nervous while writing programs.
14. Programming improves your problem-solving skills.
17. I think that many problems that remain unsolved in

attitude dimension behavior tests regarding the experimental group of students. The tests results using the paired sample t-test and the shown p value was less than 0.05 (Table 7) and there were significant differences identified. The results show that the students were positive in their attitudes towards practicing the introduction to computer programming course with the Lego robots.

Table7. Experimental Group Before and After Behavior Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeBehavior - AfterBehavior	-,39333	,71726	,10144	-,59718	-,18949	-3,878	49	0,0003

Table 8 shows the results of the control group of students CPAS' behavior dimension sample T-test p-value result.

Table8. Control Group Before After Behavior Means

		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	BeforeBehavior - AfterBehavior	,04787	,94861	,13415	-,22172	,31746	,357	49	,723

Figure 3. CPAS' Behavior dimension questions.

5. Conclusions

The effects of Lego robot usage in the introduction to programming course on students' attitudes positively changed in the experimental group. According to the computer programming attitude scale results, students' attitudes' measured as three dimensions: cognition, behavior, and affections. All three dimensions of an experimental

group of students' attitude are changed positively and also students like to use the Lego robot. According to dimension some conclusion as follows:

- The affection dimension results in an experimental group the students' view about the programming is positively developed. However, control group students' affection dimension is negatively developed.
- The experimental group of students' end of the six weeks, they answered the question about cognition dimension as positively agree.
- The experimental group of students used Lego robot and their behavioral attitudes are changed and they are like to write code.
- The experimental group of students came laboratory hours willingly. On the other hands, the control group of students didn't like to come laboratory.

The Lego EV3 is a good product for engineering students and it can be used in other courses as well because of the price and its robust nature. The Lego robot enables engineering students to be creative and enable students to work in collaboration with their classmates. It also improves students' analytical thinking skills. Questionnaire results show that robotic usage in computer programming course affects students' attitude to course positively. These results related to the 2016-2017 Fall semester 100 of students who are enrolled to computer programming course in an Engineering Faculty at the European University of Lefke.

At the end of the course, it was found that attitudes towards the course increased positively for the students in the experimental group and decreased for the control group. At the beginning of the course, students in the experimental group have negative opinions that they thought programming was complicated, unnecessary and boring, while it was observed that their opinions change positively in the post-test scores applied at the end of the course. In the control group, there was a negative decrease in the attitude towards the effect. In the behavioral dimension, which is another dimension of the attitude scale, the students in the experimental group reflected positive attitude changes on their course oriented behaviors. In the control group, it was determined that there was a negative decrease in behavioral attitudes and there was a significant difference between the pre-test and post-test scores of both groups. In the experimental group used Lego EV3 robot, post-test scores of positive attitude changes were determined that it was important to program and increase problem-solving skills. It was concluded that there was a decrease in the post-test scores of students in the control group and a significant difference occurred between groups.

According to these results, the Lego robots will continue to be used in these courses and for the future work we will try to find a solution using the Lego robot for other engineering courses as well.

References

Aras,B. (2009). "Wireless and Mobile Robotics Application". (Master Thesis). İstanbul Üniversitesi, İstanbul.

Çetin, I., Ozden Y. (2014). "Development of Computer Programming Attitude Scale for University Students" Wiley Periodicals, Inc.

Cruz, M., Fernandez-Madrigal, J.A, Galindo, C., Gonzalez-Jimenez, J., Stockmans-Daou, C., Blanco-Claraco, J.L., (2012). "A Legorobotic approach for teaching at Data Acquisition, Control Systems Engineering and Real-Time Systems undergraduate courses". Computer &Education.Vol. 59, pages 974-988.

Garcia, A. C. Gomez-de, G. J. Fernandez-Lozano, J., Mandow, A. , Munoz, V.F. , Vidal, F. ve Janschek, K. (2008). Using Lego robots with labview for summer school on mechatronics. IEEE International conference Mechatronics, 1-6.

Gura, M., Copyright 2011, ISTE ® (International Society for Technology in Education), Getting Started with Robotics: A Guide for K–12 Educators.

Koç, A., Böyük, U. (2013). "Technology based learning in science and technology education: Robotic Application". Journal of Turkish Science Education, Vol. 10, No 1, pages 139-155.

Kim, S. H. ve Jeon, J. W. (2006). Education C language using Legomindstorms robotic invention system 2,0. Proceeding 2006 IEEE International conferences on Robotics and Automation, 715-720.

Mcgill, M. M. (2012). "Learning to Program with Personal Robots: Influences on Student Motivation." Acm Transactions on Computer Education, Vol. 12, No. 1, Article 4.

Uzunboylu, H., Tugun, V. (2016). "Validity and Reliability of Tablet Supported Education Attitude and Usability Scale". Journal of Universal Computer Science, Vol. 22, no. 1, pages 82-93

Wilson, B. C., Shrock, S. (2001). Contributing to success inan introductory computer science course : A study of twelve factors. ACM SIGCSE, 33(1) pages 184-188.

Yucel, O., Karahoca, D., Karahoca, A. (2016). "The effects of problem-based learning on cognitive flexibility, self regulation skills, and students' achievements". Journal of Information Technology, Vol.6, no. 1, pages 86-93.