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Robotics in Education: Examining Information Technology Teachers' Views

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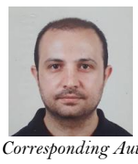
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Abstract

This study examining the robotic codings and robotic tournaments from the perspectives of Information Technology (IT) teachers was carried out using the qualitative case study method. In the study, a total of 20 teachers from private schools and state schools were asked for their views. The research data collected from the IT teachers helped determine the advantages and limitations of robotic coding and robotic tournaments. The results revealed that the IT teachers generally reported positive views about robotic coding and robotic tournaments. In addition, the teachers reported that robotic coding activities arose the students' curiosity and attention. As for the negative aspects, the teachers thought that students had to perform the tasks in a very limited time; that there was no equality between the materials owned; that the environment was encouraging; that the juries did not act objectively during the scoring phase; and that the tournaments served for corporate advertising. Consequently, it was found that the students achieved active learning with the help of the robotic coding trainings and tournaments, which increased their motivations.

Keywords: Coding, Information technology, Programming, Robotic tournament.
JEL Classification: Learning, Technological change.

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Ethical: This study follows all ethical practices during writing.

Contents

Contribution of this paper to the literature

This study contributes to the existing literature by examining the robotic codings and robotic tournaments from the perspectives of Information Technology (IT) teachers was carried out using the qualitative case study method.

1. Introduction

Raising generations in line with the requirements of the modern age has become one of the most important goals of education systems. For this reason, it is necessary to make the best use of technology in the education process. With the rapid introduction of technology into our lives in the 21st century, students' expectations have changed, and the educational curricula have started to be updated accordingly. In this respect, the course of Information Technology and Software (ITS) is one of the courses included in the secondary school program in Turkey and has contributed to the development of students' IT literacy with its recently developed content. Students are expected to gain skills such as using information and communication technologies in a correct and secure manner, developing positive attitudes while using information technologies, being able to communicate, sharing information, self-expression, doing research, questioning the accuracy of the information obtained, structuring the information and working collaboratively in BTY courses (MEB, 2019). It could be stated that the coding education has an important place for students to acquire all these skills.

Coding is defined as the process of developing applications using instruction sets to solve problems, to enable human-computer interaction and to perform a specific task with a computer (BUsiness Dictionary, 2015). In this rapidly developing world, it is increasingly important to show young generations how they can produce new programs rather than consuming the existing programs (Demirer and Sak, 2016). Coding education is not limited only to computer science alone. It also shows that students present creative and different solutions to the problems faced (Karabak and Gunes, 2013). Robotics education, which has recently become known along with coding, enables students to create new products and to make them functional by supporting the products they create with coding.

In robotic-assisted learning environments, the goal is to provide educators with a robotics curriculum integrated with science and technology as well as to make learning more meaningful and long-lasting by integrating robotic-assisted technology applications into education (Wood, 2003). With the use of robotics in education, it is stated that students will develop skills such becoming more knowledgeable about technology, having more willingness to search and explore and developing the ability to conduct teamwork (Sabanovic and Yannier, 2003).

Robotics competitions are held in Turkey and around the world by various institutions. The main purpose of robotics competitions is to encourage students for robotic projects and to exhibit their products in addition to making them love science and technology. A wide variety of robotic tournaments such as FLL, FLL JR, WRO, Vex IQ, Vex EDR are held in Turkey by various institutions. When the literature on robotics is examined, it is seen that robotics education is expected to be placed among the general sciences and that an appropriate learning environment is prepared for educational robotic applications (Koç and Böyük, 2013).

2. Related Literature

Donmez (2017) aims to determine the views of students and team coaches regarding robotics tournaments within the framework of STEM training and to examine the views of secondary and high school students and team coaches who participated in the first Lego League/Science Heroes Meet tournament regarding tournament process, robot design, programming and collaboration. The students stated that the robot kits were fun and functional and that these robot kits attracted their attention and increased their motivation and their interest in research and scientific studies. When the team coaches' views were examined, it was seen that they expressed thoughts parallel to the students', and they also stated that the tournament process had some non-transparent elements and that the tournament was conducted as a means of marketing Lego products.

Kasalak (2017) conducted a study to investigate the influence of robotic encoding on the self-efficacy perceptions of secondary school students regarding coding and aimed to determine whether there was a significant relationship between self-efficacy of the students regarding block-based programming and robotic coding activities. In the study, it was concluded that the students found the activities interesting and fun, and they were also found to be willing to participate in the activities. It was also revealed that the activities contributed positively to their personal development.

Göncü *et al.* (2018) conducted a study which examined the views of the pre-service teachers regarding the teaching of coding and worked with 12 Computer and Instructional Technologies students. As a result of the study, it was found that the views of the pre-service teachers regarding coding education were quite limited. The researchers also concluded that the pre-service teachers only mentioned problem-solving and algorithmic thinking, which is one of the basic structures of coding education.

Another study was conducted by Türker and Pala (2018) who aimed to determine the views of secondary school students, teachers and the parents of the students about coding. The results demonstrated that the majority of the students expressed their views in line with the functions of coding such as making games and programs, moving characters, making robots. When the teachers' views were examined, it was found that they did not consider themselves sufficient in coding. It was also concluded that the majority of the parents had incomplete or incorrect views about coding.

When the related literature is examined, it could be stated that the importance of coding & robotic coding is gradually increasing. A search on the database of Scopus (TITLE-ABS- KEY ("coding" AND "programming") OR TITLE-ABS-KEY ("robotic programming")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English")) revealed results regarding the number of related studies by year as presented in Figure 1.

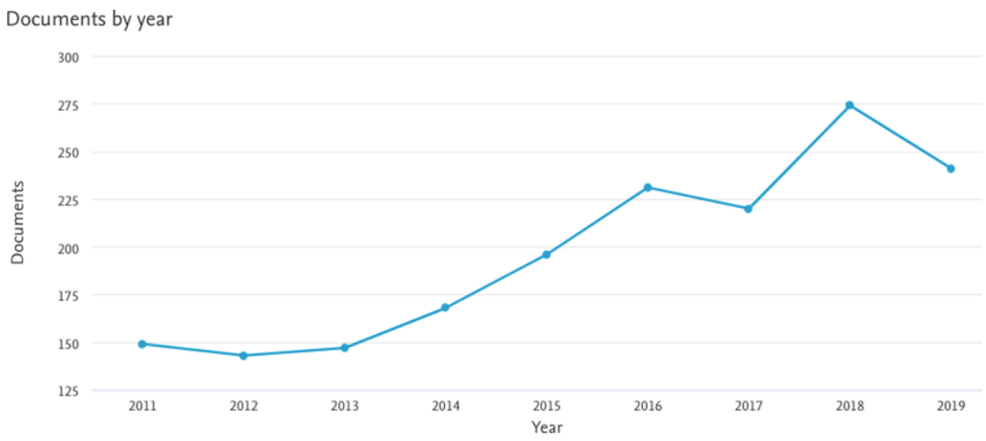

Figure-1. Number of papers in scopus database.

Source: Scopus database, 2019.

As can be seen in Figure 1, there has been a gradual increase in the number of studies conducted on coding and robotic coding. Therefore, based on this graph, it could be stated that robotic coding training has gradually gained more significance. The present study it thought to have a leading role for other studies in the field to identify the deficiencies in robotics coding training and to provide solutions to the existing problems. Therefore it will contribute to the related literature. Based on all, the purpose of this research was to determine the views of Information Technology teachers regarding the course of robotic coding and robotics competitions as well as to determine the contributions of their views to the teaching of coding.

3. Methodology

3.1. Research Model

The study was designed as a case study, and it focused on collecting in-depth data from the IT teachers in relation to their coding and robotic programming experience.

3.2. Participants

The sample of the study included Information Technology teachers (n=20) who worked in the state and private institutions affiliated to MEB in 16 different provinces in the academic year of 2018-2019. The demographic characteristics of the teachers participated in the study can be seen in detail in Table 1.

Table-1. Demographic characteristics of the participant teachers.

		Frequency (f)	Percentage (%)
School type	State School	10	50
	Private School	10	50
Grade	Kindergarten	10	50
	Secondary School	7	35
	High School	3	15
Work experience	1 – 5 Years	14	70
	6 – 10 Years	4	20
	10 years and above	2	10
Robotic experience	0 – 2 Years	13	65
	3 – 4 Years	4	20
	5 years and above	3	15

3.3. Data Collection Tools

In the study, an interview form was created on Google Forms to collect the qualitative data. The questions in the form were directed to determine the views of the respondents about robotic coding and robotic competitions, the influence of robot coding on the students and on the course, the influence of the educational robot use on courses, positive and negative aspects of educational robots in courses, which level of educational robots were being used, how they conducted their training processes and what they thought about robotic tournaments. These questions were submitted for expert opinion and then finalized.

Semi-structured interview questions used in the study were as follows:

1. Does the use of educational robots make your course efficient? Why?
2. What are the positive and negative aspects of using educational robots in teaching?
3. What are your reasons for using educational robots in your lessons?
4. Which educational robot kits do you prefer? Why?
5. When programming educational robots, do you use block programming or do you code based on any programming language? Explain.
6. Do you think robotic tournaments are useful in terms of coding training? Why?
7. Have you had any chance to participate in robotic tournaments before? If yes, when did it happen, how many people were involved, in what tournament and what was your success?

3.4. Data Analysis and Reliability

Content analysis was used for the analysis of the data obtained from the interview form. Content analysis was carried out for the analysis of non-specific themes and sub-themes if there is any (Yıldırım and Simşek, 2013). The coding process was created based on the data obtained. For the purpose of ensuring reliability, no comment was

made while presenting the findings. The researchers and a scholar experienced in the field of qualitative research designs worked on the findings together. Moreover, interview recordings, their transcripts, and the codings were saved to let other researchers check them in the future.

4. Findings and Discussions

In this section, the data collected from the teachers were analyzed, presented in tables and interpreted using appropriate techniques based on the sub-problems. % (Percentage), f (frequency) and mean scores were used to define the agreement levels of teachers.

In the first sub-problem, the teachers' views regarding the influence of using robots on the efficiency of the courses were determined. The question of "Does the use of educational robots make your course more efficient? Why?" was directed to the participants, and the themes presented in Table 2 were obtained.

Table-2. Teachers' views about the influence of using robots on the efficiency of the courses.

Themes	Frequency
The reasons for using educational robots	
Active participation/Effective participation	12
Quick learning	7
Enjoyable	6
Other	9

While the majority of the participants (N=17) felt that the use of educational robots made the lessons efficient, 3 participants stated that they had no experience in using educational robots.

When Table 2 was examined, it was seen that one of the most important reasons for robot use in education was to encourage active participation, which was followed by quick learning, helping gain concrete life experience and making the courses more enjoyable. IT9 said "I think coding makes the course efficient in terms of concretizing education. IT7 reported his/her opinion saying "Yes, it is incredible for students to see that the produced codes work and perform the functions, so it is very entertaining for students."

The results obtained from the second interview question helped determine the teacher's views about the positive and negative aspects of educational robot use. The participants were asked "What are the positive and negative aspects of using educational robots in education?", and the themes given in Table 3 were obtained.

Table-3. Teachers' views about the positive and negative aspects of educational robot use.

Themes	Frequency
Positive aspects	
Increases attention	10
Supports students' creativity	8
Facilitates the learning of subjects.	8
Motivates	6
Concretizes education	6
Other	9
Negative aspect	
Increases cost	5
Classrooms lack the necessary equipment	4
Class hours are not sufficient for implementation	2

According to Table 3, all the teachers stated that the use of educational robots was beneficial. However, it was revealed that they also mentioned about some issues such as limited class hours, lack of adequate equipment and high cost. T1 said: "children like doing something concrete by combining parts in computer classes. The negative side of it is that we cannot provide equal materials for everyone and that students lack materials and computers in their homes to practice and develop robots." T5 said: "The only negative aspect is that some students cannot get out of game mode or fully grasp the real meaning of learning, and there are many positive aspects as well, especially in helping creativity and high-level thinking that are very effective in gaining algorithmic thinking."

The third interview question aimed to determine the teacher's views about the use of educational robots in lessons. The question of "What are your reasons for using educational robots in your lessons?" was directed, and the themes given in Table 4 were obtained.

Table-4. Teachers' views on using educational robots in lessons.

Themes	Frequency
The reasons for using ER	
Catching students' attention to the lesson.	12
Helping students gain various thinking skills.	10
Teaching students robot technologies	9
Other	11

When Table 4 was examined, it was seen that 16 teachers used educational robots in their classes while 4 teachers did not. When the reasons why the teachers used educational robots were examined, it was revealed that they used these robots to attract students' attention to the lesson, to increase the efficiency of the lesson, to concretize teaching and so on. In relation to this, T1 said "I use it because it makes the lesson more attention-grabbing, facilitates helping students gain algorithmic thinking skills and increases functionality in education." T4 said "to ensure that students do not stay away from technological developments, encourage them to add new products besides what we teach, and to open a technological door to them in the future."

As the fourth interview question, the participants were asked what educational robot kits they preferred and why, and the themes given in Table 5 were obtained.

Table-5. Teachers' views about the facilities of school and about in which grade and why er is used.

Themes	Frequency
Which ER is preferred	
Arduino	16
Mbot	8
Lego Mindstorms EV3	7
Vex IQ	6
Other	12

When the teachers' views were examined, it was found that Arduino (N=16) was the most popular, while drone (N=1) was the least. T16 said: "I use it at all levels. We use Lego sets for elementary and secondary school and Arduino sets for secondary school and high school groups. Lego sets appeal to both younger age and older age groups based on group levels. For Arduino sets, I think that students with a certain level of knowledge can proceed to advanced levels (Going beyond switching on a LED). That is why we work with these sets for secondary and high school groups."

Table-6. Teachers' views about their preference of block or programming language in coding educational robots.

Themes	Frequency
Why block programming when ER coding	
Block programming is comprehensible	15
Time limitation	15
That block programming is more appropriate for those at younger ages	9
Block programming has more visual	2

The findings obtained from the fifth interview question allowed determining the teacher's views on the reasons for preferring block or programming language in coding educational robots. The participants were asked "When you're programming educational robots, are you coding based on block programming or any programming language? Please explain", and the themes given in Table 6 were obtained.

According to Table 6, the majority of the teachers stated that they used block programming while coding educational robots. They preferred block programming because it was more comprehensible and suitable for younger age groups, because it had more visuals and because of time-limitations. T10 said "I use block programming because working with more comprehensible programming gives students pleasure." T17 said: "We do it on block programming. As lack of adequate class hours hinders teaching the programming language, we teach the structure of general algorithm and then we encourage students to make the codes with block programming. I use programs like mblock and godash, which help us do block programming."

The findings obtained from the sixth interview question helped reveal the teachers' views about the benefits of robotic tournaments in coding training were tried to be determined. The question of "Do you think that robotic tournaments are useful in coding training? Why?" was directed, and the themes given in Table 7 were obtained.

Table-7. Teachers' views about the benefits of robotic coding in coding training.

Themes	Frequency
Positive aspects of robotic tournaments	
Students' sense of mission improves.	19
Students gain new ideas in the tournaments.	10
Students are more willing in lessons.	10
Students learn about process skills/teamwork.	8
Tournaments help students socialize.	5
Other	8
Negative aspects of the tournament	
Juries are not objective at the evaluation stage	8
Obligation to fulfil the task in a very limited time.	5
Tournaments serve for corporate advertising	5
Students become more ambitious to win	4
Other	6

According to Table 7, the teachers often thought that robotic tournaments were useful in coding training. T3 said "in robotic tournaments, the process is very efficient for students as they design extra codes for different robots and tasks to perform the tasks on the table, and they do multiple trials in the process both at the coding and mechanical stages." T17 said "Tournaments increases competition and the ambition to win the competition. Students who wish to satisfy their ambition to win strive to learn how to code better". Besides, the teachers stated that the tournaments were not fair enough although they were useful in terms of coding training. In relation to this, T20 said "I think it is useful, but I think there are times when an objective assessment is not done."

The findings obtained from the seventh interview question allowed determining the teachers' views about robotic tournaments were tried to be determined. The question of "Have you had any chance to participate in robotic tournaments before? If Yes, when did it happen, how many people were involved, in what tournament and what was your success?" was directed, and the themes given in Table 8 were obtained.

Table-8. Teachers' views on robotic tournaments.

Themes	Frequency
Tournaments participated	
Vex tournaments.	8
FLL tournaments	6
FLL JR. Tournaments	6
TUBITAK	3
Success in robotic tournaments	
All participants were given a prize by the nature of the tournaments.	8
Yes, I gained success.	6
No, I gained no success.	4

According to the responses given by the participants, 12 teachers were found to have participated in robotic tournaments and gained experience, while 8 teachers did not have any experience in robotics tournament. While the most frequent participation was in vex tournaments (N=8), which was followed by FLL and FLL JR tournaments (N=6). When we look at the success in robotic tournaments, it was seen that 14 teachers gained success. In relation to this, T8 reported "Yes I joined. I ranked the second with a team of 24 and the first with a team of 16 in a national tournament in Turkey, and I also won various awards with a team of 12". However, four teachers did not gain any success. T2 delivered mentioned the difference between the participants' levels saying "The students could not gain any success in a bell robot festival with a group of six people because they competed with high school students".

5. Conclusion and Suggestions for Future Research

According to the findings obtained in the study, the teachers thought that the use of educational robots made the courses efficient. The results were similar to those of a study conducted by Rich (2016) and Kasalak (2017). Zengin (2016) carried out a study to investigate 1st to 12th grade students' views about the use of robotic systems in class and found that the students had positive thoughts about robotics. A majority of the students suggested that robotics be applied in other courses and stated that the robotic projects increased their interest in the course. Similarly, Kasalak (2017) conducted a study to examine the secondary school students ' perceptions of self-efficacy in coding and revealed that the students found activities interesting and fun; that they were willing to participate in the activities; and that the activities contributed to their personal development.

In the present study, the teachers reported that they used educational robots to attract the students ' attention to the lesson, to help them develop different thinking skills, to teach them robot technology, to enable them to make production in the course, to increase the efficiency of the lesson and to concretize teaching. Similarly, Kanbul and Uzunboylu (2017) conducted a study in which they examined the importance of coding and robotics applications in the acquisition of 21st-century skills, and the researchers found that these applications increased the students ' ability to solve real-life problems with the help of mathematical modelling.

Educational robots, which started to be used at the kindergarten level in private schools, continue to be used at other educational levels. The use of educational robots in public schools usually begins at the secondary school level. In this study, when the robots used were examined in line with teachers' views, it was seen that Arduino and mBot were among the most popular educational robots due to their low cost. Besides, the educational robots such as VEX IQ, VEX EDR, Lego Mindstorms EV3, Lego We do 2.0, makeymakey, dash&dot were also used. When the views of the teachers were examined, it was seen that the teachers in private institutions were satisfied with the facilities offered by their schools and that they received financial aids, while the teachers teaching at state schools stated that their financial resources were limited and that they received support from their sponsors.

The teachers also stated that they often preferred block programming. The reasons for choosing block programming were as follows: block programming was more comprehensible and appropriate for younger age groups; it had more visuals; and the teachers had time-limitations. The teachers who preferred the programming language (N = 3) were found to work at high school level. In relation to this, Saygıner and Tüzün (2015) point out that programming requires a higher level of thinking and has abstract characteristics which make it harder for new users. To cope with this, the researchers suggest using block-based visual programming.

All of the teachers in the present study reported that they did not receive any training on educational robots during their undergraduate education. The need for training in this field is met through teachers' own efforts by learning via the Internet and watching videos, by participating in in-service training programs, by consulting other people concerned in line with the expectations of robotic tournaments and by taking private courses. In the studies conducted by Göncü *et al.* (2018) and by Türker and Pala (2018) it was concluded that teachers did not consider themselves to be sufficient in coding.

In the study, while the majority of the teachers stated that robotic tournaments were useful in providing training on coding, some of them reported that the tournaments had no benefit in coding training. Regarding the positive aspects of the tournaments, the teachers stated that students could expertise in the subject area, raise awareness of the task, improve presentation skills, gain interest and desire for the course, learn process skills/ teamwork and socialize. As for the negative aspects, the teachers thought that students had to perform the tasks in a very limited time; that there was no equality between the materials owned; that the environment was encouraging; that the juries did not act objectively during the scoring phase; and that the tournaments served for corporate advertising. Similar results were obtained by Donmez (2017) in a study which examined the views of teachers and students about robotic tournaments within the framework of STEM education. When we look at the information obtained from the students, it could be concluded that the robot kits are fun and functional; that they attract interest; that they increase motivation; and that they increase motivation to search and scientific studies. However, when we examined the views of teachers in the present study, they seemed to have parallel thoughts with the students but differed from them in that tournament process had some non-transparent elements and that tournaments were run as a means of marketing.

The majority of the teachers who participated in the study stated that they had participated in Vex tournaments, FLL and FLL Jr tournaments and TUBITAK during their training periods since 2017. Many of the teachers expressed that they gained success in robotics tournaments. The teachers mostly reported that their school administration generally supported their participation in robotic tournaments, while some teachers stated that they did not get any support.

In the light of the findings of this research, the following suggestions could be put forward for researchers:

- The views of teachers and students about the course of robotics coding could be compared.
- The views of teachers and students about robotic tournaments could be compared.
- A similar study could be performed with different groups of teachers and with more participants.
- The support of state and private institutions for robotics studies could be received.
- Teachers should be given in-service training on coding robotics.

Based on the results obtained via the qualitative data, it could be stated that teachers have positive views about robotic coding training. According to the results, teaching robotic coding and robotic tournaments contribute to the related courses by encouraging students to think differently. Therefore, the training on robotic coding needs to be expanded, and the number of studies on this subject should be increased. This study is thought to shed light on further research to be done to contribute to the related literature.

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