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Research Article

Investigation of Pre-Service Science Teachers' Learning Experiences on Educational Robotics Applications

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Abstract

The purpose of this study is to examine the learning experiences of pre-service science teachers on educational robotic applications. Within the scope of this study, both block-based coding and robotic coding activities were carried out. In this study, case study, one of the qualitative research designs, was used. The research was carried out within the scope of Technology and Project Design course in Gazi University Department of Science Education. The research group of the study consists of pre-service science teachers of the Department of Science Education (n=46). A structured interview form was developed by the researchers to collect pre-service teachers' views on the activity. In order to analyze the data obtained from the interviews, descriptive content analysis was made and categories related to student thoughts were created. To ensure the reliability of the categories, 2 field experts analyzed the codes separately and Krippendorff's alpha is used for the reliability of the analyzes. It was calculated as .81. It is seen that the majority of pre-service teachers have not participated in a robotic coding course or such an activity before. So, it is found that such a course creates significant positive contributions to them.

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Introduction

In today's pace of digitization, software and technology play an increasing role in every aspect of society and life. This situation creates the need to understand how the digital world works and what opportunities and risks it present, while learning about the physical world. The concept of programming lies behind all the digital solutions, software, and systems we use. To understand the digital world, it is necessary to know what the concept of programming is. Programming is a way of creating something new, solving problems and applying ideas to the Digital World (Nouri, Zhang, Mannila & Norén, 2020). One of the recent approaches to programming is educational robotics applications. Especially with the widespread use of STEM approach, it is seen that many curricula, programs, and courses have started to take place in it (Foss, Wilcoxen & Rasmus, 2019; Öztürk & Özdemir, 2017;

Şimşek, 2019). The aim of robotics applications in education is to try to strengthen the learning skills of future engineers and scientists through robot-based projects (Curto & Moreno, 2016). With these skills, students are expected to achieve significant gains in their field-related skills. Integrating robotic coding applications into lessons will provide students with an interesting and entertaining environment about science and engineering and enable them to directly observe the practical applications of theoretical concepts in the fields of mathematics, science, and technology (Curto & Moreno, 2016). Robotics applications in education will enable students to direct their studies and focus to areas related to STEM subjects. This direction will help students deepen their knowledge and also gain 21st century skills.

Robotic coding has become one of the new digital technologies in education with the differentiation of technology use in education. Especially in recent years, robotic activities have started to take place in the country and in the world. With activities such as robotic coding competitions and Teknofest, it is tried to create awareness of technology that will produce solutions to problems among students. Technology competitions are organized in various disciplines and categories in order to realize dreams the thousands of students who aim to increase the human resources trained in the fields of science and engineering in Turkey (Teknofest, 2021). At the same time, it is aimed to equip students with robotic coding, design and entrepreneurship skills from an early age in science centers, and to equip students with the technological production tools of the period with the Experiment Turkey project prepared by TÜBİTAK (Deneyap Turkey, 2020). In this way, competition-based activities represent a competitive learning process. The competitive approach, built on the basis of these competitions, is a process in which learning outcomes are achieved through competitions. It is seen that such activities are used in various studies in the context of technology supported science education (Çetinkaya & Taş, 2018; Eguchi, 2014; Pedaste, Mäeots, Leijen & Sarapuu, 2012).

In recent years, robotic platforms and applications that are easy enough for undergraduate coding studies have been increasing rapidly (Eguchi, 2016). The framework, curriculum and achievements of science education are effective fields for educational robotics applications (Benitti, 2012). For this aim, it will be an important tool to provide students with these skills in science education. The contents prepared in science education and the students who have or are aware of these skills will be important parts of an interdisciplinary project in their professional lives (Beer, Chiel, & Drushel, 1999). It will enable pre-service teachers to start their professional life, to gain self-confidence and to feel competent by being familiar with concepts such as coding and robotics and developing applications with them (Hashim, Mustapha, & Rahman, 2004). For this reason, the skills and awareness that pre-service teachers will gain during the undergraduate process will reduce their negative attitude or anxiety towards technology. The experiences that pre-service teachers will gain through robotic studies, applications and activities will enable them to better understand nature and the environment and to look at problems from a different perspective.

Use of Robotics Tools in Education

The origin of educational robotics applications is based on Papert's (1980) constructionism theory. The aim of this theory is to enable students to have meaningful learning experiences by taking an active part in the learning process. Differentiating it from traditional computer-assisted instructional models in which computers program children, Papert tried to create an environment where children program computers and robots. In this approach, it is aimed that children gain a sense of power over technology. The tangible nature of robots can be seen as one of its key advantages. By testing scientific and mechanical principles with robotic activities, students can understand abstract concepts and achieve a more functional level of understanding (Barker & Ansorge, 2007).

Educational robotics is an application that provide students with experiences to understand technological and mechanical systems, to understand and adapt to changes driven by complex environments, and to use knowledge in real situations, times and contexts (Eguchi, 2014). It is stated that robotics applications in education develop skills such as creativity, innovation, communication, cooperation and teamwork in both curriculum and extracurricular activities (Curto & Moreno, 2016). The development of these activities in 21st century skills such as creativity (Eguchi, 2014) and collaboration (Giang et al., 2019) is emphasized. Wong, Cheung, Ching, and Huen (2015) classify the benefits of learning coding and robotics under 5 headings: creative thinking, increasing creativity, problem solving technique, development of technology perception, and communication skills. Educational robotic applications make a significant contribution to the skills expressed as 21st century skills of students. In addition, applying educational robotic activities has been one of the effective ways for students to develop applications through robotic coding in areas such as mathematics, physics, and chemistry (Giannakopoulos, 2009). There have been many methods used for teaching with robotic applications. These are respectively learning by discovery, cooperative learning, problem solving, project-based learning, competitive learning (Altin & Pedaste, 2013).

There are many studies using robotic applications in learning process at educational environments. These are studies about project-based learning (Alimisis, Frangou & Papanikolaou, 2009); problem solving (Sartatzemi, Dagdilelis, & Kagani, 2005); project-based and cooperative learning (Karahoca, Karahoca, & Uzunboylu, 2011); exploratory learning (Sullivan & Moriarty, 2009); competitive learning (Stein, 2004). The use of robotic applications in education is used for different purposes. These applications are used as learning objects in the learning environment, as a cognition tool, and as a tool for students' learning and development (Ospennikova, Ershov, & Iljin, 2015). Eguchi (2016) proposed the robotic context at two levels in the educational process. It has been expressed as a guiding tool by students during purpose-designed learning activities or as social mediators acting as peers for students or assistants for teachers during traditional learning activities.

Robotics applications are also given in relation to STEM in the literature. It can be a field with an independent curriculum to teach robotics itself, as well as a sub-discipline to teach the robotics curriculum, concepts and applications that STEM disciplines aim to teach due to its interdisciplinary nature (Jung & Won, 2018). Despite the important gains of educational robotic applications such as gaining skills, motivation and awareness, the problems experienced in the application create various difficulties in the learning process. There may be various problems such as hardware problems experienced during the course or activity, and failure of the electronic parts used (Talan, 2020).

Literature Review

Sullivan (2008) emphasizes that robotics applications created with pedagogical approaches improve thinking and scientific process skills. The tool-rich nature of robotic activities, the built-in instant feedback, and the open-ended and broad nature of research highlight its importance for instructional design. It shows that educational robotic applications developed positive attitudes towards students' academic achievements, scientific process skills and attitudes towards science lesson (Özüdogru, 2013).

Atmatzidou and Demetriadis (2016) determined that educational robotic applications positively improved students' problem solving and cognitive thinking skills. They also stated that these practices create entertaining, attractive, and creative learning environments. Kasalak and Altun (2020) examined the relationship between robotic coding activities at the secondary level and students' self-efficacy perceptions regarding block-based programming. According to the application results of the students, it is stated that the self-efficacy perceptions of both simple and complex block-based programming showed positive changes.

In studies conducted to teach science and technology within the framework of STEM, students showed positive effects in the fields such as Science, Mathematics and Engineering. In some studies, it has been stated that learning with robotic applications is more interesting and students develop positive attitudes towards STEM subjects (Barker & Asorge, 2007; Robinson, 2005).

Aksu (2019) examined the views of Information Technologies (IT) teachers about robotic coding and robotics competitions. As a result of the study conducted with 20 IT teachers, it is stated that the participants mostly had a positive opinion about the necessity of robotic coding training and robotics competitions. Çınar (2020) examined the effectiveness of the educational robotics-assisted STEM course for Science Teachers. As a result of the study carried out with 35 science teacher candidates, it is found that the robotic supported STEM course contribute both to the meaningful construction of the relationship between STEM disciplines and to the positive attitudes of thoughts of the prospective teachers towards the use of robotic tools as educational tools in the science lesson. Hadjiachilleos, Avraamidou, and Papastavrou (2013) state that educational robotic activities increased the scientific research processes of teacher candidates. Chevalier, Giang, Piatti, and Mondada (2020) state that educational robotic activities improve students' computational thinking and creative problem-solving skills. Chevalier, Riedo, and Mondada (2016) collected the opinions of 44 teachers who participate in educational robotics activities through a questionnaire. The results show that teachers found robotic activities useful for promoting reflection and collaboration, as well as skills such as communication, learning strategies, and creative thinking. However, not all results of the use of robotics in research have positive effects. Fagin and Merkle (2003) find that robotic activities did not help introductory computer science students learn programming. The students who use the robots during the lesson got lower scores than the students who do not use the robots. Although robots have a facilitating role in the way they are implemented, they did not show a positive effect in the end.

Aim of Study

Although there are growing studies about that robotics in Education, few studies have examined implementation of robotics in Science Education (Kidd, Kaipa, Sacks & Almeida, 2020). However, investigations of how robotics influences pre-service Science teachers learning experiences and coding skills are only beginning to appear. This points to the need for more studies exploring the links between educational robotics applications and Science Education interest. More broadly, research is needed to understand how learning experiences on Science Education. Within the scope of this study, both block-based coding and robotic coding activities were carried out. It is important to evaluate the opinions of pre-service teachers about coding and robotic coding activities. As a result, it is aimed to examine the learning experiences of pre-service science teachers on educational robotic applications.

Method

Research Design

In this study, case study, one of the qualitative research designs, was used. Case study is used to present information about a situation, to clarify uncertainties, and to reveal the relationships of these situations with real life (Yin, 2003). Case study allows for in-depth, multiple exploration of various topics in real-life settings. It is preferred when there is a need for an in-depth evaluation of the subject, event, or phenomenon in the context of natural real life (Crowe et al., 2011). Within the scope of this study, it is aimed to reveal the educational effects of educational robotic activities on pre-service teachers during the courses.

Participants

The research was carried out within the scope of Technology and Project Design course in Gazi University Department of Science Education. The research group of the study consists of pre-service science teachers of the Department of Science Education.

A total of 46 students constitutes the participant group of the research. Most of the participants are female students (n=38, 83%). The number of male students participating in the study is 8 (17%).

Implementation Process

The purpose of this study is to examine the learning experiences of pre-service Science teachers regarding educational robotic applications. Within the scope of this study, activities are carried out on the block-based application (Scratch) to understand the coding logic and algorithm process before the students start robotic applications for the first 7 weeks. Because of the Scratch for Arduino (S4A) program similarly works with block-based coding logic, it is thought to be useful in terms of creating a fundemantal. The purpose of these activities is to enable students to understand the interface, to know the features of the functions to be used in menu structures, and to understand the functions to be used while creating variables. After 6 weeks were completed, a coding assignment on science education was requested from the students. In the next 7 weeks, robotic application activities were held with the students with S4A Arduino. At the end of the semester, students were asked to submit a project related to their own field. At the end of the semester, students' views on coding and educational robotics application activities were collected through online forms.

During the course, activities are held with students for a total of 14 weeks. The list of these activities is given below.

Week 1: Introduction of Scratch program, introduction of interface and menus

Week 2: Movement, sound, events in the menu, introduction of blogs and coordinate system activity

Week 3: Introduction of control, detection, blogging and sample activity

Week 4: Introduction of operators and mathematical game activity

Week 5: Introduction of variables and thermometer activity

Week 6: Algorithm logic and free fall activity

Week 7: Coding project on Science Education

Week 8: Introduction of Scratch for Arduino (S4A) program, introduction of interface and menus

Week 9: Examples of Circuit setup, introduction of Digital and Analog signal concepts, Input and Output concepts and circuit activities

Week 10: Resistor, Led, RGB Led, Button usage and sample activity

Week 11: Introduction of sensors (such as Distance, Sound) and sample activity

Week 12: Potentiometer usage and a sample activity

Week 13: Activity made on the ready-made kit (Ready-made mobile robotic coding tool)

Week 14: Robotic coding project on Science Education

Data Collection Tools

A structured interview form was developed by the researchers to collect pre-service teachers' views on the activity. There are 11 questions in the Teacher Opinions on Educational Robotic Activities form. Ensuring the content validity of the questions in the interview is important for the studies. The content validity of the questions prepared for this purpose should be provided with expert opinions (Cansız - Aktaş, 2014). The interview form prepared by the researchers initially consists of 16 questions. The interview questions were shared by 3 field experts and these experts are asked to evaluate the questions. According to the answers, the interview form was given its final form with 11 questions. In order to strengthen the reliability of the study, the obtained results were shared with the teacher candidates participating in the study and their views are taken.

Some interview questions are listed below.

"Do you prefer to work to work in robotic coding activities step by step with an instructor or by producing a project in groups?"

"Do you prefer to use this and similar activities in your lessons in your professional life, why?"

"Do you think activities are boring?"

"What do you think about the difference of the course from other courses?"

"What is most difficult part of the activities?"

Data Analyses

In order to analyze the data obtained from the interviews, descriptive content analysis was made and categories related to student thoughts were created. Consistency in the coding that different researchers or the same researcher will create in different time periods is important for reliability (Miles & Huberman, 1994). In addition, it is important for the researcher to consult the views of other researchers to increase the consistency of the results obtained. To ensure the reliability of the categories, 2 field experts analyzed the codes separately and Kripendorff's alpha is used for the reliability of the analyzes. Kripendorf coefficient is used because it reduces the chance effect and provides the opportunity to examine data other than nominal data (Wever, Schellens, Valcke & Van Keer, 2006). It is calculated as .81. The results obtained indicated that the reliability between encoders was high (Krippendorff, 2004).

Findings

The data obtained from the "Teacher Opinions on Educational Robotic Activities" form applied to pre-service science teachers were analyzed with the descriptive method, one of the qualitative analysis methods. The categories obtained and the frequency and percentage values of these categories are explained in tables. The reason why the frequencies are higher than the number of students is that some students give more than one answer to some questions.

Information on Coding Education Experiences

Students were asked whether they received coding (Scratch, Code, Alice, App Inventor) training or participated in such an activity. They stated that approximately 72% of the students did not receive coding training before (n=33), while 28% (n=13) stated that they received a coding training or participated in such an activity.

Information on Robotic Coding Education Experiences

Students were asked whether they received robotic coding (S4A, Arduino, Mblock vb.) training or participated in such an activity. They state that approximately 74% of the students did not receive coding training before (n=34), while 26% (n=12) state that they received a coding training or participated in such an activity.

Examination of Students' Lesson Attending Options in Coding and Robotic Activities

The students were asked whether they wanted to work in robotic coding activities step by step with an instructor or by producing a project in groups. When students' views on the lesson attending options of coding and robotic coding activities are asked, a balanced distribution emerges. While some (48%, n=22) students wanted to practice step-by-step with an instructor, some students (52%, n=24) stated that they wanted to design a project with their groupmates.

Table 1. Students' lesson attending options in coding and robotic activities

Lesson Attending Options	f	%
Step by step with instructor	22	48
Project design in group	24	52
Total	46	100

Views of Pre-Service Teachers on Coding Lesson and Activities

The students' views on the coding lesson and its activities were examined and it was seen that the students found the coding activities useful (n=16). Students also stated that the lessons are enjoyable and attractive (n=14). The students stated that they found it very useful avocationally and that they would use it in their professional life (n=12). Some students stated that they are important and useful for understanding coding logic (n=5). In addition, students stated that the process is instructive (n=2), the program is easy to use (n=2), and it is a good activity (n=1) for the use of technology in education. Only one student stated that he found it challenging.

Table 2. Students' views on coding lessons and activities

Category	f	%
Useful	16	30
Enjoyable and attractive	14	26
Very useful and important for their profession	12	23
Important and useful for understanding coding logic	5	9
Instructive	2	4
Easy to use (about tool)	2	4
Good activity for the use of technology	1	2
Challenging	1	2
Total	53	100

When the statements of pre-service teachers are examined, the following answers come to the fore:

"I used to think that coding was hard, my prejudice was destroyed"

"An application that will make the lesson easy and fun in terms of science education"

"A nice activity before robotic coding"

"A useful activity related to my field"

"It was great to start coding like this"

Views of Pre-Service Teachers on Robotic Coding Lesson and Activities

When the students' views on robotic coding applications were evaluated, it is seen that the students find the applications enjoyable and instructive (n=13). 19% of the students (n=10) stated that they find the practices difficult but enjoyable. Table 4 shows that, they stated that it is useful (n=7), very complex (n=5), and an important tool for STEM (n=4), respectively. 4 students stated that they want to advance and develop, 3 students stated that they gain a different perspective to the project process, 3 students would prefer the use of ready-made robotic kits, and 2 students stated that it forms the basis for robotic coding. 2 students stated that they do not find robotic coding applications useful.

Table 3. Views of pre-service teachers on robotic coding practices

Category	f	%
Enjoyable and instructive	13	24
Difficult but enjoyable	10	19
Useful	7	13
Very complex	5	9
Important tool for STEM	4	7
Advance and develop for this profession	4	7
Different perspective to the project process	3	6
Ready-made robotic kits	3	6
Building the foundation of robotic coding	2	4
Not useful	2	4
Total	54	100

Some of the pre-service teachers' views on robotic coding applications are as follows:

"The fact that the subjects in the fields that students have difficulty in learning (especially physics) can be shown visually and concretely with the project and it makes their education better. I think it was useful to make the subjects that are difficult to understand as a project with this program. I think I learned the program"

"I think that S4A events are actually very useful, and we can use them in different projects in our future lives. However, we did not see this as enough in the lesson"

"It was good that the activities were wanted to be introduced to teacher candidates. I was unfamiliar with this subject, even a simple led lighting event was difficult for me. I think that, because of the coding language is not Turkish, also influences this.

"I think that useful activities and projects can be designed for the science course"

"It was a complicated application because its language is English, but it is a very useful application"

Views on the Difference of the Course from Other Courses

Pre-service teachers stated that the lesson is the most practice-oriented lesson process in terms of the difference from other lessons (f=35). Respectively, combining the concepts of the field with technology/coding (n=8), enjoyable lesson process (n=5), active participation (n=2) are other prominent categories. Coding logic, gaining awareness of technology problem solving, being up-to-date and innovative in education, understanding the STEM approach, understanding the product creation process, and the most distinctive innovative lesson process were identified as the other categories. (n=1).

Table 4. Views on the difference of the course from other courses

Category	f	%
Most practice-oriented lesson	35	63
Combining the concepts of the field with technology/coding	8	14
Enjoyable course process	5	9
Active participation	2	4
Coding logic	1	2
Gaining awareness of problem solving with technology	1	2
Innovative in education	1	2
Understanding the STEM approach	1	2
Understanding the product creation process	1	2
Innovative course process	1	2
Total	56	100%

Some of the views of pre-service teachers on the difference of the course from other courses are as follows.

"To design something on the computer with our own imagination. The fact that the application is at a high level, and we can integrate it into our teaching life."

"It was very helpful for us to be fully involved, to participate fully in the lesson."

"This course was a course that supported us to create a productive generation by developing students with the technology brought by our age in the institutions we would work in the future. Our other courses are more theoretical courses. This course is a practical course."

"I was able to get an answer in every lesson to the question 'Where are we going to use this in our lives?'"

Views of pre-service teachers on the knowledge and experiences from course achievements

When the pre-service teachers are asked about their knowledge and experiences from the course, students 29% (n=16) stated that they have experiences in creating robotic environments. In addition, preparing robotic activities in the field of Science Education (n=14), coding (n=13), project-based work (n=8) are listed as other views. New designs and transferring these designs to students (n=3), understanding the research process (n=2), learning by trial and error (n=1) are expressed as other acquired knowledge and experiences.

Table 5. Views of pre-service teachers on the knowledge and experiences from course achievements

Category	f	%
Creating robotic environments	16	29
Preparing robotic activities in the field of Science Education	14	25
Coding	13	23
Project-based work	8	14
New designs and transferring these designs to students	3	5
Understanding the research process	2	4
Learning by trial and error	1	2
Total	56	100

Some of the views of pre-service teachers regarding the knowledge and experiences they have gained from the courses are as follows:

"I understood how to identify a problem and to reach the solution steps. In other words, how I could use the scientific process steps was mentioned."

"Using sensors, making an activity using Scratch, for example, I learned activities such as preparing a quiz show."

"I have experienced that a small child or an adult, in short, people of all ages can find solutions to the problems. And, I realize that everyone can write code and these robotic operations are not very difficult."

"I think that in my teaching profession, I will be able to explain the subject to students in different ways, that is, by using technology."

Views of Pre-Service Teachers on Importance of Robotics Coding Training

Pre-service teachers' views on whether robotic coding training is important or not, and if they thought that it is important, why they see it, were examined. Table 6 shows that, it is seen that the students mostly see it as an important field in the technology and robotics era (n=33). Then, respectively, because of being an effective production tool (n=4), to teach these subjects better to the new millennium children (n=2), to attract students' attention to the lesson (n=2), and because of the use of these tools in science education is useful (n=2) are the reasons why they think that it is important. In addition, it was stated that they are important to show science subjects as problem-solving, permanent learning, and in terms of creativity and scientific processes (n=1). Only one person stated that it is not important.

Table 6. Views of pre-service teachers on importance of robotics coding training

Category	f	%
An Important field in the technology and robotics age	33	67
An effective production tool	4	8
Teaching these subjects better to the new millennium children	3	6
Attracting students' attention	3	6
Importance of using these tools in science education	2	4
Gaining creativity and scientific processes	1	2
Showing science subjects as problem-solving	1	2
Permanent learning	1	2
Not useful	1	2
Total	49	100

Some of the pre-service teachers' experiences regarding the importance of robotics applications are listed below.

"Yes. With the new developing technology, we have to find different teaching methods for children. Our current students are also very curious and interested in technology, so their robotics training is perfect for this job."

"I think it's definitely important because we can make the topics that are normally taught in the lessons much more interesting thanks to robotics and increase the participation of the students. Therefore, I think it is necessary to provide robotics training, especially for teachers."

"An innovative education suitable for the age. I think it's important. For example, while explaining photosynthesis, soil and climate to students, they can make a difference in education by making a simple smart greenhouse by using materials such as humidity sensor and heat sensor."

Views on the Most Difficult Part of the Activities

It was seen that the most difficult part of activities is coding process (n=23). Some students stated that there is no difficult part in the activities(n=15). The language of the program is English, and the placing of hardware elements (n=3) were stated as other difficult views. Errors in the codes (n=2), working with groups (n=1) and operating logic of circuit elements (n=1) were expressed as other difficult categories.

Table 7. Views on the most difficult part of the activities

Category	f	%
Coding	23	48
No difficult part	15	31
Hardware elements	3	6
The language of the program is English	3	6
Errors in the codes	2	4
Working with groups	1	2
Operating logic of circuit elements	1	2
Total	48	100

Some of the views on the most difficult part of the activities are listed below.

"I don't think there is a hard part in classroom activities. Only coding mistakes can be made frequently."

"Writing the codes was difficult. For example, when there are too many characters or something, it is difficult to code them."

"Trying to understand the Scratch for Arduino application, trying to decode the codes, even building a simple circuit were difficult for me. Software language' s being a foreign language was a factor in this."

"In the S4A program, I had a hard time understanding the working logic of the circuit elements and how they were placed. I think the reason is that the program card is small and I couldn't be active enough because we were working with the group."

Views on the question "Do you think activities are boring?"

Some of the pre-service teachers (93%, n=43) stated that they do not find the given activities boring. 2 teacher candidates stated that it is boring, one person stated that it is boring from time to time. These students stated that it is boring because they have difficulty in using the program. The student who says yes and stated that it is boring cannot understand the activity.

Table 8. Views on the question "Do you think activities are boring?"

Category	f	%
No	43	93
Seldom	2	5
Yes	1	2
Total	46	100

Views on the question "Do you prefer to use this and similar activities in your lessons in your professional life, why?"

When the views on this question were examined, all of the students answer "Yes, I prefer". The students want to use these activities because; 45% (n=23) of the them want to carry out a practical course process, 14% (n=7) of the them want to ensure their participation in the lesson, 12% (n=6) of them want to increase their interest in the lesson, 8% (n=4) of them want to make the lesson enjoyable 6% (n= 3) of them want to develop their imagination and creativity, 4% (n=2) of them want to show that complex subjects are easy.

Table 9. *Views on the question "Do you prefer to use this and similar activities in your lessons in your professional life, why?"*

	Category	f	%
Yes	To carry out a practical course process	23	45
	To ensure their participation in the lesson	7	14
	To increase their interest in the lesson	6	12
	Importance of the skills	6	12
	To make the lesson enjoyable	4	8
	To develop their imagination and creativity	3	6
	To show that complex subjects are easy	2	4
Total		51	100%

Some of the views of pre-service teachers on using these and similar activities in lessons are as follows.

"I will definitely use it. Because I think such practices are very important in education."

"Yes. It is important to be able to follow today's technology and studies in education, to guide students in different fields, to show them what they can do when they combine the science course with not only theoretical subjects, but also engineering, that is, design and mathematics."

"I would definitely like to. I think it is enjoyable for the student, and it is necessary for the development of problem-solving abilities and engineering skills, and the development of their imaginations."

"I prefer it because I will teach science and science is an appropriate field for projects. I want to educate my students ideally.

"By integrating science subjects and using sensors, I can make simple models of photosynthesis, force, human and environmental subjects and prepare activities."

Discussion and Conclusion

It is seen that the majority of pre-service teachers have not participated in a robotic coding course or such an activity before. So, the course has created significant positive contributions to them. The results showed that pre-service teachers find educational robotics applications enjoyable and instructive, difficult but enjoyable, useful, and an important tool for STEM. A small number of students stated that they found robotic coding applications complex. Çömek and Avcı (2016) stated that the concept of robotics brings productivity, attracts attention with enjoyable and simple activities, and is a useful tool in Science Education. Erten (2019) stated that robotic supported interdisciplinary educational materials increased student interest in the course and academic success also.

When pre-service teachers' views on the lesson attending options of coding and robotic coding activities are asked, a balanced distribution emerges. While nearly half of the pre-service teachers want to work step by step in the company of an instructor, nearly the other half stated that they wanted to work by designing a project as a group. Yecan, Özçınar, and Tanyeri (2017) stated that students have completed their missing points in programming teaching of learning in groups. The fact that there is a balanced distribution in robotic programming activities shows that different processes can be operated other than coding teaching. Students' learning styles and course attending options are expected to be effective in learning outcomes.

It shows that pre-service teachers' design skills, coding skills and their ability to apply their lessons with coding and robotics have improved. Erdoğan, Toy and Kurt (2020) stated that robotic applications provide gains in students' technology and design skills. Addressing these practices within the framework of the STEM curriculum will provide different gains to teacher candidates.

Pre-service teachers think that educational robotics applications are important. It is seen that the students mostly see it as important field in the technology and robotics era, since an effective production tool, in order to teach these subjects better to the new millennium children, to attract students' attention to the lesson and using these tools in science education is useful, Similarly, supporting education with robotic applications contributes to students gaining robotic knowledge and skills, being aware of their abilities, being willing to use technology, and learning by doing (Siper-Kabadayı, 2019). Some researchers have investigated the features and functions that a robot should have when is used in a classroom. They identified that activity is important for the participants, because it helps to break the monotony of lesson. Moreover, researchers highlight the importance of scientific concepts in the real world and their enthusiasm for interacting with these tools (Walker & Burleson, 2012).

Talan (2020) lists the positive aspects of educational robotics applications as relating to real life, learning software logic, technology-supported teaching experience, desire to design robots, advancing coding skills, impressive/useful, learning computer skills, gaining programming logic, learning by doing. In the context of this study, pre-service teachers will use robotic applications in their professional lives to carry out a practical lesson process, to ensure students' participation in the lesson, to increase their interest in the lesson, to make the lesson enjoyable, to develop students' imagination and creativity, and to show that complex subjects are easy. It is seen that the findings show similar results with each other.

It is stated that studies on educational robotic activities are associated with students' knowledge and skills in different subject areas such as Mathematics, Science, scientific inquiry skills and literacy (Chambers, Carbonaro, & Murray, 2008; Junk & Won, 2018). It is seen that the experiences of pre-service teachers from robotic application activities such as creating robotic environments in science education, scientific process skills are similar.

It is seen that the most difficult parts of the pre-service teachers are the coding/algorithm, hardware, and program's language. The fact that the students did not take such a course before or did not participate in the activity can be expressed as the most important reason for this result. Similarly, Çömek and Avcı (2016) state that pre-service teachers have some difficulties in coding logic. Hardware problems experienced, inability to transfer circuit logic to robotic applications can be expressed as other reasons.

Educational robotic activities will do positive educational contribution. Systemic implementation and classroom practicality are very essential for teacher factors. Pedagogy, curriculum and practical must be entegrated (Catlin & Blamires, 2010). The activities of this study provide positive contributions with these 3 dimensions.

Recommendations

Coding and algorithm training can be given to teacher candidates before educational robotic activities. This premise will make it easier for students to adapt to robotic activities.

Affirmative answers given by pre-service teachers to the activities may be useful in terms of giving these courses from the first semester.

Considering the pre-service teachers' interests in ready-made kits, it is seen that robotic applications will motivate pre-service teachers more in the course process prepared for ready-made kits. Lessons and activities prepared in this way can be planned.

Studies can be conducted to measure the knowledge and skills of pre-service teachers in science education and their academic achievements. With this result, qualitative and quantitative data can be compared.

There seems to be a balanced distribution in the participation of pre-service teachers in the practices. It is possible to work with different groups for which the course participation options are planned.

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Author Contribution Statement

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