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Science learning needs of preschool children and science activities carried out by teachers

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ABSTRACT
The study aimed to investigate preschool children's learning needs related to science and their teachers' science activity practices. A basic qualitative research design was applied. Interviews were conducted with 15 preschool teachers and 48 children living in Ankara and subjected to content analysis. It was found that teachers mostly carried out activities and science experiments to support sense development and observation skills, used science and sensory centres and mostly preferred natural objects and living things. However, it was found that about half of the teachers considered themselves inadequate in science activities. Teachers stated that children need science activities that they can experience on their own, that take place outdoors and that are appropriate for their age, development and interests. They also stated that children need learning experiences that will improve their sensory development, observation and questioning skills. It was found that children mostly wanted to get to know scientists, learn how tools and equipment work, and conduct experiments. As a result of the research, it was revealed that teachers were aware of the importance of developing children's skills and reflected this in practice, but they could not identify the topics that children were interested in very well.

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Introduction

Learning takes place as a result of children's interactions with their natural and social environment. Children who actively play, wonder and explore their environment gain knowledge and experience as a result of these actions. According to Piaget, as a result of the new knowledge acquired through these experiences, schemas are formed and stored in the child's mind, and then the child uses this knowledge and experience to cope with new situations or problems (Berk, 2022). The child's curiosity, sense of discovery and desire to learn serve as a catalyst for the emergence of scientific actions in the early years. Children who enjoy thinking about natural phenomena, making observations in nature, collecting natural objects such as stones and shells, and playing games in nature take the first steps towards science and scientific knowledge (Eshach & Fried, 2005). While exploring the world during these activities, children, like scientists, constantly ask questions, investigate and research (Conezio & French, 2002).

Like many other concepts that children have, concepts related to science begin to form in the preschool period (Lind, 1998). Science education in preschool period is all the activities that children experience by using their senses (Uyanık Balat & Arslan Çiftçi, 2019). The fact that science is sometimes difficult to understand even by adults does not mean that scientific concepts and actions are beyond the capacity of children. Research shows that children can think about scientific concepts, and children who encounter scientific concepts at an early age are more successful in science education in their future learning (Eshach & Fried, 2005). It is of critical importance to provide children with quality science education experiences in order to develop a solid scientific foundation by developing children's research and observation skills in the preschool period (Bahar & Aksüt, 2020). Engaging in scientific activities in the preschool period supports children's readiness for the study of science and builds a foundation for future scientific understanding. Studies have shown that quality practices related to science education at an early age have positive effects on children's large muscle and small muscle motor skills, vocabulary, receptive and expressive language development, science process skills, early mathematical skills, concept development, creativity, school readiness, self-efficacy, attitudes towards science, and motivation (Brenneman, 2011; Conezio & French, 2002; Gölcük, 2017; Karamüftüoğlu, 2012; Morgan et al, 2016; Öztürk, 2016; Peterson & French, 2008; Tekerci, 2015; Uludağ, 2017; Worth, 2010). In addition, science activities offer children the opportunity to learn through trial and error without fear of making mistakes, and children can use the problem-solving skills they acquire during science activities in social situations (Conezio & French, 2002). In addition, science activities can respond to children's individual differences and different learning needs as they can be easily integrated with all other areas such as art, play, and mathematics.

Children's self-directed research is as valuable as the work of a scientist, but instead of leaving children to their own devices, guidance is needed to direct their natural curiosity and actions in a more scientific direction (Conezio & French, 2002). Appropriate guidance in science learning, combined with children's curiosity and the need to make sense of the world, can help children begin to use their inquiry skills. At this point, the preschool teacher has a critical role. Children's scientific investigations are guided by the teacher's understanding of science and scientific concepts. Whether the teacher misconceptions or not, the quality of the activities he/she plans, facilitating learning, the questions he/she asks and the comments he/she makes affect children's learning experiences related to science (Worth, 2010). Therefore, preschool teachers have an important role in helping children develop accurate understandings about scientific concepts and scientific processes and make sense of the world in the early years.

Preschool teachers should design science activities as processes in which the child plays an active role in the learning process, which do not involve too many instructions, and which are based on the child's curiosity, interaction with environment and the urge to question. In science activities, the child should be mentally engaged with questions and given enough time to interact with scientific concepts and processes. In this way, an inquiry-based approach can enable children to make sense of the world and their environment in a holistic way, rather than learning isolated pieces of science. For this, science activities should take place while children explore and play (Dejonckheere et al., 2016). Science is a part of our daily lives and science education should be incorporated into the curriculum by relating it to children's daily lives (Eliason & Jenkins, 2008). Events in the natural environment, such as observing anthills or examining the change in the leaves of a tree according to the seasons, can provide children with meaningful and relevant science experiences. Teachers should guide children by supporting their self-regulation skills, asking probing questions, focusing children's attention on causes and effects, and helping children reflect on their findings. In this way, a scientific process can take place rather than an acquisition of factual knowledge that the teacher imparts and the child receives (Dejonckheere et al., 2016). Worth and Grollman (2003) stated that for a quality science education in preschool, activities should be structured on developmental theories specific to early childhood, integrated with the child's daily life and other activities, taking into account the individual differences between children. In addition, providing children with a variety of learning opportunities, different materials and sufficient time, supporting children in developing their own ideas and

questions, having a strong communication environment in the classroom to discuss their ideas with others, documenting, presenting and reflecting on their experiences are among the foundations on which a quality science education should be based (Worth & Grollman, 2003).

Although it is known that teachers play a critical role in science education in the early years, there are some problems when international and national studies on teachers are examined. Teachers' lack of self-confidence and knowledge about science (Gerde et al., 2018; Park et al., 2017), their inability to allocate enough time for science activities (Greenfield et al. 2009, Park et al., 2017), and their inability to use materials effectively (Tu, 2006) have been shown among the factors that hinder science education. Similarly, in studies conducted in Turkey, it has been reported that preschool teachers do not use different methods, techniques and materials (Karamustafaoğlu & Kandaz, 2006; Yıldız & Tükel, 2018), have difficulties in providing suitable materials (Babaroğlu & Okur Metwalley, 2018; Ültay et al, 2018); they do not have the necessary competencies related to science (Aslan et al., 2015; Karaer & Kösterelioğlu, 2005), they do not make children active in experimental activities (Polat et al., 2021), and they do not provide children with problem-solving opportunities (Gündüz & Akduman, 2015).

To guide quality learning, teachers should create carefully designed activities based on learners' learning needs, interests and prior knowledge (Darling-Hammond et al., 2020). Research shows that interest is positively related to motivation and learning (Renninger et al., 2015). Learning environments designed by taking children's interests and learning orientations into account can have an impact on children's participation in classroom discussions and inquiry behaviours (Neitzel et al., 2017). From this point of view, it can be stated that it is very important to start from children's interests and learning needs in order to plan process-based science activities that make children active and emphasise inquiry. In addition, it is known that children's early interests and learning needs in science can continue in the following years and have significant effects on the learning process (Alexander et al., 2012). For example, a study found that preschool girls' early interest in science is a predictor of future science achievement (Leibham et al., 2013). Recognising preschool children's early interest in science by teachers and planning activities around children's interests and learning needs are also important for future science achievement (Hamel, 2021).

Although the question "What should we teach children about science at an early age?" often occupies the minds of educators and researchers, it is thought that the questions "What do children want to learn about science?" and "What are children's learning needs in science?" are often ignored. If the importance of starting from children's interests and learning needs and including children in the learning process is emphasised, investigating what they want to learn is also of critical importance. From this perspective, this study is important in that it includes children's voices by revealing not only what teachers do in science activities, but also what children want to learn about science. It is thought that this study will contribute to the literature on how well children's science-related learning needs are met by teachers. From this point of view, this study aimed to investigate preschool children's learning needs related to science and what teachers do in science activities and to examine whether these activities meet children's interests and needs. In line with this purpose, the following research questions were sought to be answered:

"What kind of science activities do preschool teachers conduct?"

"What are the materials that preschool teachers use in science activities?"

"What are the opinions of preschool teachers about their competencies in planning and implementing science activities?"

"According to preschool teachers, what kind of science activities do today's children need?"

"What are preschool children curious about science? (What do children want to learn about science?)"

Methods

Research Design

The research design was basic qualitative. This design aims to obtain detailed first-hand information about a topic or problem from individuals or other data sources (Merriam, 2013). In this design, the researcher tries to discover and understand a phenomenon, process, perspective or worldview of the participants through interviews, observations or document analysis. Basic qualitative research design is particularly well suited to gaining an in-depth understanding of educational processes (Merriam, 2002). In this study, a basic qualitative research design was used to determine what preschool children want to learn about science and what kind of science activities teachers conduct. Interviews were conducted with children and teachers to obtain detailed first-hand detailed information.

Study Group

The convenience sampling method was used to determine the study group and 15 preschool teachers and 48 children attending preschool were included in the study. Johnson and Christensen (2014) stated that in the convenience sampling method, people who meet various practical criteria (easy accessibility, geographical proximity, volunteerism, etc.) can be included in the research. In this study, teachers and children who met the criteria of geographical proximity, accessibility and volunteer constituted the study group. Table 1 shows the demographic information of the preschool teachers in the study group.

Table 1

Demographic Characteristics of the Preschool Teachers in the Study Group

Code	Educational Background	Type of Institution Worked	Duration of Professional Experience (Years)
T1	Bachelor's degree	Preschool	22
T2	Bachelor's degree	Preschool	10
T3	Bachelor's degree	Preschool	18
T4	Bachelor's degree	Preschool	12
T5	Bachelor's degree	Preschool	10
T6	Bachelor's degree	Preschool	10
T7	Bachelor's degree	Preschool	10
T8	Bachelor's degree	Preschool	19
T9	Bachelor's degree	Preschool	13
T10	Bachelor's degree	Preschool	20
T11	Bachelor's degree	Preschool	10
T12	Bachelor's degree	Preschool classroom within secondary school	2
T13	Bachelor's degree	Preschool	5
T14	Bachelor's degree	Preschool classroom within primary school	1
T15	Bachelor's degree	Preschool classroom within primary school	1

Table 1 shows that all of the 15 preschool teachers who participated in the study were female. All of the teachers work in public schools While one of the teachers has an associate degree, the remaining 14 teachers have a bachelor's degree. It was determined that 5 of the teachers had 6-10 years of professional experience, 4 had 0-5 years of professional experience, 3 had 16-20 years of professional experience, and 2 had 11-15 years of professional experience. One teacher had more than

21 years of professional experience. The demographic information of the children in the study group is given in Table 2.

Table 2

Demographic Characteristics of the Children in The Study Group

Gender	n	%	Age Group	n	%
Female	28	58	4 years	8	17
Male	20	42	5 years	40	83
Total	48	100	Total	48	100

While determining the children to be included in the study group, it was taken as a basis that the parents gave their consent for the study and that the children volunteered. Table 2 shows that 28 of the 48 children in the study group were girls and 20 were boys. In addition, 8 of the children were in the four-year age group and 40 were in the five-year age group.

Data Gathering Tools

In the study, demographic information of teachers and children were collected with the "Teacher Information Form" and "Child Information Form" developed by the researchers. The teacher information form includes items related to the teacher's gender, educational level, type of institution worked at, and length of professional experience. In the child information form, items related to the child's gender and the age group of the child attending the preschool education institution were included.

"Teacher Interview Form" and "Child Interview Form" were the other data collection tools used in the study. The questions of the Teacher Interview Form and the Child Interview Form were primarily prepared by the researchers. It was then sent to 5 faculty members who are experts in the field of pre-school education to get their opinions about validity and reliability of forms. The questions were finalised in line with their feedback. In the teacher interview form, there are four open-ended questions aimed at revealing the science activities that teachers implement, the materials they use in science activities, their thoughts about their competencies in planning and implementing science activities, and their views on what kind of science activities today's children need. During the interview, additional questions were asked to elaborate the teachers' answers if needed. In the child interview form, there was one open-ended question about what children were curious about in science. In cases where the question was not understood by the children, the question was rephrased and they were asked what they wanted to learn about science.

Data Collection Process

After obtaining the necessary permissions, semi-structured interviews were conducted with teachers and children in accordance with the research design. The interviews with the teachers were conducted face-to-face in a suitable room in the institution where they work. Before the interviews, the teachers' written consent was obtained that they participated in the research and that the interviews would be audio recorded. The interviews with teachers lasted an average of 20 minutes. For the interviews with the children, the researcher first went to the institution where the implementation would take place and explained the purpose of the research to the administrators and teachers. After obtaining the necessary permissions and parental approvals, one-on-one interviews were conducted with the children in the classroom environment where the teacher was present. The children were asked what they were curious about science and what they wanted to learn, and the answers given by

the children were recorded in writing by the researcher. Interviews with a total of 48 children were completed in one day.

Data Analysis

Merriam (2002) stated that in basic qualitative research design, an inductive analysis path should be followed to identify repeated patterns or common themes in the data. Inductive content analysis was conducted by using MAXQDA 2020 Plus software programme to analyse the data. For this purpose, firstly, the audio-recorded teacher interviews were transcribed by the researcher on computer. Then, the transcribed interviews with children were also transferred to the computer. The data obtained from all interviews were coded by two preschool education experts. During coding, the codes and data were constantly compared in order to ensure that the analysis process proceeded without errors. Sub-themes and themes were then created by the researchers from the grouped codes. While determining themes and sub-themes, interview questions and published research (Akcanca et al., 2017; Zembat et al., 2020) were utilised. While transforming the data into findings, one-to-one quotes obtained from the participants were also included. In order to ensure the confidentiality of the participants, teachers were given the codes T1, T2, T3, ..., T15 and children were given the codes C1, C2, ..., C48.

In order to ensure the validity of the study, in-depth description, expert review and the use of qualitative analysis software were used (Creswell, 2014; Glesne, 2013; Merriam, 2013; Whittemore et al., 2001). In the study, in-depth description strategy was realised by describing the study group, data collection tools, data collection process, data analysis and presentation of the findings in detail and clearly. In addition, while conveying the findings to the reader, one-to-one quotes obtained from the participants were included to help readers enter the research context. For expert review, after the interview questions were prepared by the researchers, the interview questions were finalised by taking the opinions of five experts working in the field of preschool education. Finally, in order to strengthen the validity, qualitative data analysis software was used as suggested by Whittemore et al. (2001) and analysed with MAXQDA 2020 Plus qualitative analysis program.

For the reliability of the study, the strategies suggested by Gibbs (2007) were followed. At each stage of data analysis, the analysis was carefully checked, care was taken to ensure that the meaning of the codes did not change, and the percentage of inter-coder agreement was calculated. Miles and Huberman's (1994) formula for inter-coder agreement, which is used in content analysis and increases reliability, was used and it was determined that the inter-coder reliability coefficient was 0.96.

Findings

In this section, the findings obtained from the research are presented in parallel with the research questions. Table 3 presents the findings related to the science activities carried out by preschool teachers.

Table 3

Science Activities Carried Out by Preschool Teachers

Theme	Subtheme	Code	f
Science activities	For skills	For the senses	6
		For observation skills	5
	For activity type	Observation and investigation	9
		Experiment	6
		Outdoor activity	4
		Field trip	3
		Grouping studies	3
		Science workshops with family participation	2
		Cause and effect studies	1
	For organising the environment	Use of the science centre	6
		Use of the sensory centre	5

Table 3 presents the findings related to the science activities carried out by preschool teachers. In the sub-theme "For skills", teachers stated that they carried out activities to support the senses (f=6) and observation skills (f=5); in the sub-theme "For activity type", they stated that they carried out activities such as observations and investigations (f=9), experiments (f=6) and outdoor activities. When the sub-theme "For organising the environment " is examined, it is seen that teachers stated that they used the science centre (f=6) and sensory centre (f=5) as science activities (open ended science learning experiences).

In the sub-theme "For skills", the teacher coded T2 stated that she did activities to develop senses and observation skills, and in the sub-theme "For activity type", she stated that she carried out observation, examination and grouping activities with the following sentences:

> *I think observation skill is very important. In outdoor activities, we definitely observe the seasons, for example, we take a certain tree. The reason why we take a certain tree in particular is so that children can see it and observe the continuity of the change that takes place every season. We have a nature notebook where we record the changes in nature that they observe, including the date and the weather in every nature study. What differences did we see today, what changes were there in nature? Sometimes we examine the materials we collect on a large cloth, especially a dark cloth. For example, we study leaves, they group leaves according to their characteristics... Touching the water makes them feel great, I use water a lot for the development of their senses.*

In the sub-theme of "For activity type", the teacher coded T8 stated that she conducted experiments and science workshops with family participation as follows:

> *I care about experiments in my class. For example, while younger age groups are interested in experiments such as mixing and foaming, at the age of five, children want to see a reality, a result, they are focused on the result. Last semester, we planned a science workshop with family participation. We sat down with the parents, divided everyone into groups of four, and created science workshops together. It was also a very nice interaction tool. It was very effective and satisfying for children... These are activities that make children's learning more enjoyable and more permanent...*

The last sub-theme in Table 3 is the sub-theme of "For organising the environment". The teacher coded T6, who stated that she used the science and sensory centre as a science activity, expressed her thoughts and experiences as follows:

> *We have a very well-functioning centre system in our school. We can do activities in the science centre, they can experience various materials in the sensory centre. I want them to discover the centres themselves. Otherwise, science activities are not something that can be done by telling them...*

The findings regarding the materials used by preschool teachers in science activities are presented in Table 4.

Table 4

Materials Used by Preschool Teachers in Science Activities

Theme	Subtheme	Codes	f
Materials	Natural objects and living things	Trees, leaves, flowering and non-flowering plants, seeds, water, salt, soil, ants, worms	9
	Foods	Nuts, pasta, fruits, black pepper, legumes	4
	Artificial objects	Balloons, magnets, toys and objects in the classroom	4
	Malleable and manipulative materials	Clay, sand	2

Table 4 shows that the materials used by the teachers participating in the study were included in the sub-themes of "Natural objects and living things" (f=9), "Foods" (f=4), "Artificial objects" (f=4) and "Malleable and manipulative materials" (f=2). Based on the findings, it can be stated that teachers used natural objects and living things such as plants. Use scientific terms properly the most in science activities (f=8), and malleable and manipulative materials such as clay and kinetic sand the least.

In the sub-theme of "Natural objects and living things", the teacher coded T13 stated that she used plants, soil, seeds and water in science activities as follows:

> *The materials I use are usually natural. For example, observation of the roots of plants, studies on soil, planting acorns, observations on ice, water, steam formation. Always from nature...*

The response of the teacher coded T10 regarding the materials he used in the sub-themes of "Natural objects and living things" and "Foods" is given in the following sentence:

> *I usually use materials that will enable them to discover by experimenting. We use water a lot, we can use dried legumes... We use the materials in the garden again. For example, we put some soil from the garden in a container and examine it, ants, worms, whatever is in that soil...*

In the sub-themes of "Foods" and "Artificial objects", the teacher coded T1, who stated that she used food items such as tangerines, black pepper and balloons as an artificial material, expressed her thoughts on the subject as follows:

> *For example, we do the experiment of which one floats and which one sinks, we throw peeled tangerines and unpeeled tangerines into the water. We have an experiment in which we use black pepper to teach microbes. We have activities where we use balloons.*

Table 5 presents the findings regarding preschool teachers' competencies in planning and implementing science activities.

Table 5

Teachers' Views on Their Competencies in Planning and Implementing Science Activities

Themes	Subthemes	Code	f
Teacher competence	Sufficient	Implement plans effectively	1
	Partially sufficient	Continue to develop and learn	5
		Collaborating with and receiving support from colleagues	2
	Not sufficient	Inability to conduct experiments	3
		Having problems with physical conditions (Problems in obtaining materials, limited nature opportunities)	2
		Not interested in science	1
		Large class size	1

It is a remarkable finding of the study that only 1 teacher out of 15 teachers who participated in the research stated that she considered herself sufficient in planning and implementing science activities. It is seen that 7 of the teachers consider themselves partially competent and 7 teachers do not consider themselves competent. Five of the teachers stated that they were partially competent because they continued to develop and learn, and two of them conducted science activities with the support of their colleagues. The teachers who stated that they were not adequate explained this situation with reasons such as being inadequate in conducting experiments (f=3), having problems with physical conditions due to limited material supply and nature facilities (f=2), science being out of their field of interest (f=1) and overcrowded class size (f=1).

The teacher coded T3, who considered herself sufficient in science activities, expressed her views as follows:

I feel good and sufficient in science activities because I implement the plans effectively.

In the sub-theme of "Partially sufficient", the teacher coded T6 explained that she received support in planning and implementing science activities in cooperation with her colleagues with the following sentences:

We can never be complete, there is no end to learning, but I do my best, I think about it, at least I ask what I can do. When we come together with friends and do this, it opens up ideas, more different opinions can emerge...

The teacher coded T5, who stated that she was not sufficient in planning and implementing science activities, expressed her thoughts as follows:

One point where I see myself lacking is science activities. I cannot say that I am sufficient. I am not someone who applies experiments a lot. Experiment is a very good thing in terms of enabling children to learn the cause and effect relationship. Unfortunately, I don't do experiments much...

The findings regarding the views of preschool teachers on what kind of science activities today's children need are presented in Table 6.

Table 6

Teachers' Views on What Kind of Science Activities Children Need

Theme	Subtheme	Code	f
Science activities that children need	Activity type	Activities for the child to experience first-hand	5
		Outdoor and nature activities	4
		Activities suitable for age, developmental level and interests	4
		Unstructured activities	2
		Field trips	1
		Experiments with fast results	1
	Contribution to the development area	Sensory development	2
		Cognitive development (Observation skill, questioning skill	2
	Material and environment	Sensory materials	2
		Sensory centre	1

When the table is examined, it is seen that in the sub-theme of "Activity type", teachers stated that children need activities that they can experience on their own (f=5), activities that take place outdoors and in nature (f=4), activities that are appropriate for their age, development and interests (f=4), unstructured activities (f=2), field trips (f=1) and experiments with quick results (f=1). In the sub-theme "Contribution to the development area", teachers stated that they needed activities that would improve children's sensory development (f=2) and cognitive development (f=2). In the last theme, "Material and environment", teachers stated that children need to experience sensory materials (f=2) and sensory centre (f=1).

In the sub-theme of "Activity type", the teacher coded T12 stated that children need activities that take place in nature as follows:

They need activities to get to know nature because they spend very little time in nature.

In the sub-theme of "Activity type", teacher coded T7 explained that children need activities and field trips appropriate to their age, developmental level and interests with the following statements:

In the era of technology, of course, children always need more and more, and children adapt to this very quickly. For example, we went to the science centre, Ali Kuşçu Science Centre. There were more sky and space-themed things there. We saw that the children there had a good command of this and were very interested in it. Field trips are very useful in really high quality places, you know, places that are suitable for children, where it is explained at the level of children. Afterwards, complementary activities can be done in the classroom...

The opinions of the teacher coded T9 under the sub-themes of "Activity type" and "Contribution to the development area" are given below:

Children need activities that develop their questioning skills. You know, like why this happened. Children are very unresponsive to experiments that are too far above their age, they cannot question. I can say that they need science activities that are appropriate for their age level and most importantly, planned in a way that they can do it themselves.

In the sub-theme of "Contribution to the development area", the teacher coded T4 stated that children need support for their sensory development and cognitive development (observation skills) with the following sentences:

There is a situation like this, observation skills need to develop right now. Let me put it this way, one day I didn't give any instructions when we went out to the garden, I came back and asked what sound

did you hear in the garden and they all stayed. There is no answer from any of them, there are those who say it by heart, I heard a bird, I heard a cricket. What is a cricket doing in the middle of winter? I analysed this situation. I said, 'Next time when you go out, please listen to the sounds, I'll ask you when you enter the classroom, let's see who heard which sounds.' One of them finally realised that there was a song playing from a car, we talked about what the sounds in the environment are and what they are not... They don't have observation skills right now. In other words, they don't have the ability to use the five senses. Children come home, get in the car, get out of the car, walk to the school gate, enter the school, leave the school gate, get in the car and go home. So there is no experience.

In the sub-theme of "Material and environment", the teacher coded T2 explained that today's children need sensory materials and sensory centres as follows:

I think that since the sensory centre is a centre with a lot of learning, which they really like, I think the area of that centre can be expanded even more. And we have plastic containers that we use to fill with water, but I think we can expand it with a large table and a covered area where they can play with sand more easily. I think we can actually work a little bit towards this, the area can be kept wider. Because it is a centre where children participate with great pleasure, after all, it is a part of our lives. Even when grating a piece of soap, they enjoy it, we don't spare anything. Of course, our parents are a little worried about this, but we always say that they will learn by experimenting. Of course, small accidents will always happen in life, even when we grow up, not only when we are young. We don't want to cause any harm, but we think we should give them the opportunity to learn... As I said, the new generation is deprived of many natural things, closed environments, concrete buildings and schools. And school has become an environment where they can develop their senses...

The findings of the research on what children want to learn about science and what they are curious about are shown in Table 7.

Table 7

Topics That Children Want to Learn About Science

Theme	Code	f
Science subjects	Meeting scientists	10
	Learning how tools and equipment are made/work (how magnets work, how balls are inflated, how napkins are made, how telescopes work, etc.)	8
	Conducting experiments	7
	Conducting research and investigations	5
	Getting to know space (astronauts, stars, etc.)	4
	Learning to do science	3
	Recognising living things (dinosaurs, forest plants, etc.)	3
	Getting to know nature and natural phenomena (clouds, doing research on nature, etc.)	3
	Looking at books about science	2
	Going to the past	1
	Learning why fingerprints are different	1
	Learning how planes and birds fly	1

It is seen that children mostly want to get to know scientists (f=10), learn how tools and equipment are made/work (f=8) and conduct experiments (f=7). In addition, children stated that they wanted to conduct research and investigations (f=5), get to know space (f=4), get to know living things (f=3), learn how to do science (n=3), get to know nature and natural phenomena (f=3) and look at

books about science (f=2). Other responses included learning how to go back in time, why fingerprints are different, and how to fly.

Examples of children's answers about what they were curious about or what they wanted to learn about science are given below in the form of one-to-one quotations:

I would like to learn about events related to nature. (C41, age 4, female)
I wonder about scientists, how they are. (C43, 4 years old, male)
How did dinosaurs become extinct? (C44, age 4, female)
How magnetic things attract. (C47, age 4, male)
I would like to learn experiments. (C8, 5 years old, female)
For example, I am curious about space, to learn how I can go there. (C22, 5 years old, male)
To learn how clouds are formed. (C30, 5 years old, female)
I wonder how the balls are inflated. (C37, 5 years old male)

Discussion

In the study, it was found that the science activities carried out by preschool teachers took place under the sub-themes of "For skills", "For activity type", and "For organising the environment". Teachers stated that they conducted activities that supported senses and observation skills under the sub-theme of "For skills"; observations and investigations, experiments, outdoor activities, field trips, grouping activities, science workshops with family participation and cause and effect studies under the sub-theme of "For activity type". In the sub-theme "For organising the environment", it was determined that teachers used the science centre and sensory centre as science activities (Child-initiated open-ended science learning experiences). Similar to the results of this study, in other studies, preschool teachers stated that they mostly conducted experiments, observations and nature study activities (Akcanca et al., 2017; Polat et al., 2021; Simsar et al., 2017). The results of the studies and the results of this study show that observation, investigation and experimentation activities are frequently preferred by teachers within the scope of science studies in preschool period. Observation, investigation and experiment studies are very important in terms of the fact that children use all their senses, actively participate by doing and experiencing, communicate, generate ideas by asking questions, establish cause and effect relationships, facilitate the understanding of scientific concepts and support the sense of discovery (Uyanık Balat & Önkol, 2017). In this context, this result of the study can be considered positive in terms of preschool teachers providing qualified science learning experiences appropriate to children's ages and developments. In this study, activities that children can experiment completely by themselves were ranked first by the teachers. A quality science education at preschool level is based on child-centred activities in which children are actively involved and implement (Uyanık Balat & Arslan Çiftçi, 2019). The fact that the teachers in the study carried out sensory activities, observation activities, investigations, experiments, and used the science centre and sensory centre, which enabled children to gain first-hand experience, suggests that they made children active in science studies.

Worth (2010) stated that the quality of the activities planned by the teacher affects children's learning experiences related to science. Materials are also an important component of activities and therefore, it can be stated that the materials used in science activities can also affect the learning process. In support of this view, Nayfeld et al. (2011) stated that children should interact with science content and materials appropriate to their developmental level in order to explore the world around them and develop their scientific reasoning skills during science activities. In this study, it was found that the materials used by preschool teachers in science activities were mostly natural objects and living things such as trees, leaves, seeds, ants, followed by foods such as nuts, fruits and pasta, and artificial objects such as balloons, magnets and toys in the classroom. Malleable and manipulative materials such as kinetic sand and clay were found to be less preferred by teachers. In another study, similar to the research result, teachers stated that they mostly used plants, magnifying glass, stones, soil, sand and objects in nature in science activities (Karaman Eflatun & Kuloğlu, 2021). In preschool

learning environments, open-ended materials should be presented to children, materials should be kept up-to-date and accessible to children with different experiences and backgrounds (Tu, 2006). From this point of view, the fact that the teachers participating in this study included open-ended natural and non-natural materials can be considered as a positive finding. In addition, children should benefit from tools such as magnifying glasses, microscopes, magnets, compasses and binoculars in preschool science studies (Ministry of National Education, 2013). These tools can contribute to the development of children's science process skills such as observation. It is noteworthy that the number of teachers who stated that they use these tools is low. In another study conducted on the subject, unlike the results of the research, it was found that teachers most frequently used materials such as the Earth sphere, human body, tooth model, magnifying glass and scales, while they used natural materials such as seeds, soil, leaves, stones and water very rarely. In the same study, most of the teachers stated that the classroom environments in which they carried out science and nature studies were inadequate in terms of materials (Simsar et al., 2017). Considering the results of the research and the results of related studies, it can be said that including more natural materials in the implementation of science activities can provide children with more experience with open-ended materials. Tools such as scales, magnifying glasses, binoculars and magnets should be used together with open-ended natural materials to support the scientific, qualified and effective progress of the learning process.

Teachers have an important role in ensuring effective science education in the preschool period (Ormancı & Çepni, 2019). Teachers' access to resources, field knowledge and self-efficacy in science are important variables that affect the time they allocate to science education in preschool (Kallery & Psillos, 2001; Saçkes, 2014). It is a striking finding of the study that only one teacher out of the 15 teachers who participated in the study stated that she considered herself competent in planning and implementing science activities. It was determined that half of the remaining teachers considered themselves partially competent and half of them did not consider themselves competent. Teachers who considered themselves partially competent stated that they continued to learn, that there was no end to learning and research, and that they improved themselves by cooperating with their colleagues. Teachers who stated that they were not adequately competent in science activities explained this situation with reasons such as being inadequate in conducting experiments, having problems with physical conditions due to the limited supply of materials and nature, science being out of their field of interest and the large class size. In the study conducted by Babaroğlu and Okur Metwalley (2018) on the subject, it was concluded that 55.5% of preschool teachers considered themselves sufficient in science education, while 44.5% considered themselves insufficient. Teachers who considered themselves inadequate attributed this situation to reasons such as lack of knowledge, deficiencies and inadequacies in practice, difficulties in providing materials, and problems in planning activities. The results of this study and related studies show that class size, lack of equipment and materials, inadequate classroom environment and garden are among the most frequently mentioned problems in preschool science education (Akcanca et al., 2017; Aslan et al., 2015; Çınar, 2013; Karaman Eflatun & Kuloğlu, 2021; Karamustafaoğlu & Kandaz, 2006).

In the study, preschool teachers stated that children need science activities that they can experience on their own, that take place outdoors and in nature, that are appropriate for their age, development and interests, that are unstructured, that will develop their senses, observation and questioning skills, and that they need to experience sensory materials and sensory centres. Teachers also stated that children preferred field trips and experiments with quick results. It is seen that these views coincide with the activities that teachers stated that they carried out, such as activities to develop senses and observation skills, observations and investigations, experiments, outdoor activities and field trips. Based on the teachers' statements, it can be said that they take children's needs into consideration when planning science activities. It is noteworthy that the teachers who participated in the study emphasised children's need for their own learning experiences, nature, observation and questioning. Teachers stated that children spend very little time in nature, do not mobilise their questioning skills, do not use their observation skills effectively enough, and do not have

opportunities to use their five senses. Similarly, Sağlam and Aral (2015) concluded that preschool teachers believe in the effectiveness of science activities in which children are actively involved, methods such as trial-and-error, learning by doing and experimentation, and processes that children directly observe. In the study conducted by Ültay et al. (2018), preschool teachers emphasised that for an effective science education, children should be made more active, the importance of being intertwined with nature, and the variety of materials and materials should be increased. The findings of both this study and other studies reveal that preschool children especially need science activities that they experience completely on their own, learning experiences that take place outdoors and in nature, and activities that develop their observation and questioning skills and support their sensory development.

The interests that children have in the preschool period can affect academic achievement and become permanent interests in later life (Alexander et al., 2012; Leibham et al., 2013; Neitzel et al., 2019). In addition, research shows that interest is related to motivation and learning (Renninger et al., 2015). Therefore, it can be stated that in science activities prepared for preschool children, it is critical to plan learning processes based on their interests so that children can be motivated to apply scientific processes and learning can take place. Some studies indicate that the use of ready-made plans is very common among preschool teachers in planning science activities (Sağlam & Aral, 2015). In the study conducted by Alabay and Yağan Güder (2015), it was concluded that a large proportion of the science activities in the ready-made plans did not meet criteria such as being child-centred, play-based, discovery learning, family involvement, use of learning centres and use of daily life experiences. When planning science activities, teachers should prepare their activities by determining the concepts to be addressed in line with children's developmental needs and interests, rather than preferring ready-made plans. Approximately one third of the teachers participating in the study stated that they need activities that are appropriate for children's age, developmental level and interests. As a result of the research, it was found that children wanted to get to know scientists, learn how tools and equipment are made/work, conduct experiments, conduct research and investigations, get to know space and living things, and get to know nature and natural phenomena. Supporting the research result, in the study conducted by Torres-Porras and Alcantara-Manzanares (2022), it was found that children ask complex questions that require explanations about the functional, evolutionary or process-related features of scientific phenomena. In another study, similar to the results of this study, it was found that children were most curious about space, astronauts, clouds, animal species, plant growth and how machines work (Gözün Kahraman et al., 2015). When planning science activities, children's interests should be identified. In this study, it was concluded that children most wanted to get to know scientists. However, none of the teachers mentioned that they had conducted studies on scientists or that children needed these activities. It appears that teachers are aware of children's skills that need to be developed, but they do not identify the topics that children are interested in well enough. Based on this point, it can be stated that teachers should identify children's interests and learning needs by using multiple data sources. For this purpose, teachers can utilise assessment methods such as observations and anecdotes, and they can also have conversations with children about what they want to learn about science. Science activities can be based on the lives of scientists and include how the tools and equipment we use in our daily lives work. Including scientists in science activities in preschool has positive effects on children's learning and motivation towards science (Yıldız Taşdemir, 2021). Children's attitudes and thoughts about science and scientists begin to form in the preschool period. These perceptions acquired at an early age can have an impact on children's solutions to problems and play a role in shaping their thoughts and attitudes towards scientific actions at a later age (Ayvacı et al., 2016). In addition, introducing scientists to children dispels common myths, helps children perceive that thinking and research are the basis of science and that science is a method for understanding and exploring the world and benefiting humanity (Altun & Yıldız Demirtaş, 2013; Hickey & Robson, 2013).

Conclusion and Implications

Although the use of natural materials by the preschool teachers participating in the study is positive, it is noteworthy that the number of teachers who stated that they use tools such as magnifying glasses, scales, binoculars is quite low. Teachers should strengthen the scientific process in their activities by including more open-ended activities in which natural materials (stones, soil, leaves, branches, etc.) and scientific tools (magnifying glass, scales, magnets, etc.) are used together. In this context, activities such as examining the differences of various stones collected from nature with magnifying glasses and weighing various natural materials with scales and discussing which of them is heavier can be planned in this way they can use both natural materials and scientific tools together.
In the study, teachers stated that they considered themselves inadequate in science activities due to reasons such as being inadequate in conducting experiments, having problems with physical conditions due to the limited supply of materials and nature, science being out of their field of interest, and overcrowded class sizes. Workshops on experiments can be organised for teachers through university collaborations. Through these workshops, teachers' perspectives on experiments and other science activities that can be planned with accessible materials can be expanded. In crowded preschool classrooms, science activities can be implemented in small groups, more than one sensory centre and science centre can be established and children can spend time in these centres in stations.

As a result of the research, it was concluded that children wanted to get to know scientists, learn how tools and equipment are made/work, conduct experiments, conduct research and investigations, get to know space and living things, and get to know nature and natural phenomena. Using illustrated children's books introducing local and foreign scientists in science activities can help children recognise scientists and their work. Movies and animations about scientists that are appropriate for children's age and developmental level can be watched. Field trips to planetariums can be organized to support children to learn what they are curious about space. In addition, open source planetarium software can be used to provide learning experiences about space in the classroom environment. Animals and plants can be observed with the naked eye or with tools such as binoculars and magnifying glasses. Projects can be organized about living things that children especially want to get to know.

The findings obtained in this study regarding the topics that children want to learn about science are specific to the research group. Each child may be interested in different topics related to science. Therefore, before planning science activities, teachers should determine what children want to learn about science by observing children both during science activities and other activities, as well as during different time periods in the daily flow such as free time, garden time and mealtime. In addition to revealing children's interest in science by observing them, teachers can shape the learning process according to children's interests by determining what they want to learn about science at the time of starting the day or evaluating the day.

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Appendix 1

Teacher Information Form

1. Name / Surname:

2. Type of institution where you work:

3. Sex: Female ☐ Male ☐

4. Education level:

   ☐ Associate degree
   ☐ Undergraduate degree
   ☐ Master's degree
   ☐ Doctorate degree

   Last graduated program:

5. Duration of professional experience:

Child Information Form

1. Name / Surname:

2. Name of pre-school education institution:

3. Sex: Female ☐ Male ☐

4. Age group:

   ☐ 4
   ☐ 5

Teacher Interview Form

1. What kind of science activities do you implement in your classroom?
2. What kind of materials do you use in science activities?
3. Do you think you are competent in planning and implementing science activities? Could you explain why you think so?
4. What kind of science activities do you think today's children need?

Child Interview Form

What are you curious about science? / What do you want to learn about science?