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RESEARCH ARTICLE

Integration of Block-Based Coding Activities Prepared for Preschool Children into Teaching: Focused on Activity Plans

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ABSTRACT

This research aims to examine the activity plans prepared by pre-school teacher candidates for block-based Scratch applications in terms of their general characteristics and educational qualities. For this purpose, the research was carried out based on document review. The research group, consisting of 29 pre-school teacher candidates, participated in a 10-week block-based Scratch training. During this training process, prospective teachers were asked to prepare projects and activity plans for science and mathematics education achievements in the Scratch program. The data of the research were collected through the activity plans prepared by the teacher candidates. Descriptive and content analysis methods were used to analyze the 29 data collected. In this context, it is seen that among the activity plans prepared by prospective teachers regarding their success in science and mathematics education, the most relevant activity types belong to the 48-72 months and the most are science activities. In activity plans, Scratch applications are mostly included in the measurement/evaluation section. As a result of the content analysis conducted to examine the activity plans in terms of educational qualities, 5 themes were reached. Within the scope of the theme based on child-centered approach, it is seen that they mostly support student-centered teaching strategies and teachers take on roles appropriate to child-centered teaching strategies. It was concluded that within the scope of science theme, it most often requires learning, understanding and using basic science concepts and/or big science ideas and the use of process skills. Within the scope of the mathematics theme, it is stated that it requires learning, understanding and using basic mathematical concepts at most. In the theme of supporting collaborative learning, it was concluded that teamwork was not supported most often and that the majority of cooperative learning groups did not have individual responsibility. Among the themes of supporting scientific communication, it was concluded that students should mostly convey science concepts. Within the scope of the theme of supporting scientific communication, it includes the most discussion strategy requirements and the most small group/individual work. It seems that the most common teaching method is interactive games.

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1. Introduction

Considering today's digital transformations and developments in technology, programming education is of great importance. In this context, research on learning environments designed for programming and the effects of these applications on students attracts great attention. It is emphasized that programming activities contribute greatly to the development of children's problem solving, communication, teamwork, decision-making, planning, evaluation, creativity and critical thinking skills, as well as their technology knowledge and ultimately their ability to be

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successful. jobs of the future (Johnson, 2003; Wood, 2003). It is especially important to carry out these activities in early childhood, which is considered the "critical period" when individuals show high sensitivity to learning, as Senemoğlu (2012) puts it. Because it is known that the interventions made during this period have a permanent effect on individuals' personalities, social behaviors and cognitive capacities (UNICEF, 2003; Bredekamp, 2015).

Providing programming education to children in early childhood is carried out by pre-school teachers. Teachers use coding skills to achieve educational goals in the preschool period. However, for effective teaching, the learning environment and activities appropriate to the developmental levels of children must be planned (Dağlıoğlu, 2010). For this reason, teacher competencies for integrating programming practices into teaching are of critical importance (Şimşek, 2018; Yılmaz, 2018). In terms of the nature and quality of pre-service teaching, developing and determining these competencies of teachers is an issue that should be addressed as a priority (TED, 2009). Teachers are required to receive programming training appropriate to their field in order to benefit from ready-made coding products and use coding in their daily educational activities. In terms of guiding teacher training (Göncü et al., 2018). It is a profession (Lambdin et al., 1997; Parker, 1997). Universities that train teachers need to make plans for the use of information technologies and educational technologies (Kaya & Yılayaz, 2013). In this context, this research aims to examine the activity plans prepared by pre-school teacher candidates for block-based Scratch applications in terms of their suitability for the preschool education program and their educational qualities.

Studies covering early and early childhood and studies on educational environments report that teachers are not familiar with robotic technologies and lack expertise and confidence in robotics-based STEM activities (Ertmer, 1999, Ifenthaler & Schweinbenz, 2013; Chalmers, 2018). These deficiencies can be attributed to the fact that teachers mostly lack the content knowledge and pedagogical perspectives to teach programming using robotic technologies (Voogt et al., 2015; Angeli et al., 2016; Chalmers, 2018). Teachers state that they have no idea about coding activities and practices and do not believe that coding activities cannot be integrated into preschool education programs (Aktemur Gürler & Ömeroğlu, 2022). It has been revealed that coding activities can be integrated into the kindergarten curriculum with other subject areas such as music, movement and dance, art, science and mathematics (Macrides et al., 2022). In order for teachers to fully integrate programming into teaching in early childhood education, they need to research their pedagogical competencies and make practices that will help them gain them. It aims to integrate the educational digital products (such as games, digital stories, animations) they have developed at the end of the coding training into teaching in terms of their suitability for the preschool education program and their educational qualities. For this purpose, the following research questions were examined:

1. How does it integrate the educational tools developed by pre-school teacher candidates using the block-based coding program into teaching?

2.What are the activity plans prepared by pre-school teacher candidates for using the digital tools they have developed, in terms of educational qualities?

It is very important to choose the right programming environment to ensure effective learning, achieve teaching goals, and ensure interest and motivation (Özmen & Varol, 2012; Sayan, 2016). Especially for those who are just starting to learn coding, it is recommended to use block-based coding programs that do not require coding because they are technically quite complex (Sırakaya, 2018). In this context, the conceptual framework for block-based coding used in the research is presented as follows.

1.1. Block Based Coding

In block-based programming environments, coding is done by dragging and dropping code blocks on a graphical interface, without the need to regularly write code in the programming language (Yünkül et al., 2017; Sırakaya, 2018).

Researchers state that block-based programming environments are the most suitable programming environment for children and beginners in teaching programming for various reasons (Yünkül et al., 2017). Especially in early childhood years, block-based programming applications such as Scratch are frequently used compared to textual programming tools (Fields et al., 2015). The advantages of block-based programming environments are that the interface is simple. It is user-friendly, does not require professional programming skills, uses a language that is close to daily spoken language and supports Turkish, visualizes and concretizes programming, and application development is faster and more cost-effective (Mohamad et al., 2011; Sırakaya, 2018). Scratch is used in schools today. It is one of the most used visual block-based programming tools. It works web-based and is free to use and subscribe.

Scratch, a visual tool, can be easily applied in the game design process due to its simple interface, easy design opportunities and free availability (Malan & Leitner, 2007). Game design work via Scratch; It helps students understand the process better by increasing their interest and motivation in programming. It allows them to better understand the basic programming process and logic. There are studies concluding that robotic applications improve 21st century skills such as group work, creative thinking and computational thinking (Lee et al., 2011; Eguchi, 2014). Users can create animations, games or digital stories and scenarios with Scratch. You can share

these projects with other users on the Scratch online groups page.

Basic features of Scratch; These can be listed as coding with block code, easy-to-use interface, fast debugging structure, multimedia content, design-oriented structure, sharing and collaboration and compatibility with other programming structures. Due to these advantages, the Scratch program was used in this research, considering that teachers or candidates who do not have any previous experience in using technological tools can easily develop a digital product to be integrated into teaching.

2. Method

In this study, document analysis method was applied based on the qualitative research approach. The document analysis method is the systematic examination of existing records or documents as a data source (Karasar, 2016). Within the scope of the research, the activity plans prepared by pre-school teacher candidates to integrate an educational product into teaching using Scracht, a block-based coding program, in the fall semester of the 2022-2023 academic year were examined. For this purpose, a research group was formed from prospective teachers studying in the preschool teaching department of a medium-sized university in Türkiye. Coding training and practices to be given to teacher candidates within the scope of the Children and Media course, which is given as an elective at the beginning of the 2022-2023 fall semester, were mentioned, and those who wanted to participate in this course were asked to choose this course from the process. Students who did not volunteer for the practices were able to drop out of the course at the beginning of the semester and choose alternative elective courses. In this sense, the research group consisting of 29 pre-school teacher candidates was determined on a voluntary basis using the purposeful sampling method.

2.1. Data Collection Process

The research lasted 14 weeks within the scope of the "Children and Media" elective course that pre-school teacher candidates took in the spring semester. Lessons were held in the computer laboratory, and the study was supported through the virtual classroom created through Classroom. In addition to the face-to-face lesson, researchers shot screen videos showing how coding was done using the Scratch program, which can provide technical support to prospective teachers, and these videos were added to the virtual classroom. In order to ensure understanding of the practices in face-to-face lessons and to increase interaction, issues that the prospective teachers did not understand were emphasized and necessary practices were carried out. As shown in Figure 1, first of all, topics such as media products, the effects of these products on development, digital media products used in the preschool period and the educational features of these products are theoretically discussed within the scope of the course. Then, face-to-face practices were held to introduce the Scratch program interface, introduce the codes, and create sample science and mathematics activities. Application videos of these examples have been uploaded to the virtual classroom. Following this coding training, prospective teachers were asked to develop an activity plan and an educational tool (such as animation, game, digital story) according to the achievements of science and mathematics education according to the "2013 Preschool Program". Via Scratch, suitable for preschool level. Pre-service teachers determined which science or mathematics achievement they would plan for. At the end of the 10-week course period, teachers uploaded their projects and activity plans to the virtual classroom.

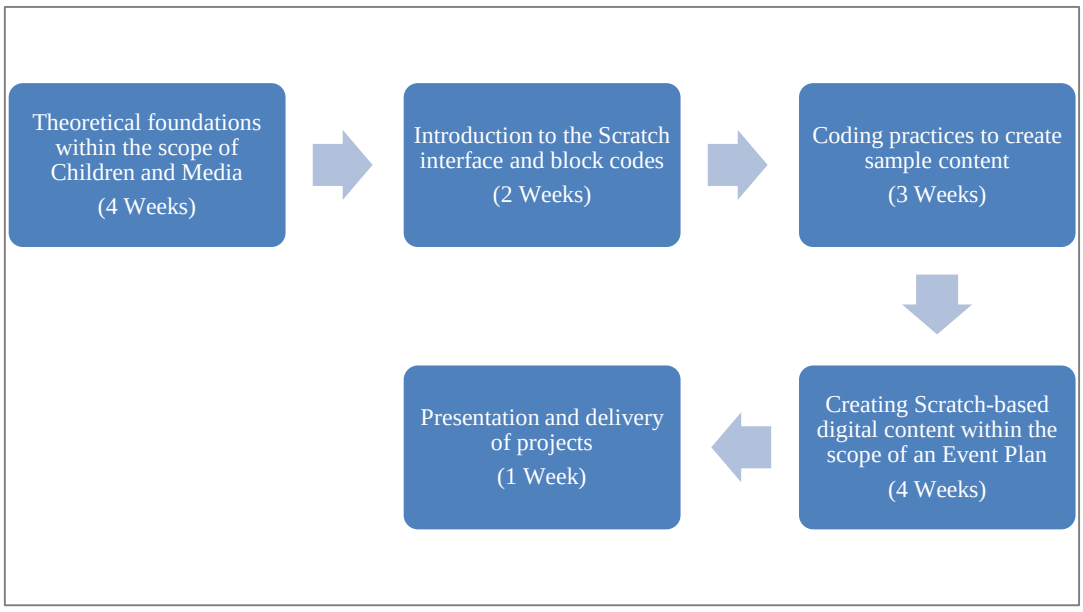

Figure 1. Data collection process.

2.2. Data Analysis Process

In the first step of data analysis, the event plans were examined in their entirety and analyzed with codes generated from the content (emerging codes) (Merriam, 2009). In this way, the general characteristics and educational features of the activity plans were determined in outline. In this preliminary analysis, a descriptive content analysis table was created regarding the development periods (months), development areas, activity types, the way the activity was implemented, and the methods used in the activity. In line with the first sub-problem, it was examined how prospective teachers integrated the digital products they developed in the Scratch program into their activity plans. In this context, the study findings were obtained by performing a micro analysis on at what stage of the course and for what reasons digital products were integrated. In line with the second sub-problem, codes were made as a result of micro-analyses for the educational features of the activity plans, and five themes appropriate to these codes were reached: Supporting science, mathematics, cooperative learning and supporting scientific communication, based on a child-centered approach. The analysis was checked by two independent researchers and findings and comments were created after consensus was reached.

3. Results

Within the scope of the first sub-problem, the findings regarding how pre-school teacher candidates integrated Scratch as an educational digital tool into their activity plans while teaching the achievements of Pre-School Education programs were examined through descriptive and content analysis of 29 lessons. It is planned and presented as follows.

In this context, the distribution of activity plans prepared by teacher candidates according to months and development areas is given in Table 1.

Table 1. Distribution by months.

Months	***f***	**%**
48-72	14	48.28
60-72	12	41.38
48-60	3	10.34

According to Table 1, distribution by months of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that 14 (48.28%) were for 48-72 months, 12 (41.38%) were for 60-72 months and 3 (10.34%) were for 48-60 months of them.

The distribution of activity plans prepared by teacher candidates according to their development areas is given in Table 2.

Table 2. Distribution according to development areas.

Development Areas	***f***	**%**
Cognitive	13	44.83
Cognitive / Language / Personal Care	1	3.45
Cognitive / Language	10	34.48
Cognitive / Language / Social Emotional	3	10.34
Cognitive / Social Emotional / Motor	1	3.45
Cognitive / Language / Personal Care	1	3.45

According to Table 2; development areas of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that 13 (44.83%) were cognitive, 10 (34.48%) were cognitive / language, 3 (10.34%) were cognitive / language / social emotional, 1 (3.45%) were cognitive / language / personal care, cognitive / social emotional / motor, cognitive / language / personal care of them.

The distribution of activity plans prepared by teacher candidates according to activity types is given in Table 3.

Table 3. Distribution by activity types.

Activity Types	***f***	**%**
Science / Drama / Art / Turkish	1	3.45
Science / Game / Art	1	3.45
Science / Art / Math	1	3.45
Science / Art / Turkish	2	6.90
Drama	1	3.45
Science / Mathematics	3	10.34
Science	11	37.93
Science / Drama	1	3.45
Science / Art	3	10.34
Science / Engine	1	3.45
Maths	2	6.90
Science / Turkish	2	6.90

According to Table 3; activity types of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that 11 (37.93%) were science, 3 (10.34%) were science / art and science / mathematics, 2 (6.90%) mathematics, science / Turkish and science / art / Turkish, and the other activity types were 1 each (3.45%) of them.

The distribution of activity plans prepared by teacher candidates according to science and mathematics activity types is given in Table 3.

Table 4. Distribution by science and mathematics activity types.

Activity Types	*f*	%
Science	26	89.66
Maths	3	10.34

According to Table 4; science and mathematics activity types of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that 26 (89.66%) were science activities and 3 (10.34%) were mathematics activity types of them.

In the lesson plans prepared by pre-school teacher candidates by integrating into the Scratch program; It was examined in three lesson stages: introduction, development and conclusion. In the prepared lesson plans, it was seen that the Scratch program was integrated into at least one stage of the lesson. The findings showing which parts of the lesson plans the teacher candidates integrated the Scratch program are given in Table 5.

Table 5. Distribution showing the integration stage of Scratch applications at the integrated activity plan stage.

Integrated Activity Plan Stages	Reason for Integration	*f*	%
Entrance	Attracting Attention	5	17.24
Development	Discovery	9	31.03
	Explanation	5	17.24
Assessment and evaluation	Evaluation	10	34.48

According to Table 5; integrated activity plan stages of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that 5 (17.24%) were at entrance stage–attraction attention, 9 (31.03%) were at development stage–exploration, 5 were (17.24%) were development stage-explanation and 10 (34.48%) are measurement / evaluation of them.

Within the scope of the second sub-problem, lesson plans were examined in terms of educational qualities and the following themes and codes are given in Table 6.

Table 6. Distribution showing the theme and code frequencies of Scratch applications in the activity plan.

Theme	Code	Yes *(f)*	Yes *(%)*	No *(f)*	No *(%)*
Based on Child-Focused Approach	Supports student-centered teaching strategies	24	82.76	5	17.24
	Teachers take on roles consistent with the child-centered approach	24	82.76	5	17.24
Science	Requires them to learn, understand, and use basic science concepts and/or big scientific ideas	23	79.31	6	20.69
	Requires the use of scientific process skills	23	79.31	6	20.69
Maths	Requires them to learn, understand and use basic mathematical concepts	19	65.52	10	34.48
Supporting Collaborative Learning	Does it support teamwork?	10	34.48	19	65.52
	There is individual responsibility	10	34.48	19	65.52
Supporting Scientific Communication	Requires students to convey science concepts (e.g., orally, in writing, and through visual means such as tables and graphs)	26	89.66	3	10.34
	Includes a requirement for discussion strategies	21	72.41	8	27.59

According to Table 6; themes based on child-centered approach of activity plans in Scratch project applications prepared by teacher candidates based on their science and mathematics education achievements were observed that, in the theme based on child-centered approach, while 24 (82.76%) supported student-centered teaching strategies, 5 of them (17.24%) did not support the teaching strategies. Furthermore while 24 (82.76%) teachers took on roles consistent with the child-centered approach, 5 of them (17.24%) did not.

In the science theme 23 (79.31%) were required them to learn, understand, and use basic science concepts and/or big scientific ideas, 6 of them (20.69%) ıt is said that it is not required. Again, while 23 (79.31%) it is required the use of scientific process skills, 6 of them (20.69%) did not.

Mathematics theme 19 of the codes (65.52%) help them learn and understand basic mathematical concepts. And that it requires them to use it, while 10 of them (34.48%) do not require it.

10 (34.48%) of the codes in the theme of supporting collaborative learning support teamwork. Support and 19 of them (65.52%) do not support teamwork. Again, 10 of the codes included in the theme of supporting collaborative learning (34.48%) stated that there is individual responsibility

in collaborative learning groups, and 19% (65.52%) is that it is not.

Scientific communication 26 (89.66%) of the codes in the supporting theme affect students science concepts. Their communication (e.g. verbal, written, visual tools such as charts and graphs) requires, while 3 of them (10.34%) It is said that it is not required. Also included in the theme of supporting scientific communication 21 of the field codes (72.41%) included a requirement for discussion strategies, 8 (27.59%) does not contain any requirements.

The distribution of activity plans prepared by teacher candidates, showing the way the activity is implemented, is given in Table 7.

Table 7. Distribution showing the implementation of the activity in Scratch applications in the activity plan.

Implementation of the Activity	***f***	**%**
Small Group	3	10.34
big group	3	10.34
Large Group / Individual Studies	9	31.03
Individual Studies	3	10.34
Small Group / Individual Studies	11	37.93

According to Table 7, the way activity plans are implemented: 11 small group/individual studies (37.93%), 9 (31.03%) large group/individual studies, 3 (10.34%) small groups, 3 It is seen that there are 1 (10.34%) small group/individual studies. (10.34%) large group work and 3 (10.34%) individual work.

The distribution of activity plans prepared by teacher candidates showing the activity method is given in Table 8.

Table 8. Distribution showing teaching methods.

Method	***f***	**%**
Digital Storytelling	4	13.79
Interactive Games	22	75.86
Lesson	2	6.90
Animation	1	3.45

According to Table 8, of the teaching methods used in the activity plans, 22 (75.86%) were interactive games, 4 (13.79%) were digital storytelling, 2 (6.90%) were plain narrative and 1 (3.45%) appears to be animation.

4. Discussion and Conclusion

The aim of the research is to examine the activity plans prepared by pre-school teacher candidates for block-based Scratch applications in terms of their suitability for the preschool education program and their educational qualities. In this section, the research findings are discussed and comments are presented in the context of the sub-problems that form the basis of the research. In addition, the results obtained during the study process and various suggestions for teachers and researchers in line with these results are included.

Achievements and indicators serve as a guide for teachers while preparing activity plans (Karadoğan et al., 2019). However, in our study, it is seen that when preparing activity plans, they organized them according to the applied Scratch program, not according to the outcomes and indicators. In early childhood, children need to actively participate in scientific process skills (Jirout & Zimmerman, 2015). In our research, it is seen that teachers make an effort for the active participation of students and provide guidance. Preschool children have difficulty understanding abstract concepts (Bilaloğlu, 2005; Şahin, 2016). Therefore, teachers need to take into account the development levels of students when implementing and preparing activity plans. Abstract coding studies were made concrete through the Scratch program. It has been determined that they include concepts other than the science and mathematics subjects that are intended to be explained in the learning process. It is seen that other concepts other than the science and mathematics concepts targeted in the activity plans are also mentioned. Materials used in the preschool period should be appropriate to the development levels of students (Zembat et al., 2020). It was observed that coding training designed for science and mathematics was not included in the activity plans and its importance was not emphasized. In early childhood, children learn by exploring (Siahaan et al., 2021). It is thought that teachers and pre-school teacher candidates should direct students to explore and learn through the questions they ask. It has been observed that exploration is actively used due to the appearance feature of the Scratch program and the interactive progress of the application.

The positive aspects of block-based Scratch application programs include the generalizability of the program, the diversity of activities, their impact on development, and communication elements between children and adults (Alp, 2019). Again, research shows that teachers support the use of robotics and technology application activities as a pedagogical tool and have positive attitudes towards robotics. shows that he has opinions (González & Muñoz-Repiso, 2018). It is important to diversify program activities by combining coding with other activities (Bers et al., 2019; Saxena et al., 2020). As a result, when the activity plans made by pre-service teachers in block-based Scratch education applications are examined, it is seen that various types of activities, mostly science activities, are included in the learning process.

Student-centered education approach includes activities in which students participate; The teacher-centered education approach, on the other hand, highlights the activities that the teacher uses to encourage learning (Kim et al., 2013). In the student-centered approach, the student interacts with other students during the learning-teaching process in the learning

environment through information resources, teachers, and technology (Özer, 2008). In the student-centered approach, teachers in learning environments should provide students with the opportunity to gain experience, use initiative, and self-evaluate during the learning process (Sabancı & Şahin, 2005). According to our research findings; It is seen that among the themes related to the student-centered approach in the activity plans, student-centered teaching strategies are most frequently supported.

The teacher gives students responsibility for their learning, instead of constantly transferring information to the students and checking their learning with questions; It creates options that facilitate and enrich their learning (Özer, 2008). According to our research findings; The teacher's role in activity plans is often such that he/she assumes roles in accordance with child-centered teaching strategies.

It is emphasized that science teaching should be designed to include teaching scientific process skills (Saat, 2004; Huppert et al., 2002). It is stated that students acquire scientific process skills by becoming aware of the scientific process, gaining habit, and becoming automatic (Saat, 2004). In this context, it was concluded that the science theme most often requires learning, understanding and using basic science concepts and/or big science ideas and the use of scientific process skills.

This research is limited to 29 teacher candidates attending Kastamonu University, Faculty of Education, Department of Preschool Education Teaching in the spring semester of the 2022-2023 academic year.

It is thought that the results of the study will contribute to the literature by revealing the science and mathematics education activity plan preparation skills and orientations of pre-school teacher candidates who will teach with block-based Scratch application tools in the coming years. In this context, science and mathematics education activity plans of preschool teachers can be examined through coding and any deficiencies encountered can be completed with in-service training. It is recommended to provide coding training in higher education institutions and to train pre-school teacher candidates on how to create activity plans after coding training.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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