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Views of parents with preschool children on computational thinking and educational robotics[1]

Levent DURDU*
Department of Computer Education & Instructional Technology, Kocaeli University, Kocaeli, Türkiye, ORCID: 0000-0003-3788-7226

Funda DAĞ
Department of Computer Education & Instructional Technology, Kocaeli University, Kocaeli, Türkiye, ORCID: 0000-0002-0868-6647

Tuğba KONAKLI
Department of Educational Administration, Kocaeli University, Kocaeli, Türkiye
ORCID: 0000-0003-4745-1805

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During the pandemic period, all levels of education, including pre-school, partially or completely moved to online education as a means of emergency remote teaching. With the transition to online education, teachers, students, and parents became more aware of the use of technological tools in education. With this awareness, parents have been introduced not only to technological tools but also to new concepts related to children's cognitive processes. These concepts include computational thinking (CT), which has been frequently encountered in different levels of education in recent years, and educational robotics (ER) as one of the methods applied in the development of CT. Several studies have been conducted to determine and improve the CT skills of students at different educational levels, such as primary, secondary, and higher education. At the preschool level, there are fewer studies on CT, which is mostly addressed through unplugged activities and educational robotics. As a part of 21st century skills, the relationship between CT and pre-school education is an issue that has been investigated to a limited extent. This descriptive quantitative survey model study explored the opinions of parents of preschool children about computational thinking and educational robotics applications. The participants of the study consisted of 84 parents in Kocaeli province. The participants were accessed through convenience sampling, and the data were collected using an online questionnaire. According to the results of the study, the majority of the parents stated that they believed that children in preschool education should have experience in CT and ER. Parents stated that they would like to learn more about the benefits of CT and ER for children and their learning. In this direction, it is suggested to organize seminars focusing on the importance and content of CT and ER for pre-school.

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* Correspondency: levent.durdu@kocaeli.edu.tr

Introduction

In recent years, there has been an increase in interest and effort in the understanding and teaching of computational thinking (CT) in schools. CT is defined as a way of thinking and behaving that involves the application of general rules or strategies in meaningful steps to problems (Brennan & Resnick, 2012; Kong, 2016; Wing, 2006). Algorithms are at the heart of CT, which is also characterized as a cognitive skill that individuals should possess. Algorithms range from simple tasks, such as a child following the steps for brushing his or her teeth, to much more complex tasks, such as the steps to follow in a project management process, and are at the heart of various tasks performed by everyone (Wing, 2011; Yadav, Stephenson, & Hong, 2017). Although algorithms are a subfield of computer science (CS), which generally contributes to the functionality of machines, they also affect or are affected by other disciplines such as mathematics, statistics, chemistry, physics, and biology. With a perspective that encompasses these multifaceted interactions, CT, which started with the concept of algorithmic thinking in the 1950s, has come back on the agenda with the new perspective brought by Wing (2006) as a thinking process involved in solving a problem (Denning, 2009; Grover & Pea, 2013; Guzdial, 2008; Wing, 2011).

CT is the use of computer science concepts to solve real-world problems, in addition to and different from the mechanical thinking taught to computers through algorithms (Wing, 2006). There is an argument for the wide-ranging benefits of CT in schools, with an emphasis on cognitive skills, creativity, and participation, as well as social justice and ethics (Kafai, Proctor, & Lui, 2020). In this direction, in line with the efforts to train individuals with the necessary CT skills from an early age, CT has become a topic of interest in many countries and has started to be used in education.

In terms of early childhood, information and communication technologies (ICT) are not viewed as a major requirement in preschool education. Play is fundamental for children. Play plays an important role in the development and education of children, especially in early childhood, but it is also an essential activity for children. Playgrounds that support communication and the development of motor and thinking skills play an important role in preparing children for life. In playgrounds, children can learn and develop their communication skills, master their motor skills, and explore their imagination and creativity (Bers 2018; Jenson & Droumeva, 2016). Some studies suggest that providing children with digital environments that they can build themselves as a playground can help develop their interest in science and technology fields and build their self-confidence (Angeli et al., 2016; Jenson & Droumeva 2016). In recent years, there has been a growing, albeit slow, body of work on early childhood CT, examining how computer science tools can be used to develop young children's cognitive and reasoning skills as well as CT (Bers, Strawhacker, & Sullivan, 2022). With these studies, a body of literature has begun to emerge on the CT concepts and skills that should be emphasized and what kind of CT tools can be used to develop children's CT concepts and skills in early childhood (Bers, Strawhacker, & Sullivan, 2022). The studies conducted in this context show that unplugged activities and educational robotics applications are particularly important and preferred in the pre-school phase. Although experimental studies that produce meaningful evidence on the relationship between CT skills and cognitive, social, and emotional development in early childhood have not yet become widespread, early studies have shown that physical robotic construction sets can positively contribute to children's cognitive and social development (Sullivan, Bers, & Mihm, 2017; Sullivan, Elkin, & Bers, 2015). Children can develop problem-solving skills while learning to code their applications using educational robotic sets (Relkin & Bers, 2020). In addition, educational robotics can help children understand mathematical concepts such as number, size, and shape (Bers, Strawhacker, & Sullivan, 2022; Resnick, 1998). Moreover, preschool children's activities with unplugged and educational robotics can have positive effects not only on the development of CT skills but also on their cooperation and social development. Having multiple children work together on a project to build a robot can encourage them to share, co-produce, and develop social coordination skills, while fostering cooperation and social development in ways that other tools cannot (Bers, Strawhacker, & Sullivan, 2022).

Despite the aforementioned research on CT skills in preschools, there is still very limited research on preschool teachers' knowledge and attitudes toward teaching CT, parents' knowledge and attitudes on this topic, and as well as children's digital experiences in home environments. Studies showing that children's digital experiences in the home have positive effects on their socioemotional learning are still rare and cannot be generalized (Lehrl et al., 2021). Although there is still a long way to go in this topic, considering the digital and online experiences during Covid-19, in addition to research on information and communication technologies in preschool, there is a need for research examining computational thinking. This can contribute to the body of knowledge for understanding how to effectively provide digital experiences for children's learning.

In the literature, there are studies examining different variables related to computational thinking and educational robotics (Angeli & Valanides, 2020; Bati, 2020; Flannery et al., 2013) at different educational levels, such as secondary school students (Kaya, Korkmaz, & Çakır, 2020) and pre-service teachers (Akgün, 2020; Güçlü, 2022); however, the number of studies involving parents is limited (Ehsan et al., 2019; Kourti et al., 2023). The systematic literature review studies conducted on this topic also confirm that the target audience of the studies is mostly secondary school students and pre-service teachers, but studies on the preschool level are also limited (Tosik-Gün & Güyer, 2019; Elçiçek, 2020; İliç & Haseski, 2019). As a result, studies that include parents' views on computational thinking and educational robotics applications have a high potential to contribute to the literature.

The purpose of this study was to identify the views of parents of preschool children regarding computational thinking and educational robotics applications. The expectations of parents regarding their children's experiences in this context and their own interest in these topics can contribute to the development of a projection of needs for both preschool education and parents. Thus, revealing the expectations of parents with preschool children for both their children and themselves can contribute to the emergence of priorities for the steps to be taken toward computational thinking and educational robotics applications. Accordingly, the following research questions were asked in this study:

(1) What are the views of parents with preschool children on computational thinking in preschool education?
(2) What are the views of parents with preschool children regarding educational robotic applications in preschool education?
(3) What topics would parents with preschool children like to learn more about computational thinking and educational robotics applications?

Method

This study used a survey model, one of the quantitative research methods (Atalmış, 2021; Büyüköztürk et al., 2012). Data were collected from 84 parents in Kocaeli province, Turkey, who were accessed through convenience sampling using an online questionnaire. The questionnaire was reviewed by two experts in the fields of preschool education and computer education for clarity, understandability, and validity. The information section of the questionnaire provided brief definitions about computational thinking and educational robotics. The questionnaire had two parts. The first part consisted of 10 4-point Likert-type statements targeting parents' views on CT and ER in preschool education. The second part consisted of 7 topics, allowing parents to make multiple selections from the topics they would like to learn more about computational thinking and educational robotics applications. For the first part of the questionnaire, Cronbach's alpha was calculated as .95, the lowest standard deviation as.95, the highest as 1.12, and the mean of the statements as 3.05. Descriptive analysis of the means and standard deviations of the survey questions is presented in Table 1. To make the data easier to interpret, positive and negative opinions were grouped and presented as percentages.

Table 1. Descriptive Analysis of Survey Questions.

Statement	Mean	S.D.
I believe that children in preschool education should have experience with computational thinking.	3.14	0.95
I think it would be useful to have activities related to computational thinking in preschool education.	2.86	1.08
I am enthusiastic about computational thinking in preschool education.	3.09	0.98
I feel comfortable supporting children in preschool education through activities that encourage computational thinking.	2.92	1.00
I am excited to learn more about computational thinking in preschool education.	2.96	0.96
I believe that children in preschool education should have experience with educational robotics.	3.15	0.99
I think it is useful to conduct educational robotics activities in preschool education.	3.01	1.12
I am enthusiastic about educational robotics in preschool education.	3.03	1.06
I feel comfortable supporting children in preschool education through encouraging activities for educational robotics.	2.96	1.05
I am enthusiastic about learning about educational robotics in preschool education.	2.97	1.01

Research ethics

Ethical rules were followed throughout the entire process from the planning, implementation, data collection, and data analysis of this study. Scientific, ethical, and citation rules were followed in the writing process of the study; no falsification was made on the collected data, and this study was not sent to any other academic publication environment for evaluation.

Findings

Views on computational thinking in preschool education

Of the parents, 70.24% stated that they believed that children in preschool education should have experience with computational thinking. On the other hand, 20.24% stated that they did not find this experience important. The percentage of parents who stated that they did not have information about this issue was 9.52%. The percentages of parents who think that it is useful to carry out activities related to computational thinking in preschool education are the same (70.24%, 20.24% and 9.52%).

Although parents had positive views about children's experiences with computational thinking and activities in this context, they responded less positively to the question about whether they were enthusiastic about computational thinking in preschool education. Although 59.52% of the parents stated that they were enthusiastic, 28.57% stated that they were unenthusiastic. Parents mostly expressed that they felt comfortable supporting their children with activities that encourage computational thinking in preschool education. The percentage of parents who responded positively was 65.48%, the percentage of those who did not feel comfortable was 23.81%, and the percentage of those who did not want to give an opinion on this issue was 10.71%.

In general, parents expressed their intention to learn more about computational thinking. Although 65.48% of the parents stated that they were very interested in learning computational thinking, the percentage of parents who did not give importance to it was 27.38%, and the percentage of those who did not express an opinion was 7.14%. Parents' views on computational thinking in preschool education are presented in Table 2.

Table 2. Parents' Views on Computational Thinking in Preschool Education.

Statement	Positive	Negative	No Opinion
I believe that children in preschool education should have experience with computational thinking.	70.24%	20.24%	9.52%
I think it would be useful to have activities related to computational thinking in preschool education.	70.24%	20.24%	9.52%
I am enthusiastic about computational thinking in preschool education.	59.52%	28.57%	11.90%
I feel comfortable supporting children in preschool education through activities that encourage computational thinking.	65.48%	23.81%	10.71%
I am enthusiastic to learn more about computational thinking in preschool education.	65.48%	27.38%	7.14%

Opinions on educational robotics applications in preschool education

Opinions on the experiences of preschool children with regard to educational robotics are in parallel with opinions on computational thinking. Among parents, 70.24% thought that children's experience with educational robotics was important. The percentage of parents who did not consider this experience important was 22.62%, and the percentage of parents who said they had no opinion on the subject was 7.14%. The percentage of those who think that it is important to carry out activities within this scope is 64.29%, the percentage of parents who do not find the activities important is 28.57%, and those who state that they do not have information about the subject is 7.14%.

Compared with the parents' views on educational robotic experiences and activities, it was seen that they were less enthusiastic about educational robotics in preschool education. Although 61.90% of the parents stated that they were enthusiastic about educational robotics, 29.76% stated that they were unenthusiastic and 8.33% stated that they had no idea about the subject. According to the participants, 61.90% stated that they felt very comfortable supporting children through encouraging activities for educational robotics in preschool education. The proportion of parents who did not feel comfortable with these activities was 30.95%, and the proportion of parents who did not express an opinion was 7.14%.

In general, parents expressed their intention to learn more about educational robotics. While 61.90% of the parents stated that they were interested in learning about educational robotics to a great extent, the percentage of parents who did not give importance to this was 27.38%, and the percentage of those who did not express an opinion was 10.71%. Parents' views on educational robotics in preschool education are presented in Table 3.

Table 3. Parents' Views on Educational Robotics in Preschool Education.

Statement	Positive	Negative	No Opinion
I believe that children in preschool education should have experience with educational robotics.	70.24%	22.62%	7.14%
I think it is useful to conduct educational robotics activities in preschool education.	64.29%	28.57%	7.14%
I am enthusiastic about educational robotics in preschool education.	61.90%	29.76%	8.33%
I feel comfortable supporting children in preschool education through encouraging activities for educational robotics.	61.90%	30.95%	7.14%
I am enthusiastic about learning about educational robotics in preschool education.	61.90%	27.38%	10.71%

Topics that parents would like to learn more about computational thinking and educational robotics

Table 4 shows the responses of the parents on the topics on which they would like to learn more about computational thinking and educational robotics. A total of 84 participants could provide multiple answers to the questions, and the responses are presented as percentages according to the total number of participants.

The benefits of educational robotics (52.4%) and computational and algorithmic thinking (47.6%) for children and learning were the topics that parents most wanted to learn about. These were followed by coding tools that can be used to develop computational thinking in preschool education with 40.5%, physical programming and computational thinking with educational robotics in preschool education with 39.3%, methods and strategies to develop computational thinking with 38.1%, computational and algorithmic thinking: characteristics and types with 36.9%, and plugged and unplugged activities for computational thinking and curriculum for preschool education with 33.3%.

Table 4. Topics that Parents Would Like to Know More About.

Topic	Percentage
Benefits of educational robotics for children and learning	52.4%
Benefits of computational and algorithmic thinking for children and learning	47.6%
Coding tools for developing computational thinking in preschool education	40.5%
Physical programing and computational thinking using educational robotics in preschool education	39.3%
Methods and strategies for developing computational thinking	38.1%
Computational and algorithmic thinking: characteristics and types	36.9%
Plugged and unplugged activities for computational thinking and curriculum for preschool education	33.3%

Discussion and Conclusion

As a result of this study, which attempted to reveal the views of parents of preschool children on computational thinking and educational robotics, it was found that parents generally had positive views. Parents stated that they believed their children should have experiences in both computational thinking and educational robotics, and that it was useful to organize activities in this context. In addition, they emphasized their need to learn about the benefits of educational robotics and CT at the preschool level.

Although CT is considered a basic skill for the 21st century and research on CT is increasing day by day, it is not enough to determine why and how CT education should be conducted at the preschool level and to form a general curriculum in this direction (Zheng et al., 2023). For this reason, especially at the preschool level, CT finds a place in educational environments through practices such as awareness activities, after-school programs, and summer courses (Ahn et al., 2021; Pila et al., 2019; Qu & Fok, 2021). In addition, the low knowledge and competence of educational authorities and teachers regarding CT education at the preschool level prevents the spread of CT practices in preschool education (Strawhacker et al., 2018; Zheng et al., 2023). Considering all these, it is not expected that parents will have knowledge and awareness about CT and educational robotics.

Our findings indicate that parents view CT and educational robotics positively at the preschool level, but they also highlight their need to gain a better understanding of the benefits of CT and educational robotics during the preschool period. Although this study did not collect data on parents' technological knowledge, Kourti et al. (2023) found that as parents' familiarity and experience with technology increased, their views of their children's use of technology-based tools and activities became more positive. Considering that parents' familiarity with technological tools increased during the pandemic period, this study supports Kourti et al. On the other hand, Kourti et al. (2023) found that parents' awareness of using technology for educational purposes is low. Therefore, an important and supportive finding of our study is that parents primarily want to learn about the benefits of computational thinking and educational robotics for children and learning. The role of parental involvement in children's CT education is important (Cai & Wong, 2023). Ehsan et al. (2019) concluded that the family has an important influence on the development of children's understanding of computational thinking and that family– child interactions, in particular, contribute to supporting the development of children's computational thinking skills.

Although parents have partial knowledge of these concepts in one way or another, their intention to learn about the importance of these concepts for children and learning should be considered. Kourti et al. (2023) found that parents have limited understanding of the concept of computational thinking. In the context of this study, it can be similarly interpreted that parents wanted to learn what these concepts are and how they contribute to their children's learning. Therefore, seminars can be organized to raise parents' awareness of the importance of these concepts for their children and for their children's learning. Increasing parents' knowledge of these concepts can be a factor in valuing and appreciating these skills and extracurricular activities related to CT. By increasing the knowledge and awareness of parents on these issues, children's CT learning efficiency can be increased and contribute to the development of problem-solving skills in the 21st century (Cai & Wong, 2023). In this regard, Ehsan et al. (2019) suggested that in addition to content-focused trainings and workshops, seminars should be provided to parents on how to teach these skills. Alam (2022) argued that such seminars should encourage parents to become more involved in their children's educational endeavors.

Within the scope of this study, generally positive opinions were discussed more. It is recommended that further studies be conducted to reveal the concerns of parents who are undecided and have concerns about computational thinking and educational robotics. Because the parents' enthusiasm and willingness to learn about computational thinking and educational robotics had relatively less positive percentages, it was interpreted as their intention to perform educational practices through in-school experiences and activities. Preschool parental involvement and learning at home have been linked to children's overall school readiness, and in this context, CT education in preschool requires the involvement of both preschool teachers and parents (Harper et al., 2023). Therefore, in addition to parent awareness and informative seminars, the development of activities that parents can perform with their children at home can contribute to the development of these skills outside of school and support parental participation in CT education. Parents' out-of-school activities for computational thinking, especially through question-answer and role-modeling, contribute to students' learning and motivation (Rehmat, Ehsan, & Cardella, 2020). In this respect, there is a need for support to ensure that parents have a comprehensive understanding of CT content in creating a framework for CT education in early childhood settings.

Since this study involved a small number of parents and relied on descriptive analysis of their views on CT and educational robotics in early childhood, its generalizability is limited. Nevertheless, the findings are similar to other studies on parents in the CT literature, such as those conducted by Cai and Wong (2023), Ehsan et al. (2019), and Kourti et al. (2023). Linking CT concepts with family activities and experiences at home and school can have a positive impact on children's CT learning (Harper et al., 2023). Therefore, further research on the influence of parents' knowledge, awareness, and experiences on children's CT learning, especially in early childhood education, is recommended.

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