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Robotic Coding Perceptions of Middle School Students

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Abstract

This study aims to determine middle school students' perceptions of robotic coding. For this purpose, the case study design of the qualitative research method was used in the research. The research was carried out with 76 middle school students studying in a district of Kayseri province. A questionnaire consisting of nine open-ended questions was used as a data collection tool. The questions were asked to the participants in the online environment. The data were analyzed by content analysis, which is one of the qualitative data analysis types. In this direction, codes and categories related to the data were determined. The findings of the research are explained through direct quotations. The research concluded that the students associated the concept of the robot with technology, the students had never encountered a robot before, they wanted to design a robot, the concept of coding was expressed as giving commands, and they wanted to receive coding training. Based on these results, we recommended expanding robotic coding training.

Keywords: Coding, middle school students, perception, robotic.

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Ortaokul Öğrencilerinin Robotik Kodlama Algıları*

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Öz

Bu araştırmada ortaokul öğrencilerinin robotik kodlamaya ilişkin algılarını belirlemek amaçlanmıştır. Bu amaç doğrultusunda araştırmada nitel araştırma yönteminin durum çalışması deseni kullanılmıştır. Araştırma Kayseri ilinin bir ilçesinde öğrenim görmekte olan 76 ortaokul öğrencisi ile yürütülmüştür. Veri toplama aracı olarak dokuz adet açık uçlu sorudan oluşan anket kullanılmıştır. Katılımcılara çevrimiçi ortamda sunulan anket sorularından elde edilen veriler nitel veri analizi çeşitlerinden olan içerik analizi ile çözümlenmiştir. Bu doğrultuda verilere ilişkin kod ve kategoriler belirlenmiştir. Araştırmanın bulguları doğrudan alıntılar yoluyla açıklanmıştır. Araştırmada; öğrencilerin robot kavramını teknoloji ile ilişkilendirdiği, öğrencilerin daha önce bir robotla karşılaşmadıkları, bir robot tasarlamak istedikleri, kodlama kavramını ise komut verme olarak ifade ettikleri ve kodlama eğitimi almak istedikleri gibi sonuçlara ulaşılmıştır. Bu sonuçlardan yola çıkılarak robotik kodlama eğitimlerinin yaygınlaştırılması önerilebilir.

Anahtar Sözcükler: Kodlama, ortaokul öğrencileri, algı, robotik.

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Introduction

Rapid developments in technology have led to changes every field, including the field of education. Along with these changes, the importance of information has increased, and methods of information access, sharing, and production have simultaneously changed. . One of the innovations brought by developments in technology is robotics technology. Robotic technologies, which are encountered in almost every aspect of daily life, have been included in educational environments to facilitate learning.

The use of robotic technologies in educational environments can occur in two ways. The first method involves the teaching of robotic technology itself as a learning object. The second and most important is the use of robotic technologies as a tool in the teaching of subjects. In this respect, robotic technologies should be used as a guide and tool for learning in the educational process (Alimisis, 2012; Altin & Pedasta, 2013). In this process, robotic activities provide opportunities for students to discover and apply knowledge to find solutions to the problems they may encounter in daily life. They also provide an environment for students to use scientific methods such as testing hypotheses, problem-solving, and learning through discovery, and to increase their imagination (Barak & Assal, 2016; Ching et al., 2019; Elkin et al., 2016; Isnaini et al., 2020; Taylor & Baek, 2017). Robotics helps to embody abstract concepts and present them in a visual form (Thanyaphongphat et al., 2020). Additionally, it provides a practical and interesting environment for the acquisition of basic electronics knowledge that students may encounter in daily life (Sullivan & Bers, 2016).

An increase in the importance given to robotics also increases the importance given to coding. Coding, which is defined as telling a robot what to do, is not just defined with robots, and can also be defined as communicating with tools such as computers, applications, and phones (Ozer Sanal & Erdem, 2017). Considering that in today's technology, each machine and electronic device carries a brain within itself, it will be of great benefit to the public in terms of managing and robotizing these brains by giving commands from outside, teaching this to students, producing the technologies of the future, and increasing their tendency towards scientific processes (Goksoy & Yilmaz, 2018).

Theoretical framework

The educational environment offered with robotic coding has the potential to enable students to not only readily access information but also to take an active part in the process (Jung et al., 2019). For this reason, robotic learning environments have been strongly associated with constructivist learning theory since the middle of the 20th century (Barak & Assal, 2016; Kucuk & Sisman, 2018).

The concepts of "active participation" and "learning by doing and experiencing" provided by constructivist educational environments also form the foundation of the educational environment realized with robotic coding (Cakir, 2019). In this respect, while constructivist educational environments facilitate the learning of robotic coding, the use of robotic coding in educational environments also supports the constructivist philosophy as it enables learning by doing. In other words, constructivist philosophy and robotic coding activities used in educational environments can be thought of as an intertwined system of wheels (Figure 1).

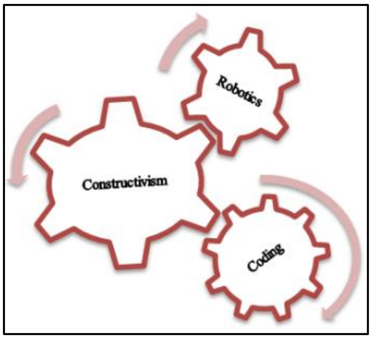

Figure 1. *Robotic Coding and Constructivist Approach*

Literature review

Cakir (2019) examined the relationship between robotic coding and academic achievement. Additionally, previously conducted studies have examined various topics such as attitudes towards robotic coding (Avci et al., 2021; Kaloti-Hallak, 2014; Sumer et al., 2019; Welch and Huffman, 2011), motivation (Peng et al., 2020), problem-solving skills (Cakir et al., 2021; Ciftci & Bildiren, 2019), scientific process skills (Cakir, 2019), self-efficacy (Banzato & Tosato, 2017; Guleryuz, 2019; Kasalak & Altun, 2020), and creative thinking skills (Cakir et al., 2021; Jamali, 2019; Noh & Lee, 2019).

Similar to the current research, Yayla Eskici et al. (2020), aiming to investigate the effect of robotic coding on students' mental images, asked two open-ended questions in their study they conducted with eight middle school students. In their study, they concluded that robotics coding had a positive effect on students' mental images. In their study, Ceylan and Gundogdu (2018) aimed to determine the perceptions of school principals, information technology teachers, students, and parents on coding. As a result of the study, it was concluded that the participants had different perceptions and that they did not have a complete understanding and awareness of the concept of coding. Timur et al. (2021) examined students' images using the draw-tell technique. As a result of the research, it was seen that students generally drew robots that were humanoid and had lifelike characteristics.

Numerous studies in the literature have investigated the perceptions of teachers (Butuner & Dundar, 2018; Ceylan & Gundogdu, 2018; Goksoy & Yilmaz, 2018; Ugur Erdogmus, 2021), preschool (Bozkurt Polat & Kabadayi, 2021), primary (Timur et al., 2021) and secondary school students (Ceylan & Gundogdu, 2018; Yayla Eskici et al., 2020) towards robotics coding. At the middle school level, Ceylan & Gündoğdu (2018) determined the perceptions of students who had received coding education in previous years and those who were currently receiving it. For this purpose, the authors conducted interviews consisting of open-ended questions with five students. Similarly, Yayla Eskici et al. (2020) worked with eight students with basic coding knowledge and revealed student perceptions through student drawings. The current study revealed the perceptions of middle school students who did not receive education regarding robotic coding. Therefore, the authors revealed students' perceptions before they acquired knowledge and experience. In this respect, this study is unique because the perceptions of students who have not received robotic coding education will shed light on robotic coding education planners as they are free from experience and prejudice. From this perspective, a robotic coding education planned through the consideration of the perceptions of students who have not received robotic coding education will be a pioneer in raising creative students.

In the current research, nine open-ended questions were asked to 76 students. In this respect, this study aims to investigate student perceptions in a more comprehensive and detailed manner. Considering the advantages offered by robotics and coding to students and educational environments, it is important to deal with students' perceptions of these concepts in-depth and comprehensively. This research aims to reveal the perceptions of students regarding robotics and coding and to reveal their thoughts. Subsequently, support will be provided in the planning and continuation of training to be held in the future, taking the perceptions of the students into account. To this end, the research question was determined as follows:

1) What are the perceptions of middle school students regarding robotic coding?

Method

Research Design

In this study, the case study design of the qualitative research method was utilized. A case study aims to obtain in-depth information, describe the situation in question, or create themes through interviews, observations, documents, or reports about a determined situation at a certain time (Merriam, 2009).

Research Sample

This study was conducted with 76 students (11-14 years old) selected voluntarily, studying at 16 public middle schools in Kayseri in the fall semester of the 2021-2022 academic year. Convenience sampling was used to determine the participants included in the study group. Convenience sampling is the sampling method conducted through the determination of the individuals suitable for the research task at hand (Fraenkel et al., 2012).

In the study, the confidentiality of the participants' information was given importance and the participants were represented with the letter "P". Participants P18, P22, P28, P52, P57, P67, and P70 stated that they have previously received robotic coding training.

Research Instruments

In this study, a questionnaire consisting of open-ended questions, one of the data collection tools commonly used in case studies, was utilized (Johnson & Christensen, 2019). The questions in the questionnaires aimed to determine the perceptions of the students regarding robotic coding. The questions were prepared by the researchers based on the results of a literature review (Ceylan & Gundogdu, 2018; Yayla Eskici et al., 2020). The questionnaire, which was first prepared as a draft, was examined by an expert science educator and a Turkish teacher, followed by a finalization process in which the necessary arrangements were made. The questions in the questionnaire have been given below:

1) What comes to mind when you think of a robot?
2) Have you ever seen a robot in your life? If yes, where did you see it? What were the characteristics of the robot?
3) Would you like to design a robot? Why?
4) If you were to design a robot, what would be the characteristics of the robot you designed?
5) What would you need to design a robot?
6) What comes to mind when you think of coding?
7) Would you like to take coding training?
8) What do you need to be able to code?
9) Would you like to work in a profession that will require you to code in the future?

Validity and reliability

The validity and reliability studies are detailed in Table 1 under the headings of internal validity, external validity, internal reliability, and external reliability.

Table 1

Precautions Regarding Validity and Reliability

Validity-Reliability	Definition	Measures taken
Internal Validity	The consistent progress of the entire research process in research and the clear expression of this consistency (Yildirim & Simsek, 2016). It is recommended to include participant confirmation and expert opinion to ensure internal validity. Additionally, data-sources, investigators, methods, and theory triangulation can be done (Merriam, 2009).	● The opinions of an expert science educator and a Turkish teacher were taken for the questionnaire to be used in the research. ● Four researchers involved in the study participated in the data collection and analysis processes. (Investigator triangulation) ● The direct opinions of the participants were included in the findings section. ● After the analysis, participant confirmation was carried out by asking the participants whether the findings of the study accurately reflected their thoughts. ● Meaningless and irrelevant expressions were not included in the content analysis.

External Validity	The research results are generalizable (Fraenkel et al., 2012; Yildirim & Simsek, 2016).	● The steps performed in the research are explained in detail. ● Participant confidentiality was protected by giving codes to the participants.
Internal Reliability	Different researchers obtaining similar results with the same data (Fraenkel et al., 2012; Yildirim & Simsek, 2016).	● Findings are presented as they are, without comment. ● The purpose and result of the research are clearly stated.
External Reliability	Whether or not data similar to research data can be obtained in environments similar to that of the research (Fraenkel et al., 2012; Yildirim & Simsek, 2016).	● The findings, conclusion, and discussion sections of the research are explained clearly and comprehensibly. ● The findings of the research were explained in line with the expert opinions.

Data Analysis

The data was analyzed through content analysis. The data was defined by the researchers and codes were determined to summarize the responses of the participants. Similar codes were grouped under categories that summarized the questions at hand. Additionally, the data was examined by the four researchers, and the final codes were determined by reaching a consensus with them. The percentage of agreement of the codes as determined by the four researchers was calculated according to Miles and Huberman's (2015) formula. For the content analysis to be reliable, it is necessary to provide a consensus rate of 80% among the coding of the researchers (Miles & Huberman, 2015; Patton, 2002). Since the percentage of the agreement between the four coders was found to be 85% in the study, the findings obtained were reliable.

Results

In this section, the data was categorized and listed in tables. Each table contains the codes for a category. Additionally, direct quotations of the participants for each code are also included in the tables.

Table 2

Findings Regarding the Category of "Associations to the Concept of Robot"

Codes	f	%	Sample statements
Technology	29	38.16	P43: *"Machines that make human life easier by developing with technology."*
Machine	24	31.58	P9: *"Machines that make our job easier."*
Assistant	24	31.58	P21: "*Technological tool made by people to make our lives easier.*"
Artificial intelligence	15	19.74	P35: *"Artificial intelligence made to make things easier"*
Invention	6	7.90	P38: *"All of the inventions that aid human affairs or human health"*
Scientific and Technological Research Council of Turkey (TUBITAK)	1	1.32	P2: *"Scientific and Technological Research Council of Turkey (TUBITAK)"*
Toy	1	1.32	P65: *"Toy that moves all over"*
Science	1	1.32	P75: *"Science"*

When Table 2 is examined, it can be observed that the students mostly associated the concept of the robot with the concepts of technology, machines, and assistants. Moreover, many students associated it with the concept of artificial intelligence.

Table 3

Findings Regarding the Category of "Encountering with the Robot"

Codes	f	%	Sample statements
No	57	75.00	P69: *"No, I haven't seen."* P74: *"No"*
Yes	19	25.00	P22: *"Yes. I saw it when I attended coding training. He was making small movements when commanded."*

Most of the students have not encountered a robot before (Table 3). Students who stated that they had seen a robot before, on the other hand, stated that they generally saw it on television and in educational environments.

Table 4

Findings Regarding the Category of "Desire to Design a Robot"

Codes	f	%	Sample statements
Being beneficial to humanity	28	36.84	P3: *"Yes, I would like, because it's nice to make people's lives easier."*
Individual benefit	25	32.90	P63: *"Yes, I would like to design a robot, but I would usually use the robot I designed to make my daily life easier."*
Curiosity	8	10.53	P48: *"Yes, because I find robots interesting and I would love to study them."*
Being beneficial to the country	5	6.58	P38: *"Yes, because I would like to contribute to our country and the whole world."*
Interest	5	6.58	P19: *"Yes. I like to fix things."*
Being happy	4	5.26	P1: *"Yes, I would be happy when it walks."*
Being beneficial to the nature	2	2.63	P57: *"Yes. Because most importantly, I would like to make a robot to pollute the environment and nature less."*
Making difference	2	2.63	P44: *"Yes, because I would like to design in a different way other than everyone else, be one of the highlights, and share my knowledge."*
I do not want to design a robot	2	2.63	P68: *"I do not want to design robots because I am afraid of robots."*
Experiment	1	1.32	P30: *"To make experiments.*"

Students generally wanted to design a robot (Table 4). The general reason for this desire was the thought that the robots they designed would benefit humanity and themselves. Additionally, it can be seen that students' curiosity about robots is also effective in their desire to design them.

Table 5

Findings Regarding the Category of "Features of Robot Designs"

Codes	f	%	Sample statements
Showing human characteristics	47	61.84	P1: *"It should walk, talk and play ball."* P12: *"I would like to design a robot that teaches me like a teacher.*" P17: *"It would talk to people and understand them."* P19: *"The robot would do the things we do like a human, there would be two of us."* P34: *"I would like to make a design that can fly, walk and swim."*
Serving humanity	14	18.42	P75: *"I would like to design a robot that will meet the needs of people with disabilities."*
Doing any kind of business	13	17.11	P23: *"A robot that can speak and understand all the languages of the world, can make all kinds of drawings, is stronger than humans, can always recognize the person in front of it, can take pictures whenever we want, answer incoming calls, has a video player, and can drive a vehicle."*
Defense	5	7	P57: *"A militarily strong robot, can think analytically, can make the job of our soldiers easier, and neutralize the enemy as soon as possible. It would have domestic and national materials that are strong like steel, flexible like pasta, highly mobile."*

Detection	4	5.26	P46: *"I wish it could detect a person."*
Protecting nature	4	5.26	P8: *"Cleanliness, self-defense and being kind to animals"*
Being waterproof	4	5.26	P15: *"To be waterproof, to talk, to be smart, to be able to answer my question."*
Artificial intelligence	3	3.95	P11: *"It would have artificial intelligence."*
Repairing	2	2.63	P54: "*Must be able to repair the car and be waterproof.*"
Being not scary	1	1.32	P68: *"Doing people's work, being tolerant, being not scary"*
Storing information	1	1.32	P39: *"I would like to design a robot that can store information."*
Being customized	1	1.32	P5: *"It could talk and it could be customized"*
Imitating	1	1.32	P10: *"It would have an imitation feature."*
Auto-sleep	1	1.32	P74: "*Auto-sleep and waterproofing*"
Having a screen	1	1.32	P55: *"I would like it to have a screen."*

When Table 5 is examined, it can be seen that the robots would generally exhibit human features such as speaking, swimming, walking, and sensing. Additionally, according to many students, serving humanity and doing all kinds of work are features of robots.

Table 6

Findings Regarding the Category of "Needs in Robot Design"

Codes	f	%	Sample statements
Technological tool	51	67.11	P3: *"Example of technological tools: tablet."* P31: *"Battery, cable, electricity, aluminum, button."*
Metal	19	25.00	P20: *"Things like metal and solder."*
Cable	15	19.74	P31: *"Cable, sensor, processor, motion motors."*
Robotic coding	9	11.84	P57: *"Imagination, a coding program, motion sensor, powerful processor, waterproof frame."*
Knowledge	7	9.21	P53: *"Artificial intelligence, knowledge, equipment."*
Electricity	5	6.58	P42: *"Metal, battery, motor, electricity, circuit components."*
Artificial intelligence	5	6.58	P11: *"Artificial intelligence."*
Unclear	5	6.58	P61: *"I would need some things."*
Creative thinking	4	5.26	P68: *"I would need tools and human intelligence."*
Money	3	3.95	P1: *"Money, knowledge."*
Expert	2	2.63	P10: *"To someone who understands computer systems, to the mechanical engineers, etc."*
Employee	2	2.63	P72: *"Money, employee, some technological tools"*
Laboratory	1	1.32	P73: *"Money, employee, construction tools, atelier, laboratory"*

Table 6 indicates that students generally need technological tools to design a robot. Moreover, metal parts and cables are also needed.

Table 7

Findings Regarding the Category of "Associations to the Concept of Coding"

Codes	f	%	Sample statements
Giving commands	25	32.90	P16: *"To command something"*
Technology	15	19.74	P72: *"Computer science comes to my mind."*
Software	12	15.79	P13: *"Software"*
Robotic materials	9	11.84	P8: *"Main material inside the robot."*
Numbers	10	13.16	P42: *"Making a code with numbers."*
Password	8	10.53	P10: *"Encryption with numbers"*
Knowledge	1	1.32	P33: *"Knowledge required to build a robot."*
Applications	1	1.32	P6: *"Applications"*
Detection	1	1.32	P56: *"Applications"*

When Table 7 is examined, it can be seen that the students mostly associated the concept of coding with the concept of giving commands. On the other hand, it can be seen that many students associated coding with technology and software concepts.

Table 8

Findings Regarding the Category of "Desire to Getting Coding Education"

Codes	f	%	Sample statements
Yes	73	96.05	P23: "*I would like it very badly. I am very curious what it is like.*"
No	3	3.95	P7: "*No.*"

When Table 8 is examined, it can be seen that most of the students want to receive coding training, and only three students do not want to receive coding training.

Table 9

Findings Regarding the Category of "Needs for Coding"

Codes	f	%	Sample statements
Computer	45	59.21	P5: *"Computer and software."*
Electronic device	15	19.74	P52: *"First of all, I need to know the software and coding, then I need a device that can do the coding."*
Software tools	13	17.11	P34: *"Computer and software codes."*
Education	12	15.79	P43: *"Coding program, a good computer, and coding education."*
Expert	3	3.95	P2: *"A few supplementary materials and experts in their field."*
Mechanical system	3	3.95	P38: *"I would need a computer, electronic circuit, and mechanical systems."*
Internet	3	3.95	P72: *"Computer and internet"*
Tablet	3	3.95	P20: *"I would need a tablet."*
Unclear	3	3.95	P44: *"I don't know, I haven't done robotic coding before."*
Numbers and figures	2	2.63	P55: *"We need numbers and figures."*
Keyboard	2	2.63	P6: *"Computer and keyboard"*
Supplementary material	1	1.32	P2: *"A few helpful materials and an expert in his/her field."*
Cable	1	1.32	P4: *"Computer, cable, something to do coding."*
Telephone	1	1.32	P29: *"Technology (computer, tablet, telephone)"*
Algorithm	1	1.32	P13: *"Algorithm"*
Sensor	1	1.32	P28: *"A robot for robotic coding, or a device with a system that can receive the signal of my command, and a controller to give the commands."*

When Table 9 is examined, it can be seen students most need a computer to code. Additionally, students also stated that they need electronic devices, software tools, and training.

Table 10

Findings Regarding the Category of "Thoughts on Working in a Profession That Requires Coding"

Codes	f	%	Sample statements
Yes	60	78.95	P18: *"I would like to, one of my dream professions is computer engineering"*
No	14	18.42	P17: *"I want to be a pilot and fly an airplane."* P32: *"No because I want to be a doctor."*
Undecided	2	2.63	P49: *"It may or may not be…"*

Most of the students want to work in a profession that will require coding in the future (Table 10). Students who do not want to work in a profession that requires coding are interested in and willing to different professions.

Discussion, Conclusion and Recommendations

Discussion

The study aims to investigate the middle school students' perceptions of robotic coding. This research draws attention to several important findings. First of all, based on the content analysis results, most of the students stated that they have never encountered a robot before. Only a quarter of the participants stated that they had seen a robot on television or in educational settings before.

However, robots are becoming commonplace in our daily lives (Lum, 2020; Winfield et al., 2021) despite the fact very few robots look like humans. Thus, the participants may not be aware of the robots they encounter in daily life.

The results revealed that students mostly associated the concept of robots with the concepts of technology, machine, and assistant. This finding is parallel to those of the literature. In the study conducted by Cetintas & Avcu (2017) in which they examined the metaphorical perceptions of high school students regarding the concept of robotics, “technology” was the most used metaphor. Moreover, in the same study, metaphors were categorized into conceptual categories of their common features, and one of the three most common categories was “assistant”. In parallel to the findings obtained in the current study, Korkmaz et al. (2014) found that one of the most frequently used metaphors for robotics by high school students were the machines in their studies.

According to the results, it can be seen that almost all of the students want to design a robot. The reason for this is that they think that the robots they design would benefit humanity and themselves. This result coincides with the results of Guleryuz's (2019) study inspecting the opinions of secondary school students about robotic coding were investigated stating that the students believe that their living standards will increase as a result of robotic coding, and it will contribute to their future lives.

Students mostly stated that they would need technological tools to design a robot. Moreover, some students said they need metal pieces and cables. As is known, even ready-made robotics kits include cables and metal parts (i.e., LEGO® NXT Mindstorms, etc.). Considering that it is inevitable to use technological tools while designing robots, the findings are meaningful. For example, to code with a set such as Arduino, add-ons such as inputs, sensors, lights and displays are needed (Kondaveeti et al., 2021).

In the study, it can be seen that the middle school students usually imagined that the robots they would design would have human and living features such as speaking, flying, swimming, walking, and sensing. Similarly, in the study conducted by Timur et al. (2021), it was found that the majority of primary school students added human and living features such as faces and hands to the robots they drew. It was reported by the researchers that anthropomorphism, which is defined as the loading of human and living features into inanimate objects, is frequently seen in young children, and that anthropomorphism mostly decreases as individuals grow older (Byrne et al., 2009; Kallery & Psillos, 2004; Kattmann, 2008; cited by Timur et al., 2021). Cetintas and Avcu (2017) also found that “human features” is one of the metaphors used by high school students for the concept of robotics. Accordingly, the finding obtained in the current study appears to be widespread.

The results revealed that the students mostly associated coding with the concept of commands. In addition to this, many students associated coding with the concepts of technology and software. In Cakir et al.’s (2021) study, it was found that gifted middle school students often included the concepts of science and technology, command, and software while defining coding. This result is parallel with the literature. Coding is defined as “the process of writing a *command* sequence to get a computer system to act” or “the process of creating *software* that automatically fulfills a specific purpose, using a coding language and tool.” (Sayin & Seferoglu, 2016). Therefore, students put their fingers on the right points while describing coding.

According to the results, students mostly stated that they would need a computer to be able to code. Some students also said that they need electronic devices, software tools, and training. Likewise, the results revealed that almost all of the students want to receive coding education, and only three students do not want to receive an education on this subject. Parallel to this result, it can be seen that most of the participants want to work in a profession that will require coding in the future. Students who do not want to work in a profession that requires coding stated that they are interested and willing to work in different professions. There are three trends in the use of robotics in the field of education around the world: 1) Robotics as a learning goal, 2) robotics as a teaching aid, and 3) robotics as a learning tool. Robotics as a learning objective includes acquiring knowledge and skills required for careers in computer science, engineering, artificial intelligence, and robotics, especially at the university level. The use of robotics as a teaching aid includes the use of robotic technologies in order to assist the teacher. Finally, the use of robotics as a learning tool includes the utilization of robotics to ensure effective learning and to increase students' motivation (Eguchi, 2012). The sooner students are introduced to robotic coding, the stronger their motivation will be to pursue careers in fields such as science, technology, mathematics, and engineering. This will undoubtedly have a long-term positive impact on the country's economy.

Conclusion

This study aimed to reveal the mental perceptions of students aged 11-14 regarding robotics and coding. The questionnaire consisting of nine open-ended questions prepared for this purpose were given to 76 students online and the data were analyzed by content analysis. In line with the findings obtained, it was concluded that students mostly associated the concept of robots with technology, machines, and assistants, that they have an interest and desire for robotics and coding, and that they expect robots to demonstrate living features. Moreover, it was observed that the students mostly associated coding with the concept of giving commands.

Recommendations

In the light of the findings, some suggestions were provided for educators and researchers who may perform studies on similar subjects in the future:

1) Considering the students imagine that the robots they will design will show human and living features, activities to introduce students to robotic applications other than humanoid robots, visits to the workshops of the relevant departments of universities and institutions and organizations working in the field of robotics can be organized.

2) In addition, designing robots that display human and liveliness characteristics in parallel with students' perceptions in the early stages of their training in robotic coding can increase students' interest and motivation.

3) This study can be repeated with different age groups. Additionally, different methods and techniques such as the draw-and-explain method could be used to collect data.

4) Research similar to this study could be conducted with students with and without knowledge regarding robotic coding. Subsequently, differences between student perceptions could be compared.

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