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PRE-SERVICE PRE-SCHOOL TEACHERS' OPINIONS ABOUT USING BLOCK-BASED CODING/SCRATCH

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Abstract: In this study, it was aimed to examine the pre-service pre-school teachers' opinions about using block-based coding/Scratch in education. 28 pre-service pre-school teachers were participated studying at a public university in a Marmara province region. Within the scope of the study, pre-service teachers were trained on the block-based coding Scratch program for four weeks. A semi-structured interview form consisting of 12 questions was used to determine the opinions of the participants. The data of the study were analyzed using the descriptive analysis method. As a result of the study, 85.71% of pre-school teacher candidates stated that block-based coding education should start at an early age like a language education, this education is important as a necessity of the technology age and all students should benefit from this education in order to provide an effective education, 14.25% of teacher candidates specified that this education is untimely for younger age levels and should not be given to everyone. In addition, the pre-service teachers stated that the block-based coding/Scratch program training helped them gain new ideas in terms of creating materials, improved their creativity and contributed to design abstract material in addition to concrete ones. Additionally, 46.42% of pre-service teachers stated that block-based coding education should start between the ages of 5-7. In this context, it is recommended to provide coding education both in pre-school and undergraduate education.

Key words: block-based coding, coding education, scratch program, pre-school, pre-service teachers, technology, material design

1. Introduction

It is obvious that technological developments shape the education system. Today, education is shifting from teacher-centered to student-centered and technology-based learning, which requires the development of technology-supported education programs (UNESCO, 2002). Rapid developments in instructional technologies caused the current approaches to be questioned and revealed the need to develop and present innovative solutions in teaching and learning processes (Cviko, McKenney, & Voogt, 2012). When the related literature was examined, it was determined that using technology at the beginning of the lesson helped students to concentrate (Spires, Lee, Turner, & Johnson, 2008). It was obvious that the most widely used technology in lessons is computers.

Although teacher attitudes were not considered in computer applications in the past, many scientists now argue that successful practices and teachers' attitudes towards computers should be addressed (Hunter & deLeeuw, 1988, as cited in Violato, Mariniz, & Hunter, 1989). The ability of teachers to use technological devices well and to keep up with today's age for a quality and efficient education and training environment shows the quality of the education they provide. Keeping the use of technology at the forefront in the trainings given to pre-service teachers can increase the use of technology in their own lessons for our future teachers. In this case, pre-service teachers' attitudes towards technology should be examined by taking into the foreground. Many studies suggest that this attitude is an important element in teaching computers to children (Woodrow, 1990). Pre-service teachers' technology attitudes may change as a result of their training. Their attitude towards technology may affect their future use of technology and various technological devices in their classroom.

It is thought that it would be beneficial to use coding programs in trainings and in-class materials in order to use the computer from technological devices in a useful way by integrating technology into

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education. Programming education is an important educational environment that ensures the continuity of the software field, which is at the base of information technologies (Kert & Uğraş, 2009). Nowadays, courses involving coding instruction are included in secondary school, primary school, and pre-school education programs (Jones, Liu, Cheng, Huang, Kalelioğlu, Bers, & Houlden, 2014). Saygıner and Tüzün (2017) stated that the importance of programming education is recognized and that programming courses are included in the education curricula of many countries. According to Demirer and Sak (2016), the ability of young children to comprehend the logic of design by learning coding, to produce new ideas, to put the ideas into practice, and to produce solutions by correcting the mistakes they encounter would also increase their ability to work together. These trainings, which are also provided in various institutions to prevent students in young age groups from having difficulties in coding education and to provide a simple and colorful visual coding environment for them, are carried out using simple and easy-to-use coding applications such as Scratch, Blockly, code.org and codemonkey. It can be said that block-based coding applications such as Scratch provide an easier coding environment due to their simple and colorful interfaces. According to Glushkova (2016), combining the use of block-based programming and game-based learning enhances the effect of education and increases its efficiency, arising students' interest, motivation, and engagement.

1.1. Scratch Block Based Coding Program

Scratch program is a visual programming platform that appeals to users of all ages. The Scratch website is designed for use by individuals between the ages of 8 and 16, but adults can also join and design animations and games (Resnick et al., 2009). The installation of the program is completely free, but its use is for educational purposes. Users can also share their games and animations on the Scratch website as they share on social media sites because Scratch has a social computing network to share projects (Meerbaum-Salant, Armoni, & Ben-Ari, 2013). When the Scratch program is examined, it is observed that its design is quite simple and understandable. In the program's interface, there are ready-made code blocks grouped according to different purposes (motion, sound, appearance, control, events, processes, etc.). These code blocks can be moved to the work screen by drag and drop method by the users.

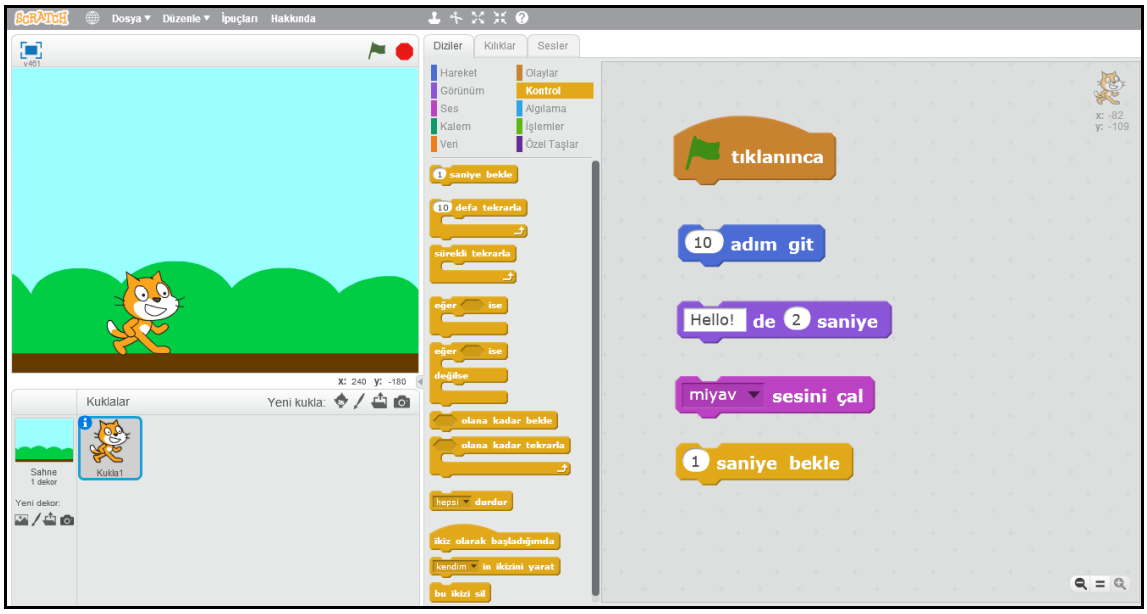

Figure 1. *Moving scratch program codes onto code area*

Figure 1 shows the interface of the Scratch program. Different colors of ready-made code blocks grouped for different purposes also provide convenience. The commands given by the designer are executed on the designed screen on the left. The right-hand area is the area where the desired changes

can be made, and code blocks can be used on the left. The code blocks are dropped into the code area on the right by drag and drop with the help of the mouse, and the codes are combined in this area. There are ready-made code blocks under the headings of motion, appearance, sound, pencil, data, events, perception, transactions, and special stones in different colors in the section of the arrays.

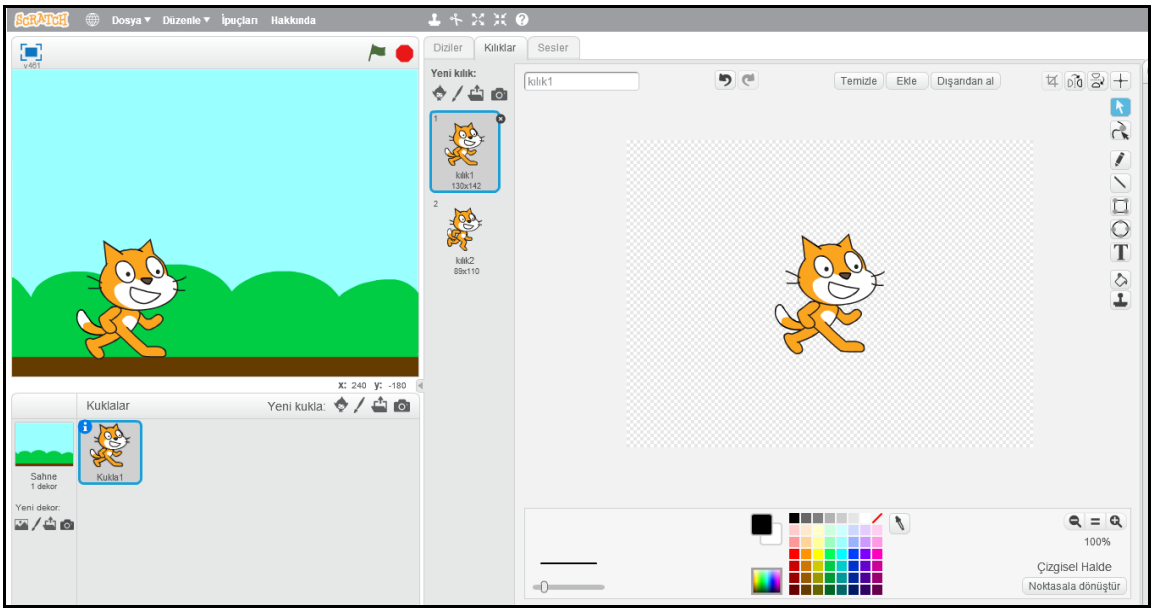

Figure 2. *Changing the character costume in scratch program*

Figure 2 shows the costume/disguises part. In this section, the costume, shape, color, size of the character can be changed, and text and shapes can be added to the character. In this section, character costumes can be arranged in interesting colors and shapes to attract the attention of young children. Ready-made images that can be uploaded to the computer from the Files section can also be selected as characters. Depending on the creativity of the designer, the characters can be created in different ways.

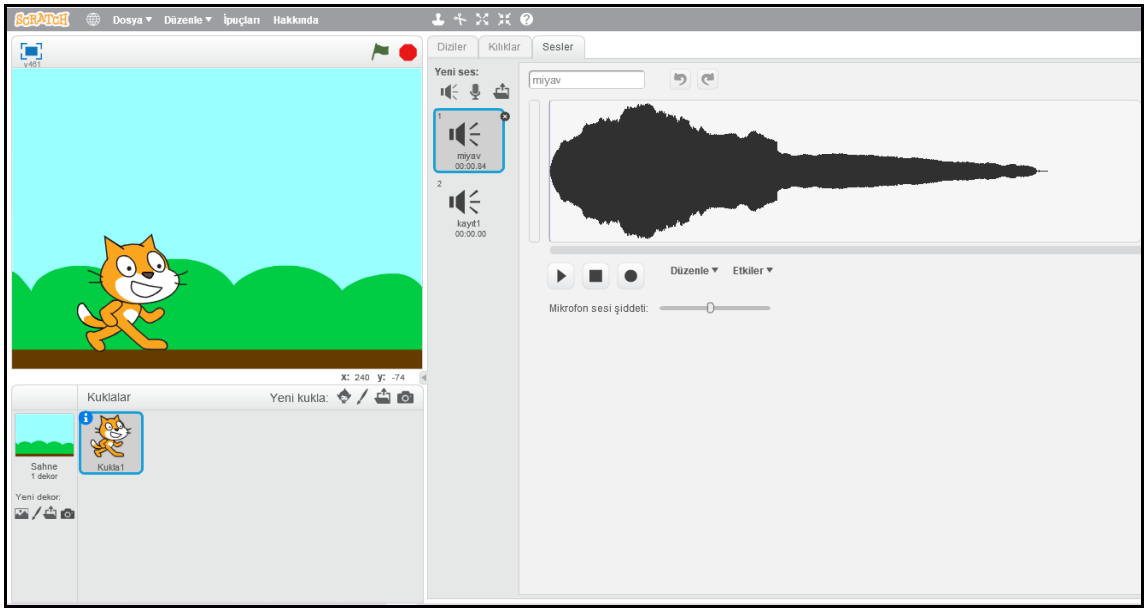

Figure 3. *Adding voice to character in scratch program*

Ready-made voice recordings for the characters, voice recordings created by the teacher candidates or voice recordings can be added by selecting a file from the computer (Figure 3). This area is where various animal sounds and some object sounds can be added, and the designer can also record and add their own voice. In the related literature, it was emphasized that one of the important factors affecting the quality of a child's experience with computers at school may be the teacher's attitude towards computers (Todman & Dick, 1993). However, it is observed that pre-school teachers have difficulty in combining technological facilities with pre-school education practices (Bourbour, Vigmo, & Samuelsson, 2015). Carlson (2005) argues that engaging young minds with technology is a very effective way to improve student learning. With the changes in education, the use of different approaches and methods has increased, and various applications have been developed. One of these developing applications is coding. Scratch program, which is a block-based coding program, draws attention as one of these innovative educational applications. Designing various games, animations and videos with the Scratch program can affect students' learning processes. With this program, teachers can develop various games for students in order to provide the necessary gains in the course. As a matter of fact, according to Weintrop and Wilensky (2015), the effectiveness of game-based learning in the learning process has been proven.

Game-based learning can be seen as an opportunity to simulate real situations as well as increasing interest in education, motivation, and educational effect (Glushkova, 2014). In addition, unlike other approaches, creating video-mediated materials to create learning materials has proven to be easy and inexpensive (Bennedsen & Caspersen, 2008). The study by Glushkova (2016) found that this programming style is particularly successful as it offers school students and beginning programmers a path to their professional future development. It was also stated that this situation laid the groundwork for the continuation of experiments and studies in this direction.

The ability of teacher candidates to use technological applications in their professional lives, to create technological materials with coding, to develop their own games by coding would both increase student interest and motivation and facilitate students' adaptation to technology. Therefore, in this study, it was aimed to examine the opinions of pre-service teachers on this subject by giving block-based coding/Scratch training to pre-school pre-service teachers within the scope of the material design course. Recently, there has been an increasing interest in the Scracth program, which is one of the tools that anyone, from children to adults, can design and develop their own games, especially those who do not have a high level of programming knowledge (Lamb & Johnson, 2011).

In the related literature, it was emphasized that one of the important factors affecting the quality of a child's experience with computers at school might be the teacher's attitude towards computers (Todman & Dick, 1993). The fact that this study on the use of block-based coding/Scratch education in pre-school education enables pre-service teachers to use technological applications in their professional lives, to develop their own games by coding and promotes their interest and motivation towards the lessons and may help to adapt to the technology. This training was given within the scope of the material design lesson so that the teacher candidates can produce a product using technology and create their own original materials. As the pre-service teachers' beliefs about using technology in education increased, their attitudes towards teaching profession also increased (Usta & Korkmaz, 2010). Consequently, pre-service teachers taking part in different technology-related practices and activities would contribute to their future professional life.

There are various studies conducted with pre-service teachers from different departments (İnce, 2019; Erten, 2019; Pala & Mıhcı-Türker, 2019; Göncü, Çetin, & Top, 2019; Korkmaz, Şahin, Çakır, & Erdoğmuş, 2019), and with secondary school students, high school students and young age groups (Akkaş Baysal, Ocak, & Ocak, 2020; Özer, 2019; Toklu, 2019; Korucu & Taşdöndüren, 2019; Şahin, 2019) regarding the applications of coding and programming in the field of education in literature. This study would contribute to the relevant literature since the current research is a trend topic and there is no study reported investigating the opinions of pre-school teacher candidates about designing materials related to coding. The following question were sought in this study: What are the opinions of pre-service teachers trained about block-based coding/Scratch program about using it?

The sub-problems of the current study are as follows;

- What are the gains and professional benefits of pre-service teachers from the block-based coding/Scratch program education?
- What are the pre-service teachers' opinions regarding the inclusion of block-based coding/Scratch program as a subject in the curriculum?
- What are the pre-service teachers' opinions about the use of block-based coding/Scratch program in pre-school education?
- What are the pre-service teachers' opinions on the level of benefit provided by the block-based coding/Scratch program training taken in the material design course?
- What are the pre-service teachers' opinions on which subjects and concepts they would use to block-based coding/Scratch program in pre-school education?
- What are the pre-service teachers' opinions on which science subjects and concepts they would use to block-based coding/Scratch program?

2. Methodology

In this section, research design, study group, data collection tools, data analysis and the implementation process regarding the block-based coding training were explained in detail.

2.1. Research Design

Case study design, one of the qualitative research methods, was used in this study. The semi-structured interview form used in collecting the study data took its final form by receiving expert opinions. Interviews with pre-service teachers were conducted through video conferences and the related data were recorded. The interview data were transcribed and analyzed by the descriptive analysis method via the researchers of the study.

2.2. Study Group

This study was carried out with 28 pre-service teachers studying at pre-school education department in a public university located in the Marmara Region of Turkey. Participants of the study was coded like S1, S2, S3, …, S28. Convenience sampling method was used in this study. The reason why 3rd year students were selected in the current study was that pre-service pre-school teachers take major area courses in the 1st and 2nd year in their formal education and take both major and technology related courses from the 3rd school year. The reason why 4th year students were not selected as the study group was that they were not willing to participate in the study as they were preparing for the exam for teacher appointments. Pre-service teachers learned to design various puppet and toy materials related to their fields in the material design lesson they took in previous periods. They also learned that material and game design can be took place with block-based coding in the material design lesson where study data was collected. Block-based coding/Scratch program training was planned by the researchers and divided into weeks, and this training was given by the researcher, a robotic coding instructor.

Table 1. *Demographic features of pre-service teachers*

Feature		f	%
Gender	Female	23	82.14
	Male	5	17.85
Age	20-25	25	89.28
	26-30	3	10.71
Telephone use frequency	1-6 hours	14	50
	7 and above hours	14	50
Having personal computer	Yes	24	85.71
	No	4	14.28

Frequency of computer use	1-6 hours 7 and above hours	16 9	57.14 32.14
Social media they use	Instagram Twitter Youtube Facebook	21 19 5 4	75 67.85 17.85 14.28
For what purposes they use social media	Contact Socialization Getting information Entertainment	17 16 15 7	60.71 57.14 53.57 25
Internet Access	Yes No	28 0	100 0
Opportunity to work in Scratch program outside of class	Yes No	24 4	85.71 14.28

In Table 1, the majority of the participants (82%) were female pre-service teachers, the average age of them varied mostly between 20 and 25, most of them (85%) had their own computers, they mostly used Instagram and Twitter as social media communication tools, they used these tools for communication, socializing and getting information, all of the pre-service teachers had access to the internet, and the majority of the pre-service teachers (85%) had the opportunity to work outside the classroom for the Scratch program.

2.3. Data Collection Tools

An "Opinion Form/Open-Ended Questionnaire" consisting of 22 questions was prepared by the researchers of the study to reveal the opinions of pre-service teachers about the use of coding practices in science teaching, considering the topics, contents and research questions in the studies examined. The prepared questions were restructured as a result of the feedbacks received from the two field experts and the opinion form consisting of 12 questions took its final form. The prepared form consists of two parts. In the first part, there are demographic questions such as gender, age, frequency of using the phone, whether they have their own computer, daily computer usage time, and in the second part, there are 12 semi-structured open-ended questions. Interview questions were directed by face-to-face video conferencing through Microsoft Teams program and the data were recorded by audio recording. This program is a program used by pre-service teachers to follow their lessons in formal education in distance education. This program is specific to the student with the e-mails and passwords given to the students, and the communication with each student was kept confidential. The recorded sound recordings were transcribed in computer environment. Approximately 20 minutes interview time was allocated to each teacher candidate. In the analysis of the data obtained through interviews, the audio data were written down and analyzed using descriptive analysis method, one of the data analysis methods used in qualitative research.

2.4. Data Analysis

The data obtained from the study were analyzed using descriptive analysis technique. Descriptive analysis is a qualitative data analysis technique that includes summarizing and interpreting the data collected with different data collection techniques according to the previously determined themes/categories (Özdemir, 2010 p.336). The data collected in descriptive analysis is the approach of pre-determining and interpreting themes as opposed to content analysis. In the descriptive analysis, the direct quotations are frequently presented since the opinions obtained from the interviewed individuals are desired to be reflected in a remarkable way (Yıldırım & Şimşek, 2005 p. 224). In the current study, the data were analyzed according to the sub-categories revealed by the research questions, and the questions used in the interview form were taken as sub-categories and analyzed. The categories and sub-catogories were determined by the researchers of the study. These categories were compared, and kappa coefficient was found for each category. The kappa values for the categories were 0.73, 0.76, 0.78, and 0.79. For the reliability of the qualitative findings, two other researchers from outside of the study who have mastered the subject were selected and the thematic codes in three interview forms,

randomly selected from the student interview forms with pre-determined thematic/categorical coding, were examined.

2.5. Implementation Process

In the block-based coding/Scratch program training prepared for pre-service teachers, activities that would contribute to pre-school teacher candidates' skills in designing materials were designed by trainers and researchers. Block based coding/Scratch program (2.0 version) training steps were presented in Figure 4.

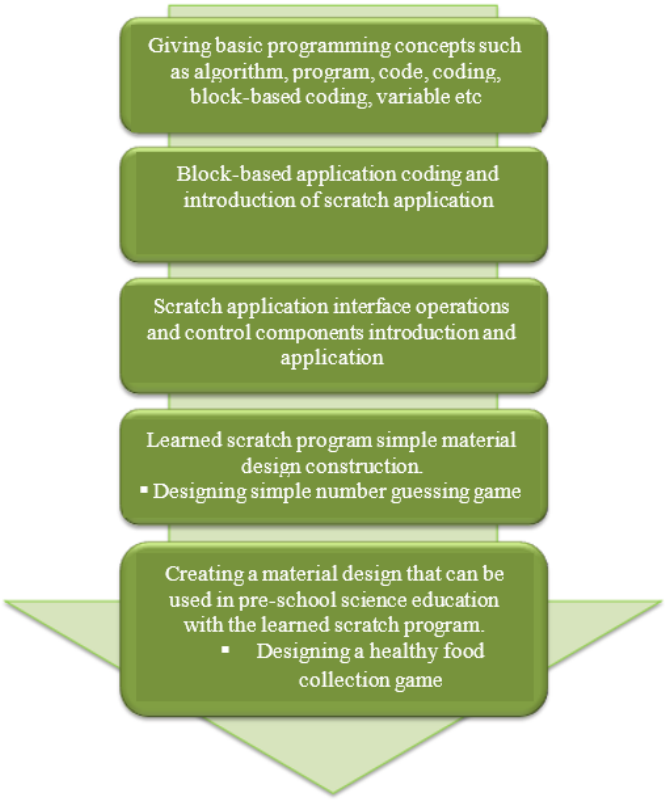

Figure 4. *Stages of block-based coding/scratch program training*

After receiving training about block-based coding/scratch program, pre-service teachers were asked to design simple level games and use the Scratch program. In the Scratch application, pre-service teachers developed the interface operations such as changing scene/decor, adding and removing puppets, moving puppets, adding, and removing sounds. Pre-service teachers were asked to design various games using Scratch program for a better understanding of this program. After developing simple algorithms related to the course content, pre-service teachers carried out some Scratch applications such as finding a number held by the individual, finding a number held by the computer.

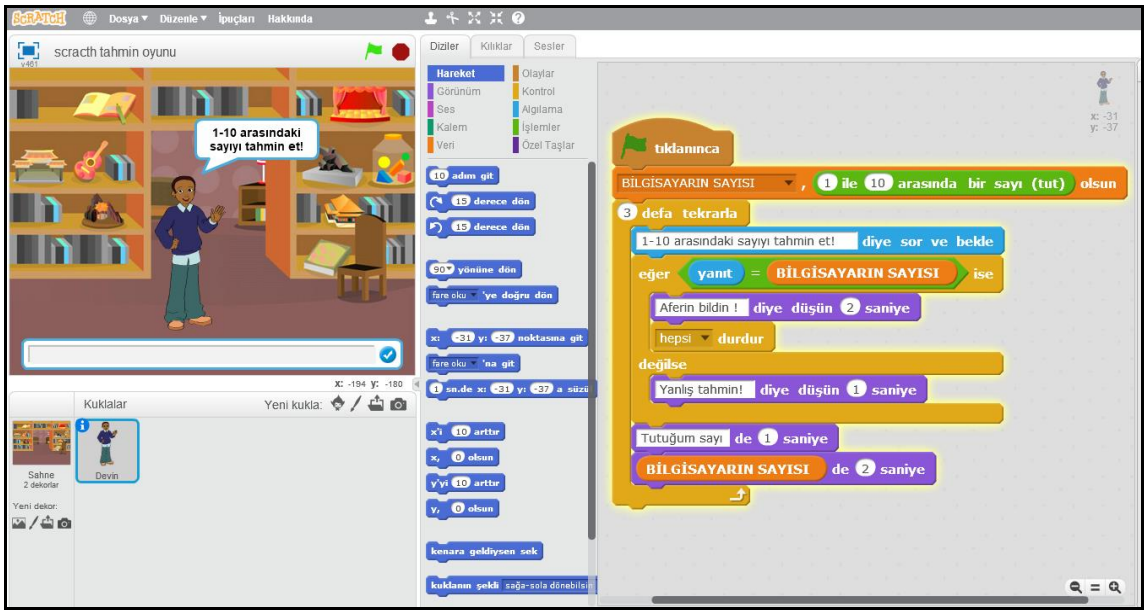

Figure 5. *Simple game design sample block codes*

In Figure 5, the codes of a simple game design example were given. The pre-service teachers wrote codes like the given codes. Since each study varies according to the creativity of the teacher candidates, elements such as stage, costume and character differ in the teacher candidates' work.

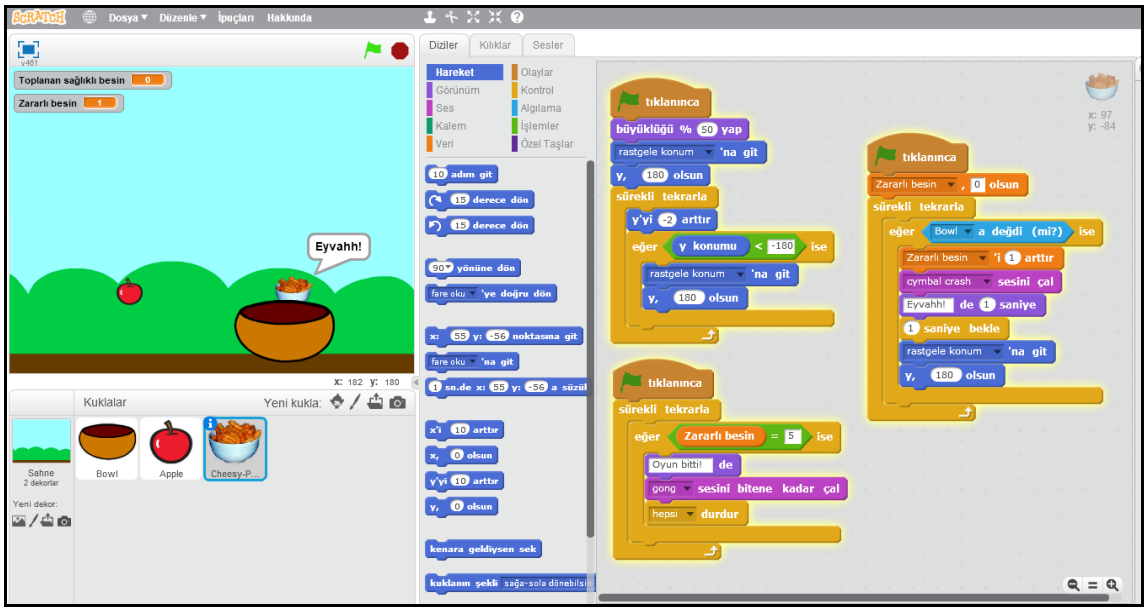

Figure 6. *Game codes for catching healthy foods*

The game "Catching Healthy Foods" was designed with healthy and harmful foods as shown in Figure 6. In Figure 6, the codes given to harmful food (chips) can be seen. Each harmful food dropped in the bowl increases the number in the “harmful food” variable. When the number of harmful foods in the bowl reached to 5, the text “☹ game over” (or sound can also be added) was displayed on the screen along with the “gong” sound.

After showing sample games that pre-service teachers can use in their own classes, they were asked to design a game titled “Catching Healthy Foods”. It is a game designed by moving the “bowl” in the interface of the “Catching Healthy Foods” game with the left and right arrow keys and catching the healthy foods (apples, bananas, etc.) falling from the top down, and not putting the harmful foods in the bowl (Figure 6). The coding instructor paid attention to one-on-one attention to teacher candidates

during the training but deemed it appropriate for the candidates to work in groups of two, due to the high-class size and the fact that the candidates had difficulties with this training for the first time. The problems experienced by the teacher candidates were solved as quickly as possible by the instructor and they were provided to design games.

2.6. Limitations of the Study

The study group of the current study were not selected reandom sampling method and limited to 28 pre-service teachers studying at pre-school education department in a public university. The subject of the study was limited to block-based coding/Scratch program training. Qualitative data analysis technique was followed.

3. Findings

At the end of the block-based coding/Scratch program training, interviews were conducted with pre-service teachers via the "Opinion Form" prepared by the researchers. In the first part of the form, demographic characteristics of the participants were taken, and the collected data were presented in Table 1. The responses collected in the study were analyzed within the framework of four categories as "*gains and professional benefits"*, "*use in education and training"*, "*use of coding in material lesson*", and "*desire to use"* which were determined by the researchers and were given in Table 2. Many direct quotations were included for each sub-purpose to reveal and reflect the opinions expressed by pre-service teachers.

Table 2. *Categories and sub-categories*

Category	Sub-category
Gains and Professional Benefits	3.1. Findings related to gains and professional benefit level gained through pre-school pre-service teachers' block-based coding/Scratch program education • What did you learn in the block-based coding/scratch program training you received? Did you know about this subject before? • What skills do you think an individual's block-based coding/scratch program training contributes to? • Would you use coding in your future career or create a material related to coding? If yes, write how to use it?
Use in Education and Training	3.2. Findings of pre-school pre-service teachers' opinions regarding the inclusion of block-based coding/Scratch program as a subject in the curriculum • What are your opinions on the inclusion of coding or block-based coding practices in school curricula? • Do you think that block-based coding education should be compulsory in the curriculum at all grade levels (by providing an appropriate education for class levels)? 3.2.1 Findings of pre-school pre-service teachers' opinions about the use of block-based coding/Scratch program in pre-school education • Do you think all students should get block-based coding training? • Do you think block-based coding can be used in pre-school education? If yes, write how can it be used? • What do you think can take block-based coding education contribute to the education of pre-school students? • What do you think should be the starting age for block-based coding training? Explain why?
Use of Coding in the Material Course	3.3. Findings regarding pre-school pre-service teachers' opinions on the level of benefit provided by the block-based coding/Scratch program training taken in the material design course
Desire to Use	3.4. Findings regarding pre-school pre-service teachers' opinions on which subjects and concepts they would use to block-based coding/Scratch program in pre-school education 3.5. Findings regarding pre-school pre-service teachers' opinions on which science subjects and concepts they would use to block-based coding/Scratch program

3.1. Findings regarding the first research question: What are the gains and professional benefits of pre-service teachers from the block-based coding/Scratch program education?

All pre-service teachers believed block-based coding/Scratch program education would be beneficial for their professional development. Although many of them (67.85%) stated that they had never heard of block-based coding/Scratch program, some of them (32.14%) had an idea about this program before the training. They stated that most teacher candidates heard about this training for the first time and would like to receive certified trainings in this regard in the future.

"I think it is very useful to have this training before we become a teacher. I learned that we could make a game in this block-based coding training I received. I can do activities for our children who need special education with this method that block-based coding is not too difficult. I realized that it wasn't that hard, we shouldn't overestimate, and we should definitely get this training" (S9).

"I had information about coding. I had already learned a few basic information in the lesson, I enhanced my knowledge because I wanted to learn it. For example, I was able to design the game individually and now I am trying to discover it myself" (S27).

"I only knew by name, I didn't know what it was, but I had a lot of fun learning the application. I can teach my students in a different way when I become a teacher. I think this training actually brought me innovation and made me a teacher that should be" (S14).

When pre-service teachers' responses about the question of "What skills do you think an individual's block-based coding/scratch program training contributes to?" were evaluated, they stated that this education/training contributed to the individual's learning technology, fast and solution-oriented thinking, systematic thinking, creative thinking, and cognitive skills.

"It contributes to visual communication skills and individual's learning technology. It can actually help in many applications. It is an application that directs auditory." (S10).

"It develops creative thoughts and improved collaborative learning. It was a collaborative training as we held the activities in groups of two." (S4).

"It has contributed to communication skills, thinking skills, quick thinking and may provide solution-oriented thinking." (S8).

When pre-service teachers' responses about the question of "Will you use coding in your future career or create a material related to coding? How?" were evaluated in general, all of them stated that they would use the block-based coding/Scratch program in their professional life in their future.

"…When I become a pre-school teacher in the future, maybe I can organize games and activities in line with different achievements. We did not know such a thing before this study. We take computer lessons, but nothing for coding has ever happened in any of our lessons." (S11).

"Actually, I want a lot, so I really want to learn. I think for this reason I use it to learn a very fun method for children. For example, I can teach children the concept of direction, we had an activity on healthy unhealthy food. For example, instead of showing children with felt, I can show them in this way by playing on a game. For example, I can use it in many concepts teaching in science so that they can achieve science learning outcomes." (S14).

"I would definitely like to use it. First, I would take the materials of robotic coding in the form of carpets to my class. Then, for example, I would try to use the Scratch program we used or a similar program with children in small groups." (S28).

3.2. Findings regarding the second research question: What are the pre-service teachers' opinions regarding the inclusion of block-based coding/Scratch program as a subject in the curriculum?

The second research question was the "What are the pre-service teachers' opinions regarding the inclusion of block-based coding/Scratch program as a subject in the curriculum?". In addition to this

reseach question, they also were asked "Do you think that block-based coding education should be compulsory for students in all classes (by giving them an education appropriate to their class levels)?".

Table 3. *Frequency and percentage values of the answers given by pre-service teachers related to the question of "What are the pre-service teachers' opinions regarding the inclusion of block-based coding/Scratch program as a subject in the curriculum?"*

		f	%
Should coding or block-based coding practices be included in the school curriculum?	Yes	27	96.42
	No	1	3.57

When the responses of the pre-service teachers were evaluated, most of them (96.42%) thought that the block-based coding or coding course should be included into school curriculum.

"It should be included in the school curriculum. It provides cognitive thinking because it both entertains and provides problem solving skills and even provides collaboration. As a result, I think it does benefit in every way, so it should be included in the curriculum." (S22).

"I think it should definitely include into the curriculum. It should be included in the university curriculum especially. We took a second time material development lesson with different name, but I can say that this is more useful than others." (S24).

"Of course, it should be included into the curriculum, I am positive about this. As a society, we need to accept technology. I don't know what it means for someone who has nothing to do with technology, but I think that every individual should get acquainted with technology." (S28).

Table 4. *Frequency and percentage values of the answers given by pre-service teachers related to the question of "Should block-based coding education be compulsory for students in all classes (by providing an appropriate education at grade levels)?"*

		f	%
Should block-based coding education be compulsory for students in all classes (by providing an appropriate education at grade levels)?	Yes	16	57.14
	No	12	42.85

When the answers given by pre-service teachers to this question were evaluated, some of them (57%) stated that this education should be given as a compulsory course in the curriculum, but some of them (43%) should be left to the individual's preferences as an elective course.

"I think it must be a compulsory course because it is very useful, very fun, different, something that they are not accustomed to, not ordinary. Of course, after a compulsory period, it would become ordinary for a certain period, but I think it may be because it makes learning more fun in terms of benefits and improves children's thinking skills." (S14).

"I think it shouldn't be compulsory because every child is not on the same mental level, so all children have to do it if they have compulsory education. Not every child may have an interest, but if it is an elective course instead of compulsory course, this training can be given by selecting children according to their own development areas." (S15).

"I think it should not be mandatory, it depends on volunteering because everyone's desire to learn may be different. For example, I liked this application very much, I would love the application too, but some people may not like it. So, it shouldn't be compulsory. When it is compulsory, it is not very useful to do something with that compulsion." (S23).

3.2.1. Findings regarding third research question: What are the pre-service teachers' opinions about the use of block-based coding/Scratch program in pre-school education?

Regarding to the third research question, pre-service teachers were asked the questions of "Do you think that block-based coding education should be given to all students? Why? Please explain.",

“What is your opinion opinion about the use of block-based coding/Scratch program in pre-school education? How? "What do you think may be the importance of block-based coding for pre-school students?", “What do you think should be the starting age for blok-based coding training? Why?”.

Table 5. *Frequency and percentage values of the answers given by pre-service teachers related to the question of “Do you think that block-based coding/Scratch education should be given to all students? Why? Please explain.”*

		f	%
Do you think that block-based coding education should be given to all students?	Yes	24	85.71
	No	4	14.28

When the results were evaluated, 85% of the pre-service teachers stated that block-based coding/Scratch education should be given to all students, and 14% of them reported the opposite opinion.

“No, it should not be given. This education is a late age for the university, but I think it is too early for the 5-6 age level. I think it is ideal to be given in middle and high school. Especially in middle school, children are better off with technology, so even those who don't know it at all are more interested. I think they can do the commands or directions better, so I think it will be easier for them to learn.” (S10).

“I think it should be given; we are already in the age of technology. Children are already familiar with technology before they come to school. Therefore, we can increase the creativity of children by giving robotic coding. We can ensure their productivity. I think it should be given.” (S15).

“I think it should definitely be given to all grades of students. It should be given not only in pre-school but in all branches because it really makes a difference. If it gives us this difference, I'm sure it would do something different for the children. I think it is an application that we can use while teaching and training. If it gives us this difference, I am sure it will lead to different things for children. I think it is an application that we can use while teaching and training.” (S23).

Pre-service teachers were asked “Do you think block-based coding can be used in pre-school education? How?". All pre-service teachers stated that block-based coding can be used in pre-school education.

“It can be used because sometimes classroom game activities are not enough. Coding can sometimes be adapted to all activities, not only as a game, but also as an art, or as a science. children are constantly playing games with the tablet at home, at least it can be used in classrooms as an educational game.” (S21).

“I think that coding directly addresses pre-school… Such a fun thing… I think I can appeal to all development areas with games that include different colors, concepts, and numbers. Attracting attention by making differences… For example, it will make children see something different and get excited when they come to the classroom.” (S23).

“Obviously, pre-school is a very important period as a child's upbringing and if we consider that children are starting to use tablets etc. from the age of 3, it should definitely be used. At least, parents can be contacted about how to use them correctly, and such training can be given to them in this regard.” (S27).

Pre-service teachers answered the question of "What do you think is the importance of block-based coding for pre-school students?". They stated that block-based coding improves the creative thinking of pre-school students, increasing their curiosity, improve their cognitive areas, ensure the permanence of the concepts learned, discover their interests at an early age, gain their attention, analyze skills, and gain different perspectives, and easy adaptation to technology.

“I think it develops creative thinking in children. Since it is a cooperative learning, it can develop these feelings in children.” (S4).

"Its importance for pre-school students makes children think creatively to find new ideas, they can know how to produce a new game, they can think from different angles." (S9).

"I think it enables students to actually think scientifically, analyze, look at something from different angles, and learn. It improves them cognitively." (S14).

Pre-service teachers were asked "What should be the starting age for block-based coding education? Why?". 46.42% of the pre-service teachers stated that students should start coding education between the ages of 5 and 7, 21.42% between the ages of 3 and 5, 10.71% 11 - 13 years old, 10.71% between 13 - 15 years old, 7.14% between 9 - 11 years old and 3.57% between 7 – 9 years old.

"It must be 11-12 years old. As they reach puberty, children tend to stay away from classes at that time. This can make these lessons enjoyable, knowing that they have produced a product and be confident in themselves." (S7).

"It must be 5 years old because I think children learn some things from a young age, do things, have a predisposition, and come to a better result by constantly adding information. For example, I think that it should be given at a young age so that they can actually start with small steps and think from wider angles as they approach the result." (S14).

"The age of onset can be 13. Frankly, I do not think that it will be understood much when given to pre-school students via computer because it may be a little more complex than children, but as long as it is simplified, they can apply to them." (S21).

3.3. Findings regarding the fourth research question: What are the pre-service teachers' opinions on the level of benefit provided by the block-based coding/Scratch program training taken in the material design course?

For the fourth sub-research question of the study, the pre-service teachers asked: "What are the benefits of having coding training in the material design course?". The pre-service teachers stated that they gained new ideas that they could design materials with computers instead of only concrete objects.

"When talking about material design, we always think of concrete materials, known materials, dummy mobiles, etc. It was good for us to have such a training and include it in the course content. We have always done such concrete challenging things in the lesson we took last year. This is also challenging, but I think it is more technological, it adds more information to us." (S8).

"Learning in the materials lesson made me realize that there are not only tangible things but also materials that can be done in a computer environment." (S9).

"I have taken the material development course before, and we are constantly designing materials. This coding has brought me a different perspective. This lesson was a good example in terms of designing different activities and materials that are different from concrete materials instead of just making materials." (S23).

3.4. Findings regarding the fifth research question What are the pre-service teachers' opinions on which subjects and concepts they would use to block-based coding/Scratch program in pre-school education?

Pre-service teachers stated that they can use the block-based coding program Scratch in mathematics education (f = 11), teaching self-care skills (f = 6), colors (f = 5), music, harmful-beneficial foods, location-direction concept, supporting motor development, in subjects and trainings that would develop the concept of big-small, the concept of old-young, science and nature, arts, literacy exercises, animals, drama activities, effective communication, certain days and weeks, classroom order, hand-eye coordination, mental and cognitive skills.

"I can use it in science and nature, mathematics education. If I am going to make an animation, I can use it for drama activities." (S8).

"For example, I can use it in animals, colors, shapes, internal organs and math activities." (S11).

"In pre-school, I think it can be used to improve self-care skills. Because we often neglect self-care skills, we can use it to teach children. We can use it in all areas, self-care skills, cognitive skills, not social skills, but we can definitely use it in others." (S16).

3.5. Findings regarding the sixth research question: What are the pre-service teachers' opinions on which science subjects and concepts they would use to block-based coding/Scratch program?

Pre-service teachers were asked "How can coding education be used in pre-school science education? Give an example". Pre-service teachers stated that they can use block-based coding program Scratch in pre-school science teaching mostly to create an animation of an experiment (f = 28), to teach healthy-harmful foods (f = 3), to grow plants (f = 3), to mix colors (f = 3), in teaching seasons (f = 2). They also specified that they could use some concepts such as animals, sinking objects, internal organs, hot-cold concept, soft-hard objects, bacteria by block-based coding/Scratch program in teaching.

"For example, it may be related to internal organs, the locations of organs can be taught. I personally didn't know much about these issues when I was little. Things that are harmful to health and beneficial can be taught." (S6).

"It can be watched for a while during the growth of the plant; the seed takes root, grows tall, blooms, I would envision it as a slowly growing plant." (S13).

"A bacteria experiment can be made more remarkable with the application of Scratch. That's why I think it can be used in science education." (S23).

4. Discussion and Results

It is important for pre-service teachers to have sufficient knowledge and skills in the field of computer technologies for their own development and for being able to direct and train their students when they become teachers (Tekinarslan, 2008). The ability of teacher candidates to guide their students properly and to integrate technology into their lessons is also related to how they are intertwined with technology and whether they use technology or not. Today, every individual, young and old alike, uses many different technological tools and devices every day. Helping us fulfill basic needs, these devices can be seen by children as an entertainment tool. Children's use of these devices in an appropriate and beneficial way, knowing how to use technology and tools such as computers depends on the education they receive at school as well as the education received in the family. Nowadays, while they are so intertwined with technology, children should not only teach how to use these technologies, but also encourage children's coding learning in order to support their creativity and enable them to produce original products on their own.

According to Anderson (2016), coding education has become a basic requirement just like reading-writing or mathematics education in our developing digital world. Children who learn to code are better equipped to contribute to the development and vision of their country (Meccawy, 2017). In a study by Baz (2018), various coding platforms for early coding education were examined and compared to coding environments. In the research, block-based software such as Code.org and Scratch were found to be more useful and useful for teaching algorithm structure due to its structure. In the study conducted by Patan (2016) with pre-school students aged 4 and 5, it was observed that the students who were applied a pre-school coding curriculum had a positive attitude towards coding, and it was concluded that 80% of the students participating in the pre-implementation were successful in these applications. It can be assumed that pre-school teachers also influence the young age group's ability to like and use technological applications and coding programs. It can be said that for teachers to have information on this subject, the training they receive should be oriented towards this.

It was observed that as the pre-service teachers' beliefs of using technology in education increased, their attitudes towards the teaching profession also increased (Usta & Korkmaz, 2010). The ability of teachers and teacher candidates to use these technologies would have various benefits for their own development. In the study conducted by Aydoğdu (2020) with pre-service teachers, block-based

programming activities had a positive effect on the development of pre-service teachers' self-efficacy in programming. As a result of the study by Erol and Kurt (2017) examining the motivation and success of information technologies teacher candidates for programming using Scratch, it was observed that the motivation and success of pre-service teachers using the Scratch application increased.

It can be thought that the positive opinions of the pre-service teachers about technological applications are related to their use of technology in their lessons. Considering the age of science and technology we live in, the use of technology and integration of technology in education come to the fore in the trainings provided to increase the quality of education and to facilitate learning (Balay, 2004). It is a fact that coding and robotics knowledge is an important factor in education. In this context, teacher candidates have a great responsibility to integrate coding into lessons.

In this study, an exemplary application was presented to pre-school teacher candidates so that they can use technology more beneficially and benefit more from technology by learning an application that would contribute to their professional life. When the findings obtained as a result of the study were evaluated in general, all pre-school pre-service teachers stated that they thought that block-based coding/Scratch program training was beneficial for them. Providing technology-supported trainings for pre-service teachers and keeping their technology use at the forefront may enable them to integrate technology into their own lessons and increase their use of technology.

The data obtained from the study stated that 67.85% of pre-school pre-service teachers had never heard of block-based coding before and that they encountered it for the first time in this training, and 32.14% had heard it earlier. In addition, they stated that most of the pre-service teachers wanted to continue this education, they would like to receive certified trainings in the future, and they would use the block-based coding/Scratch program in their future professional lives. It has been revealed that the teacher candidates thought that this education they received contributes to the individual's learning of technology, fast and solution-oriented thinking, systematic thinking, creative thinking, and cognitive skills. The findings also indicated that pre-service teachers were prejudiced against coding before the training, and after this training they realized that it was not that difficult.

The majority of pre-service teachers stated that block-based coding education should start at an early age like a language education, it is important to prepare children for the future as we live in the technology age, and that this education should be given to all students in order to provide an effective education, and some of them stated that this education is untimely for the younger age level and should not be given to everyone. Öymen (2014) stated that coding courses were included in the secondary education program in 24 states in the USA, and in states such as Oklahoma, Texas, Kentucky, and New Mexico, even though the coding course created controversy, it started to be counted as a "foreign language" course.

Half of the pre-service teachers thought that this education should be given as compulsory, while the other majority had the opinion that it should be left to the individual's preferences as an elective course. In 2017, studies for the integration of coding into education were started in China, and the inclusion of artificial intelligence and coding training in the primary and secondary education curriculum was approved by the Ministry of Education in 2019 (Chunying, 2019). According to Sayın and Seferoğlu (2016), they thought that coding education should be a necessity rather than a need in order to adapt to the needs of the age. Similarly, in the study conducted by Erten (2019) with students, teachers and pre-service teachers, the common opinion of teachers who participated in the study on the use of robotic technology in education was emphasized in the need of coding and robotics education at an early age.

Most pre-service teachers (85.71%) think that block-based coding education should be given to all students. In addition, all of them are of the opinion that block-based coding can be used in pre-school education. In general, pre-service teachers are of the opinion that they can design materials/games for pre-school students with the block-based coding Scratch program and use this program in the lesson, and if the students are given in accordance with their level, this education can be started at an early age. When the related literature is examined, NAEYC-National Association for the Education of Young Children (1996) emphasizes that technology has an important place in child development.

Kartal and Güven (2006) stated that access and use of computer technologies are limited in pre-school education units, in-service training is relatively less, and teachers' knowledge and experience in computer technologies are limited. The future of individuals in the society to be more productive depends on the ability to gain skills such as creative thinking and critical thinking. Programming education has a great contribution to the ability of students to acquire these skills (Benzer & Erümit, 2017). Pre-service teachers stated that block-based coding may have benefits for pre-school students such as developing creative thinking, increasing curiosity, improving the cognitive field, ensuring the permanence of the concepts learned, discovering the area of interest at an early age, focusing, analyzing skills, gaining a different perspective and easy adaptation to technology. Similar to these results, Kert and Uğraş (2009) explained the role of the Scratch environment in coding education in their study and stated that coding teaching at an early age has a positive effect on students' thinking skills, cooperative learning with peers and discovering information. In addition, it was emphasized that the coding education provided should be at the level of the students and the environment should be transformed into a fun form. In addition, Fidan (2016), in his study examining the effect of gamification on student participation in programming teaching with Scratch, stated that the education process became more enjoyable and student participation, motivation and academic success increased. Moreover, Yecan, Özçınar, and Tanyeri (2017) concluded that coding can contribute to the development of the creativity and productivity of elementary school students' skills in various fields such as problem solving, reasoning and algorithm creation.

The block-based coding/Scratch program education that pre-school pre-service teachers received helped them acquire new ideas in terms of creating materials, developed their creativity, and contributed to the production of abstract materials as well as concrete materials. Miglino, Lund, and Cardaci (1999) stated that coding training facilitates students to perceive abstract and ambiguous science subjects. According to Çakıroğlu and Taşkın (2016), concrete concepts on the computer can be embodied in a virtual environment and the computer environment is seen as an indispensable game environment by young students, making it necessary to present concrete examples in this environment. In addition, multimedia possibilities provided by computer technology, which includes student interaction as well as visual and auditory elements, are considered important for conceptual teaching in terms of concretizing abstract concepts (Yaşar, 2003).

It was found that pre-school pre-service teachers believed they thought to use block-based coding/Scratch program education in their subjects and education such as mathematics education, self-care skills, colors for pre-school students. It was found that pre-school pre-service teachers had the opinion of using block-based coding/Scratch program education in pre-school science education mostly in science subjects and education such as creating experiment animation, healthy harmful foods, growth of plants, color mixing, seasons.

5. Recommendations

- Similar studies can be conducted with different study groups.
- Different robotic coding programs can be conducted other than scratch.
- Studies can be conducted using different coding programs or using different versions of the Scratch program.
- Studies can be conducted to evaluate the long terms effects of robotic coding via longitudinal studies.
- The effectiveness of block-based coding/Scratch program can be investigated by conducting similar studies using quantitative research methods using pre- and post-tests.
- Pre-service teachers are of the opinion that the block-based coding/coding course should be included to the curriculum. Students should be encouraged to research, produce, engage in science and coding programs at an early age by ensuring that all grade-level students have access to coding education in their schools. Educators who would give this training to students should also receive the necessary training on coding programs by their specialists.

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