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What do primary school students think about mobile programming education? “Developing my own mobile game”

Miray Dağyar 1, Department of Educational Sciences, Akdeniz University, Turkey, mdagyar@akdeniz.edu.tr https://orcid.org/0000-0002-7129-9236

Gamze Kasalak, Department of Educational Sciences, Akdeniz University, Turkey, https://orcid.org/0000-0002-5084-0054

Evren Sezgin, Department of Informatics, Akdeniz University, Turkey, https://orcid.org/0000-0003-1270-581X

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Abstract

The purpose of this study is to reveal the views of 4th grade primary school students about mobile programming education. Data were collected by using interview, metaphor and student drawings under qualitative research method. Among the 135 students who participated in the mobile programming education, 24 fourth grade primary school students who were selected via the purposeful sampling method, took part in the study. Content analysis was used to analyze the data collected through the semi-structured interview form. The drawings of the students which reflected what the mobile programming education meant for them were evaluated through document analysis. As a result, it can be said that mobile programming education contributes positively to students' mobile programming, scientific and creative thinking skills and social skills. It is recommended to use MIT App Inventor in programming education for primary school students.

Keywords: Mobile programming; mobile programming education; MIT app inventor; information technology; primary school students

1 ADDRESS FOR CORRESPONDENCE: Miray Dağyar; Akdeniz University, Faculty of Education, Department of Educational Sciences, Curriculum and Instruction, Akdeniz Üniversitesi, Eğitim Fakültesi, 4. Kat Ablok/424 Konyaaltı/Antalya, Türkiye

E-mail: mdagyar@akdeniz.edu.tr; miraydagyar@gmail.com / Tel: 0090 533 732 9130

1. Introduction

With globalization, the decrease in resources, the increasing competition between countries in the field of innovation, and the acceleration of the industrial and technological development race forced countries to reform their education policies. Because globalization has led to an increase in the need for individuals who think, produce, question and creative in the fields of science, technology, engineering and mathematics (Yildirim & Altun, 2015). As a matter of fact, when 21st century skills are analyzed, it is emphasized that students must be educated to posses skills such as; informatics literacy, creativity, problem solving, critical thinking, cooperation, effective communication, accessing and analyzing data, etc. (p21, 2019). Recent advances in data transfer and telecommunication have forced our daily lives have been regulated by computers and alternative communication devices through the softwares and such systems. However, considering the people who developed the programs and the software that are believed to control life, it is clear that the main manager is those who develop information technologies. Hence, programming education is seen as effective in gaining 21st century skills to students, and programming skills are counted among the skills of this century (Akpinar & Altun, 2014). Programming education is considered important in the literature, in terms of contribution to students of critical thinking skills (Alp, 2019), creativity (Kobsiripat, 2015), information-processing thinking skills (Oluk, et.al., 2018; Yunkul, et.al., 2017), academic achievements (Dincer, 2018; Kececi, 2018), motivations (Erol, 2015; Topalli & Cagiltay, 2018), reading comprehension skills (Papatga, 2016), problem-solving skills (Bala, 2019; Vatansever & Goktalay, 2018), attitudes towards lesson and learning (Chiang & Qin, 2018; Papadakis, et.al., 2016). Considering the importance of programming education and its positive effects on individuals, in information societies, introducing individuals to coding and computer programing especially at a young age may help such societies to stand on those individuals shoulders.

In teaching programming to young students, teaching supported by a programming tool is regarded as important for children to make sense of programming more easily and particularly to love it (Chiang & Qin, 2018; Papadakis & Orfanakiz, 2016; 2018; Panselinas, et al., 2018; Papadakis, et al., 2017; Kalelioglu & Gulbahar, 2014; Shin, & Park, 2014; Uzgur & Aykac, 2016; Yildirim, 2017). Yildirim (2017) concluded that teaching with Scratch contributes to programming education in his study, which aims to develop a mobile application in Scratch programming language in order to improve the programming skills of middle school students. In another study evaluating the draft program of an Information Technology and Software course, it is stated that the Information Technologies teachers who examined the program think that the programming subject which is included in the contents and not supported by any programming tools is above the mental development of primary school students (Uzgur & Aykac, 2016). In a study by Gunes and Karabak (2013), the curriculum of Information Technologies and Software (ITS) course, taught as an elective course in the secondary school education programs in 2012, was examined; and based on the lack of a specific curriculum; they proposed a curriculum model which was grounded on the Scratch programming tool. Instead of teaching programming to primary level students with the model they developed, they stated that a curriculum in which the Scratch program was employed in order to encourage students to love and develop software was more suitable for students' mental development. Considering the cognitive structure of the students at primary level, it is thought that presenting an abstract content such as software development and programming to students firstly by means of a certain program will be useful for the course to be loved and learned more easily.

In addition to the importance given to computer programming education, mobile programming trainings are also important in information societies with the placement of computers in portable mobile devices. Reducing the size of computers to carry, has made technology more common among people. Today, it can be said that people use mobile phones or tablets more than their computers. According to the results of the statistical study of Turkey Statistical Institute (TSI) (2018) about the rate of information technologies in households, between the years 2004-2018, while the number of mobile phones and

portable computers in households increased over time and the rate of landline and desktop computers decreased. This situation has made children acquainted with portable information technologies at a very young age. In the study by Ozyurek (2018), the use of computer technologies in preschool children aged 4-6 years revealed that 53.5% of preschool children use mobile phones and 34.9% use tablet computers.

Although the children start to meet mobile devices in the preschool period, it is stated that in terms of cognitive, affective, psychomotor and social development levels the children in the primary school age are in the appropriate age range for mobile programming education in which coding is done in order to develop games and applications (Morelli, et.al., 2011; Ozdinc, 2015). Recently, a programming tool called MIT App Inventor has been developed which requires no prior programming skills in order to build an Android App which may help people to love programming. These programs allow students to learn coding without having any difficulty as if they are playing games, so children can step into the world of information technology at young ages (Gray et al., 2012).

MIT App Inventor has been developed by the Massachusetts Institute of Technology (MIT) to teach students programming. App Inventor is a visual environment where blocks are used to develop mobile apps and users have the opportunity to develop their own mobile apps. To be able to build an app using MIT App Inventor, students are required to choose appropriate blocks among many and associate them with each other in such a way they solve a jigsaw puzzle. In this way, users not only are relished, but also have an opportunity to improve their -problem-solving skills. By the advantage of this visualization provided by App Inventor program, features such as the selection of blocks from the relevant block menu and guidance of the shapes about how the blocks are to be merged minimize the syntactic and cognitive failures of beginners in programming in the learning process. Therefore, via MIT App, users are able to develop apps at a young age (Ozdinc, 2015). App Inventor is successfully used in post-graduate programs, summer camps, teacher workshops, and all computer courses from primary school to university in the USA (Gray et al. 2012). In Papadakis et al.'s (2016) experimental studies to determine the effect of using Scratch and App Inventor programming languages on student performance and attitudes, they found that the group using App Inventor had higher performances than the group using Scratch and the group using the typical text-based programming language. Papadakis, S. (2019), in his another study, analyzed the behavioral and learning differences of students for Scratch and App Inventor. It has been determined that students who learn programming with App Inventor have a more positive attitude and higher motivation and learning outcomes compared to the group with learning Scratch.

1.2. The purpose and significance of the research

In order to introduce primary school students to App Inventor, to teach them mobile programming, to make them love it, and to enable them to produce a mobile app, mobile programming education was designed within the scope of a project. The purpose of this study is to reveal the students' perceptions about mobile programming education with App Inventor, which has been developed within the scope of the project.

The study is considered to be important in terms of: Most of the studies on programming education in literature are based on Scratch programming language. Unlike Scratch, the App Inventor programming tool is important to give you the opportunity to develop applications on mobile devices. Considering the importance given to mobile devices today (TSI, 2018), it can be said that developing applications / games on mobile devices will increase the interest in programming. It is thought that the study will help to close the deficiency in the literature in terms of building mobile programming education with APP Inventor programming tool. In addition, the study is considered important because the group of students included in the study consists of primary school students who are introduced to information technologies at an early age in their lives but are intended to use them correctly. Khaddage and Margaritis (2020) emphasized the importance of primary school students who were directed to distance education during the pandemic

period to know mobile programming and emphasized students can be integrated into remote school projects and tasks by developing mobile applications.

In the 21st century, individuals must have certain skills in order to be successful both in education and business life (Uluyol & Eryilmaz, 2015). It is important to integrate science technology, engineering and mathematics education (STEM) into the curriculum in order to gain these skills to students effectively (Cepni & Ormanci, 2017). In the "STEM Education Report" published by the Turkish Ministry of National Education in 2016; It was emphasized that STEM education will contribute to the development of 21st century skills of students, increase their interest in STEM career professions and increase the success of Turkey in exams such as PISA and TIMSS. For this, it was stated that especially STEM education should cover all educational processes from preschool to higher education (MEB, 2016). For this reason, this research, which is applied by mobile programming education as out-of-school activities in primary school, is thought to contribute to the use of technology activities in primary school. Thus, it is thought that students will have positive contributions to the attitudes of primary school 4th grade students towards mobile programming education and to the development of 21st century skills. Within the scope of the study, it was tried to create a perspective for the development of 21st century skills by investigating the development of students in depth with qualitative methods. With this aspect, it is thought that the study will contribute to the literature in this field.

The purpose of this study is to reveal the views of 4th grade primary school students about mobile programming education. For this purpose, it seeks to address the following questions:

1. What are the expectations from mobile programming education?
2. What are the benefits of the mobile programming education?
3. What challenges do students face in the mobile programming education?
4. What can be done in order to improve the mobile programming education?
5. What is the importance of the mobile programming education?
6. What are the metaphors about the mobile programming education?

In addition to the research questions mentioned above, students' drawings which reflect the meaning of mobile programming education for themselves were examined that the meaning of the mobile programming education according to the views of the students.

2. Method

2.1. Research design

This study, which aimed to present the views of 4th grade students who took part in the mobile programming education on mobile programming education, was planned in qualitative research method. In this study, it is preferred to use holistic single case design, because case studies provides in-depth investigation to the researcher without intervening in an event, understanding, and the opportunity to make inferences about the effect or relationship between the subject and the individual (Saban & Ersoy, 2017).

2.2. Research group

The study group of this research consisted of 24 4th grade students who were selected among the 135 students who participated in the project via the purposeful sampling method, and who took part in the study voluntarily. In qualitative researches, in-depth interviews with 5 to 25 participants were sufficient in

terms of sample size (Yildirim & Simsek, 2018). For the project, mobile programming education was given in eight different laboratories, four of which were in the morning group and four in the afternoon group. Three students from each of these eight different laboratories were involved in the study. Based on the belief that the interviews may be inadequate in terms of age, individual interviews were conducted with 24, 4th grade students. Of the 4th grade students that participated in the study, 16 were male and 8 were female. The ages of the students ranged between 9 and 10. Totally, 19 of the students were studying in state schools and 5 were in private schools.

2.3. Data collection and analysis

Mobile programming education was designed as a 16-hour course based on the teaching of MIT App Inventor program, which was among the mobile programming tools, in order to introduce students to information technologies and to provide them with the knowledge of programming and software development. Mobile programming education had several aims for the 4th grade students who formed the target audience of the research as in the following: (1) to learn about mobile programming concepts, tools, apps, (2) to use MIT App Inventor program, (3) to have knowledge about coding and programming, (4) to acquire and develop problem solving, reasoning and information-processing skills, (5) to acquire collaborative working skills, (5) to share what they have learned online, (6) to develop an understanding of the Algorithm design, and (7) to develop innovative and original projects such as game-based apps which facilitate their learning. The development of cognitive thinking in mobile programming education is supported by various activities such as classroom observations, games, workshops and drama, as well as by the use of MIT App Inventor programming tool.

Data were collected through individual interview and document analysis methods. In the first method, data were collected through semi-structured individual interview form developed by the researchers based on the literature review, expert opinions and pilot study. In order to construct the individual interview form in accordance with the literature review and expert opinions, a pilot study was conducted with five students who were eligible for the sample criteria of the study and at the participant development level of the project.

The pilot study provided the researchers with the opportunity to conduct a detailed and effective individual interview and to lay the groundwork for thorough understanding of the individual experiences of mobile programming. It also enabled the interview questions to be reviewed and necessary corrections to be made. After the pilot study, individual interviews with the study group started. In this context, six major research questions were addressed to determine what students experienced during the mobile programming education and how they had that experience (Moustakas, 1994). Students were asked questions about the mobile programming education: (1) the expectations, (2) the benefits, (3) the challenges, (4) the suggestions, (5) the importance, and (6) the metaphors.

In order to provide an interaction that is based on trust, individual interviews were conducted in the computer lab where mobile programming education was given. Individual interviews conducted before the education took 10 minutes on average, and the individual interviews conducted after the education took 25 minutes on average. During the individual interviews, the students were asked the questions found in the semi-structured individual interview form. When the answers were not fully understood and the topic began to digress, the interview questions were expressed in different ways and in-depth information on the subject was provided.

In order to better analyze the data to be obtained from the individual interview and to save time, the voices of the students were recorded on the devices with sound recording feature. The recorded interviews were transcribed word for word in the computer environment. Approximately 32-pages-long data set was obtained. Data were analyzed through content analysis technique. With content analysis,

coding and themes/categories were formed based on the content and meaning of the important expressions that reflected the essence of the students' experiences in mobile programming education. In order to elaborate on what students experienced about mobile programming education and how they had that experience, interview texts were frequently referred.

The second data collection method of the research is document analysis. In this context, students were asked the question "What is the meaning of the mobile programming education for the students?". In the research, 4th grade students, who were in the process of transition from concrete operational stage to abstract thinking stage, were asked to draw pictures to be able to understand and answer an abstract question more easily. The drawings were examined as a document of data for the research.

In order to increase the internal validity of the research, the researchers acted flexibly at the data collection stage (Yildirim & Simsek, 2018); a long-term, close and trust-based interaction was made with the data sources; avoided being a router; a variety of sources, methods, researchers and theories were used; confirmation of participant received (Creswell & Poth 2018); the findings were consistent in themselves and the resulting concepts formed a meaningful whole (Miles & Huberman, 1994). In order to ensure the external validity of the research, the research process (research design, study group, data collection tool, data collection and analysis, findings and results) was described in detail. Thus, the data was aimed to be conveyed to the reader without any interpretation and by sticking to the nature of the data as much as possible (Yildirim & Simsek, 2018). In addition, a study group was established on the basis of accessibility, compliance and voluntariness by using purposive sampling method. In order to ensure the internal reliability of the study, two experts were asked to encode the interview transcriptions of the three students, who were selected by lot and corresponded to 12.5 % of the participants in the study group, by adhering to the coding list generated by the researchers. Kohen Kappa consistency coefficient was calculated to determine the compatibility between the coding of the experts. This coefficient value was determined as 0.84. In order to ensure the external reliability of the study, the details of the research processes were submitted to expert review and a confirmation was sought.

2.4. Ethical procedures for data collection

Prior to the individual interviews, a meeting was held with the parents of the students to ensure their participation in the research due to the fact that the students who were the participants of the research were under 18. At the meeting, the parents were asked to sign a permission form which stated that the identity of the students participating in the research would remain confidential, the results of the data to be obtained in the research would be discussed and published in scientific environments, there was no risk of physical and psychological damage in the research, recording the individual interviews on tape recorder depended on their individual permission and they could withdraw from the study if they wanted. Individual interviews started after all the parents reviewed and signed this form.

3. Findings

3.1. The expectations from the mobile programming education

Most of the students who participated in this study emphasized the importance of developing mobile applications, learning how to code, learning about the effective and healthy use of mobile devices. Some of the students stated that it was not easy to develop a mobile app before the education and after the education. Students' statement "My classmates said that the letter A looks like a very confusing letter there. In fact, I am a bit scared. I even told my parents that I couldn't do it, I would have difficulty. My parents said let's give it a shot, and when we got the opportunity, let's use it" and "I have found out that the games are not as easy as I thought." can be explanatory at this point. During the interviews, a student's

expression "…I dream of learning about professions such as computer engineering… I wonder if we can learn anything about scientists while doing this…" supports the ideas about obtaining information about scientists and learning about computer-related professions.

According to the findings, students' expectations from the mobile programming education and what they learned after the education are similar. In this case, it can be suggested that the education provided has met the expectations of the students to a large extent.

3.2. The benefits of the mobile programming education

Most of the participants mentioned that students enjoyed when they did the activities in during the mobile programming education. The activities that students enjoyed in during the mobile programming education are as follows: "we are getting ready to present our projects" (We are getting ready to present our projects", students are taught different mobile gaming apps. E.g. Image capture.) , "my dictionary" (students are enabled to develop an English-Turkish dictionary by using the App Inventor program), "How can I help you?" (an application that reads the messages received by a computer or phone is intended to be developed for people with disabilities and for those who do not have time to read.), "Finding cities on the map" (students are expected to develop an app that shows the addresses they have written on the map.), and "Let's shake the phones" (students develop an app that changes the color of the screen each time they shake their mobile devices.). During the interviews, the students were also asked to express their opinions about why they enjoyed the activity or activities which they stated they loved most. As a result of the interviews, the students loved the activities because the activities were fun, new knowledge, easy, useful. And also, they were related to education and encouraged creativity. According to the findings, students' opinions about why they liked the activities that they chose can be accepted as a sign of the fact that mobile programming education was easy to learn, fun, and in accordance with the development level of primary school students.

In the interviews, fourteen students mentioned the importance of learning the concept of mobile programming. In support of this idea, the following quoted opinions of the participants are presented below:

"… Actually I was thinking whether I could do programming before I came here and now I can do it."

"I told my friend, Melis, what a code meant. I explained that in order to move the inanimate entities, we needed to create encodings that meant the computer language. I could not answer what the code was in the past. Now I can."

During the interviews, a student's expression "…I also met the students in the classroom. I met the teachers at the university… I have seen the university… There are huge gardens." supports the idea about getting to know the university environment, meeting new friends, and meeting new teachers. Other benefits of the mobile programming education were that it taught students how to use mobile devices effectively and efficiently, it increased the belief that they could be successful, and it contributed to school lessons. A participant's opinion is considered important in terms of giving an example for this situation:

"I felt more successful when I learned how to make apps... When I learnt how to use computer, it became more helpful. My teacher had given homework, but I could not do it because I did not know beforehand, but I did my homework quickly thanks to what I learned her".

3.3. The challenges students face in the mobile programming education

In the interviews with students, almost all of them mentioned the problems failuring to create mobile programming codes and falling behind while designing mobile apps during the mobile programming education process. The problem of some students' making noise in the classroom was expressed by the

statement: "Some children talk a lot. I can't hear the teacher and I can fall behind.". In addition, four students stated that they had difficulties because the programming language was English. The statement of a participant given below reflects this situation:

"I could not decide and understand the coding part, and the programming was in English and I was confused."

In the education, the difficulties that could be faced by the students were foreseen and the necessary measures to minimize them were attempted to be taken before the education. In order to prevent students from having difficulty in creating mobile programming codes, instructor and counselor support was increased in the classroom. Although the students had difficulty in coding, since they were asked to develop an app within the scope of the project, it can be stated that they have learned coding when it is considered as a skill.

3.4. The suggestions in order to improve the mobile programming education

One of the points that was emerged in the research and overemphasized by all of the students was that duration of the education should be extended, education should be arranged according to class levels and mobile application activities should be worked on outside the education period as well. Students' statements "…I think it should be more than 4 weeks." and "…Education period should be extended a bit more. I wish I could come here more." can be explanatory at this point. A student stressed the suggestion of developing applications involving different technological devices by stating "Smart watches can be worked on. Different apps can be added into them when they develop." In addition, a student who suggested that the apps used during the education should be recorded and shared with the students expressed his opinions as follows:

"It can be faster. When it is done for the first time, it can be filmed and shown to everyone on the computer. So everyone can do it all. Students can consult to the video when they linger on something. Therefore, we don't have to wait. Solutions can be found with the video again. When the video is shot and started on YouTube, students can look at where they linger or directly at that part. Students can do by consulting to the video. In this way, it becomes a faster method."

In general, the suggestions of the students about the education indicate that they are satisfied with the education but they have also emphasized what can be done to make it better.

3.5. The importance of the mobile programming education

The students participating in the research emphasized the codes "contributing to the future profession", "increasing personal development and learning capacity" and "teaching how to use mobile device in an effective and useful way" during the interviews. Some of the students emphasized the importance of the contribution to their professional goals by stating "I think it is important for those who want to be a software engineer" and "if we study computer programming in the future when we improve ourselves, it will be useful for us." Another student considered that education was important because it offered an opportunity to improve herself by stating "I regard it as important. It improved our development of intelligence, enabled us to learn these, and helped us produce new games." In addition, a student also thought that mobile programming education was important because science and technology would be advanced in the future, he could produce products for science and technology in the future, and

it would contribute to the development of the country. A participant's opinion is considered important in terms of giving an example for this situation:

"I think that everything will be via programming in the future. That's why programming is important. We have to receive its education… because we can produce better things in the future. In this way, we can develop. We can find newer things. We will become a more developed world or country."

Students' views on the importance of the mobile programming education can be considered as an indicator to reveal the importance of education for the future of students as well as of society.

3.6. The metaphors about mobile programming education

By focusing on the different aspects of the mobile programming education, students created a total of 23 different metaphors in eight different categories as animal, electronic device, building/place, plant, hobby, human/organ, material and nature (Table 1).

Table 1. The metaphors created by the students for the mobile programming education

Categories	Codes	Categories	Codes
Animal	Dolphin (rational)	Electronic device	Advanced small ball (constructive)
	Bird (libertarian)		Computer (subsidiary)
	Dog (didactic)		Phone (didactic)
	Chameleon (fun)		Television (fun)
	Rabbit (fast)		Robot (didactic)
Building/place	Home (inclusive)	Plant	Tree (inclusive)
	Door (exploratory)		Flower (didactic)
	Stairs (progressive)		Sunflower (directive)
	Maze (exploratory)		
Hobby	Puzzle (integrative)	Human	Human (constructive)
	Book (didactic)		Brain (creative)
Material	Glass (inclusive)	Nature	Rainbow (fun)

As seen in Table 1, the reasons why students likened the metaphors they created are classified as being didactic, fun, inclusive, exploratory, constructive, rational, libertarian, fast, subsidiary, directive, integrative, progressive and creative. By likening the mobile programming education to a "dog", a student emphasized the didactic aspect of education and stated "We teach the program what to do with the commands we give. We can also teach a dog to sit down, to stand up, or to do something we want by giving it a food that it likes". Another student touched upon the fun aspect of education with the "rainbow metaphor" and stated his views in relation to this metaphor with the words "There are many different confusing and fun games, as if I was in a colorful game". The student who used "tree metaphor" mentioned the inclusive aspect of education with the opinion that "Trees are home to almost all animals. Mobile

programming education resembles this. All applications have all the excitement, love and knowledge." The student who used the "door metaphor" emphasized the exploratory aspect of education with the words "We come across new information in this education all the time just like we come across new things when a door is opened." Another student mentioned the "puzzle metaphor" and the integrative aspect of education with the view that "We merge blocks in piece in the education." According to the findings, the common aspect of the metaphors students created is that they all reflect positive thoughts about the education.

3.7. The meaning of the mobile programming education

In order to make students' perceptions about the mobile programming education more explicit, students were asked to make drawings that reflected the meaning of the mobile programming education for them. Below are samples of the students' drawings, and descriptions and comments about their drawings:

Binoculars drawn by a student are shown in Figure 1.

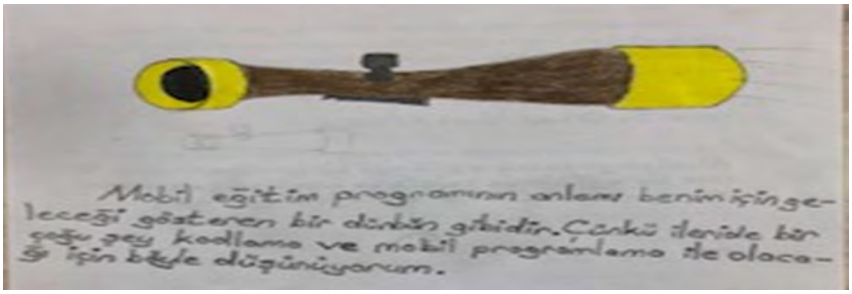

Figure 1. Looking ahead with the mobile programming education

As seen in Figure 1, the student explained the reason for drawing binoculars as "the meaning of the mobile programming for me is that it is binoculars that show the future. Because I think that many things in the future will be through coding and mobile programming." The picture that the student drew can be interpreted considering the explanation on the picture as follows: Nowadays, since children regard the devices of the time such as mobile phones, computers, and internet as parts of their lives, they see that the devices in their daily life will be a part of their future life, and people will turn to information technologies in the future even more effectively than today. For this reason, they may have perceived the mobile programming education as binoculars showing future societies, lives, and education systems, shortly the future.

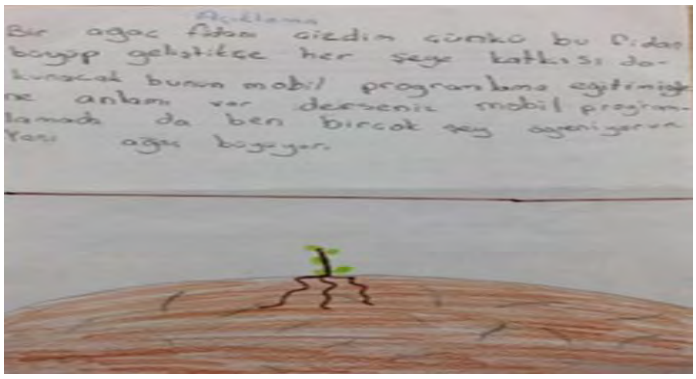

Figure 2. A sapling growing with the mobile programming education

As illustrated in Figure 2, the student explained the reason for drawing a tree sapling as "As this sapling grows, it will contribute to everything. If you ask what the connection is with the mobile programming education, I say I learn a lot in the education. In other words, the tree sapling is growing." Considering the explanation of the student on the picture, this picture can be interpreted in a way that the mobile programming education helped students see that they could do programming, and contributed to their desire to develop themselves in the field. As a matter of fact, the student likened himself to a sapling, and stated that with the mobile programming education, the sapling started to grow, and it would become a tree as it improved itself over time. Thus, he emphasized that he would help the whole society like a tree.

"The poster" drawn by a student can be seen in Figure 3.

Figure 3. S;U;C;C;E;S;S with the mobile programming education

As shown in Figure 3, in the poster, "programming" is written in large font size and blue color; the word "hardworking" is written in the yellow rectangular box; and the words "adventure" "information", "technology", "entertainment", "imagination", "understanding" and "loving" are written in the yellow hexagonal boxes. In addition, when the letters in the small triangle boxes between the yellow boxes are combined, the word "success" is formed. There are heart figures in the hexagonal boxes with the words "understanding" and "loving". It is also noteworthy that there is an "exclamation" mark in the "hardworking" box. Based on this picture, it can be stated that the student likes the mobile programming education; however, he thinks he is aware that he needs to work harder to improve himself. In addition, it can be stated that the mobile programming education is a symbol of adventure, entertainment, imagination, knowledge and success.

The drawings of a student which shows that he dreams of helping others with the mobile programming education and emphasizes that this education is a first step that can guide his future life are seen in Figure 4.

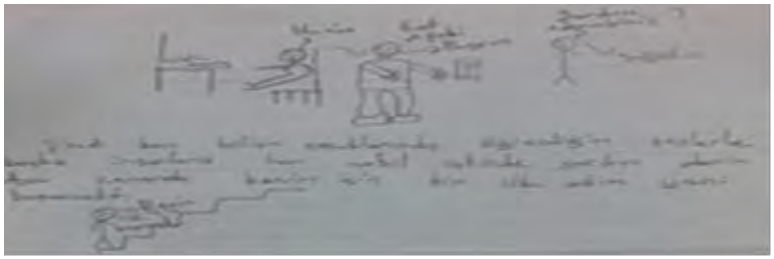

Figure 4. First step into the world of information technology with the mobile programming education

As shown in Figure 4, the drawing in the upper section of the paper shows that the student has set up a mobile base and will help a person who wants help in this mobile base. In the lower part of the drawing, the student stated that the mobile programming education he received was his first step into the world of information technology in his life. This picture of the student reveals that the education has a great place in the life of the student, that it increases imagination and creativity about helping people, and that he thinks he is educated in an area which he wants in his future as well. The student explained that he wanted to improve himself in the context of the mobile programming education which he described as a first step into the world of information technology by drawing a stair. He explained that he dreamed of going up the top of the stairs and he could offer help to the society while doing this by making many inventions for the sake of humanity thanks to programming.

4. Discussion

In this study, the views of 4th grade students in the study group on the mobile programming education and their drawings reflecting the meaning of the mobile programming education for them were evaluated. The metaphors created by the primary school students for the mobile programming education and all the drawings related to the education prove that they have a positive perception of the mobile programming education. Student views on the education confirm the metaphors and drawings of the students. The views of the students on the education were evaluated and interpreted as follows within the frame of the questions addressed to them:

One of the conditions for participation in the mobile programming education is that students have not received mobile programming education before. In this respect, the study aimed to reveal the expectations of the students from the mobile programming education before the education started. It was determined that the students mostly talked about obtaining information about the development of mobile gaming apps, coding, and the effective and healthy use of mobile devices before the education. Since the mobile programming education was conducted within the project, it was announced in the announcements made before the education that mobile programming/coding education would be given. Therefore, it can be considered normal for students to expect to develop mobile games, learn coding, and use mobile devices effectively before the education. In addition to these, there were also students who dreamed or thought that they could obtain information about electronic devices, robots, scientists, computer-related professions, etc. In order to find out whether the education conducted met the expectations of the students or not, the students were asked what they learned after the mobile programming education. In line with their expectations before the education, the students stated with a large percentage that they learned mobile programming, mobile game application and the concept of

coding and code writing within the scope of the education. Considering the aims of the 16-hour education, it can be stated that the main goals were these, and goals like computer use, opening a g-mail account were also declared by the students, and thus the education fulfilled the general objectives.

When the content of the apps that students stated as the activities they liked was examined, it was seen that there were educational and useful apps such as mobile gaming apps and dictionary or panic button. Therefore, when the students were asked why they liked the activities they stated, the students expressed that the activity they enjoyed was fun, it taught new information, and it was easy, creative and useful. Considering that students used mobile devices mostly to play games by their age, it is normal that the activities that allowed them to develop mobile games were the most interesting ones during the education.

In their research, Ouahbi, et.al. (2015) aimed to teach basic programming to high school students by using a programming tool, and to examine students' motivation for programming. According to the results of the experimental research, the success and motivation of the students in the education performed on game apps through Scratch showed a significant difference in the positive way compared to the programming education given by the teacher through instruction method. In the study of Erol (2015), which investigated the effect of Scratch programming education on the motivation of teacher candidates, it was found that game design activities with Scratch were found to be fun, easy to understand and increased motivation for programming. In another study on secondary school students designing educational computer games with Scratch (Peksen, 2019), it was stated that students enjoyed designing games and playing games with their friends, and they wanted to design games by programming other than French lessons. Fidan (2016), in his study, emphasizes that performing gamification through programming increases student participation and motivation, and as a reflection of this increase, student achievement increases.

In the research, in the stage of planning activities, attention was paid to the development level of the students and the lessons were arranged in a way that would allow them to play. In the first activities, the activities that would allow the students to gain the concept of algorithm were included in in-class game activities (jigsaw, making and flying a paper plane, wolf-lamb algorithm, etc.). After the students gained the programming infrastructure, coding instruction which would enable them to develop simple coding at first and then a mobile app on the App Inventor was given. In each activity, the coding was made more difficult than the previous one. In these respects, it is possible to explain the reasons why the students liked the mobile game activities a lot; especially the ones shown during the last two weeks, but also stated that they had the biggest challenges in these activities.

In the research, positive effects stated by the students included the fact that the education provided to the students helped them to see mobile programming as an area where they could be successful in their lives, that they thought it would contribute to their lessons in school and they would benefit from it to make use of their leisure time, and that it improved their foreign language skills and enabled them see the university. It was concluded that the students regarded meeting new friends as one of the positive effects of the education because of the fact that admission of students from different schools was taken into consideration in student selection for the education. As can be seen from the student views, the education was concluded to have many positive effects on children.

In their study, Nikou and Economides (2014) found that in the classroom where programming was taught with App Inventor, the students' motivation towards the course and self-efficacy increased, and their belief that they could perform well in the course strengthened. In his study, Kececi (2018) emphasizes that the games and activities developed with the Scratch program increase the academic success and motivation of Grade 6 students. In addition, Papatga (2016) showed that primary school students with reading comprehension problems improved their reading comprehension skills with the projects they

prepared with Scratch program. In a study by Kalelioglu and Gulbahar (2014), 5th grade students were given programming education with a programming tool and as a result of the research, it was determined that all students felt they liked programming and wanted to develop their own software even though there was no significant difference in the problem solving skills of the students. On the other hand, in his study in which Scratch teaching on secondary school students investigated the effect of students on problem solving skills, Vatansever and Goktalay (2018) states that game design is an effective method in Scratch teaching in order to increase students' problem solving skills. In the study of Shin and Park (2014), it was concluded that programming education had a positive effect on the problem-solving skills of primary school students.

Over the course of the mobile programming education, the students stated that they had the greatest difficulty in creating mobile programming codes. In addition to this, the students who stated that they had not encountered any problems and the ones who fell behind in following the steps of the process while developing the apps can also be accepted as the majority. The fact that the students who encountered mobile programming for the first time had difficulty in coding especially some applications, that they fell behind in the steps of the process or they had difficulty due to the program language were considered among the problems envisaged in the study. In order to minimize this problem, counsellors were made part of the education so as to assist the instructors and students in the classes (laboratories) where the education was provided. In this way, although the students had difficulty while coding, they were able to get help, and their falling behind the class was prevented. For example, the education booklet was prepared by considering the level of the students, and it was used during the classes. The instructors and counsellors made the necessary explanations when the students did not understand the instructions. Since the book was generally based on the codes, it may be considered normal for students to have problems in making sense.

In a study by Hsu and Ching (2013) on developing mobile apps with App Inventor in the teaching-learning process, it was stated that the students felt uncomfortable in reviewing the programming blocks when the apps they would develop became too complicated due to the inflexible interface of App Inventor. However, they also came to the conclusion that most of the students found the course and App Inventor fun and useful to reveal their creativity and create something fully functioning. Durak (2016) included students' opinions in an application for teaching the Scratch programming language. The students stated the weaknesses of the application as problems with technological equipment in the lesson, lack of lecture hours, some problems caused by Scratch, problems caused by teachers, problems caused by differences between students. At this point, it can be said that students face similar problems and difficulties in similar studies. The fact that programming trainings are employed in different courses can help to overcome the coding problems experienced by the students by gaining practicality. It can also contribute to the elimination of difficulties in teaching different subjects and coding difficulties. Kececi (2018) states that it is possible to benefit from activities that can be designed with programming in the subjects that students have difficulty in learning in different courses. Likewise, Cubukluoz (2019) stated that the mathematical games developed with Scratch were effective in eliminating the learning difficulties of secondary school students in mathematics lesson.

According to the students, mobile programming education is very important because it will contribute to their future career, increase their personal development and learning capacity and teach them to use mobile devices in an effective and useful way. In addition, it may be considered an important finding that the students think that they will contribute to the development of the country by receiving the education because science and technology will be advanced in the future. The studies carried out within the scope of a project support the students' views that the educations have positive effects on students because they are given out of school, they are satisfied with the educations, they can learn science and new

information while having fun, the information they have learned can facilitate their lives and they can do many activities they cannot do in school (Avci, et.al., 2015).

In the study, it can be stated that the mobile programming education increased student motivation for learning mobile programming since the education was provided within the scope of a project. In their study, Nikou and Economides (2014) examined student motivation for the courses in which they used Scratch and App Inventor programming tools. Since the students used mobile devices more commonly, they thought that programming mobile devices with App Inventor rather than Scratch programming tool was more useful and important. The duty value beliefs and intrinsic target motivation of the students were concluded to be stronger in the group where programming was conducted with App Inventor. The importance of programming a phone, which is important in students' lives, also gives motivation to students (Morelli et al., 2011). One of the benefits of working with App Inventor is that students can see what they are creating. This allows students to gradually develop and test their apps (Papadakis et.al, 2016).

The situation is more evident when the metaphors that the students created about mobile programming education and their drawings that reflected the meaning of the education for them are examined. Emphasizing the didactic, fun, inclusive, exploratory, constructive, rational, libertarian, fast, subsidiary, directive, integrative, progressive, and creative aspects of the education support the fact that positive perceptions occurred regarding the education. The presence of the drawings that show "looking ahead", "a growing sapling," "formation of the S,U,C,C,E,S,S slogan" and "the first step into the world of information technology" with the mobile programming education supports the fact that positive perceptions developed in students.

Bala (2019) stated in his study that he received student opinions on Scratch programming teaching, student views on programming were generally positive. The students found that programming was nice, fun, interesting, they liked the lesson, they were happy to learn new things and use the computer more effectively. In his study, Durak (2016) stated that the opinions of the students about the programming education he developed for primary school students were positive, and emphasized that the students defined the course as a practical, productive course and stated that they felt free in the course. In addition, it is stated that the programming course is beneficial for students to improve their computer use, to enable them to establish relations with other courses, to provide a variety of tools, to share resources online, and to use Scratch programming language.

4.2. Conclusion

The findings of the study show that the attitudes of the students who attended the education changed in a positive way. In addition to the interview data obtained from the study, the students were asked to develop a mobile app project either individually or as a group at the end of the four-week education. Students' self-development of an application using the MIT App Inventor program can be shown as evidence that both students improve their scientific and thinking skills. Durak (2016) developed a curriculum for gifted students in primary school, teaching the Scratch programming language, and asked students to develop projects at the end of the teaching-learning process. It was concluded that the developed projects positively affected the students to see and complete their knowledge and skill deficiencies, to gain responsibility awareness and to increase their motivation. In another study in which 5th grade students were taught coding with Scratch, it was stated that students' project development during education positively affected their critical thinking and conceptual understanding skills (Alp, 2019). The students participating in the education were selected from different schools, and the majority did not know each other before the education, which allowed them to make new friends. In addition, group work was encouraged while designing applications, which aimed to increase their social skills. Opening the

project presentations and apps of the students to share on the Google Play store also led to positive developments in students' social skills. Because of its relationship with Google, App Inventor provides many advantages for both teachers and students (Morelli et al., 2011). In the interviews, it was revealed that the education helped the students feel they would achieve, and that they made new friends and that they were pleased to share online.

4.3. Suggestions

According to the results of the research, the following suggestions can be made: (1) It is recommended to use MIT App Inventor in programming education for primary school students and to spread these educations throughout the country. (2) It can be ensured that the courses that students have difficulty in understanding or get bored, avoid certain tasks and responsibilities, and which they see as problems, can be gamified with their own developed mobile games. (3) It is recommended to undertake program development studies to incorporate the teaching-learning processes in this study and similar studies into the teaching-learning processes in schools. (4) Due to the limited number of studies in the literature for MIT App Inventor, especially the lack of experimental studies, it is recommended to conduct experimental studies in advanced research. The effectiveness of MIT APP Inventor can be examined with different research methods and patterns. (5) A meta-analysis study on experimental studies on mobile programming is recommended. (6) 21st century skills are crucial to provide students with an effective lifelong learning process and a successful professional life. The study can therefore be repeated with a focus on one or more of the different 21st century skills such as problem solving, creativity, critical thinking, technology use, collaboration and leadership.

The limitations of the study are as follows:

1. The duration of the study was limited to 4 weeks.

2. The research is limited to 24 4th grade students who agree to participate in mobile programming education and volunteer in the research process.

3. The research was limited to the opinions of the students regarding the mobile programming education process.

4. The study is limited to the qualifications covered by the learning activities of a 16-hour course based on the teaching of the MIT APP Inventor program prepared within the scope of mobile programming training.

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