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Science Education Activities in Turkey: A Qualitative Comparison Study in Preschool Classrooms

Abdulhamit Karademir[1] · **Ayça Kartal**[2] · **Cumhur Türk**[3]

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Abstract
The aim of this study is to determine preschool teachers' science education activities, problems they encounter and solutions they devise, and methods and techniques they use during those activities. Phenomenology, which is a qualitative research design, was used. The study sample consisted of 15 female preschool teachers of primary schools in the central district of the city of Muş, during the 2017–2018 academic year. Participants were recruited using criterion sampling, which is a purposeful sampling method. Study inclusion criteria were: (1) teaching children aged 60–66 months, (2) at least 3 years of professional experience, (3) voluntary participation, and (4) observations made in classrooms. Data were collected using a semi-structured interview form and through structured observations in participants' classrooms. Three teachers were excluded from the study because they gave superficial answers to probe questions. Twelve teachers were interviewed and observed. Structured observations were conducted weekly by the researchers for a 4 month period on specific dates in the classrooms of interviewees, and field notes were taken during each observation. Data were analyzed using inductive content analysis. To get a general idea for data coding, all interview transcriptions and field observation notes were read several times and video recordings were examined again and again. Interview and observational data were coded in the light of the sub-objectives of the study. Results show that materials in science centers are different from those that participants think should be available in science centers. Participants take into account such factors as children, budget parameters, and curriculum in making material selections. They mostly use direct instruction methods and demonstrate experiments in science activities. Observations show that there is a difference between theory and practice. Problems considered to be caused by physical conditions are actually due to the use of wrong methods. Participants are of the opinion that child-centered activities, into which recyclable materials and out-of-class settings are integrated, should be used to increase the quality of science education.

Keywords Preschool science education · Science education activities · Teaching methods · Teacher competencies

Introduction

The learning styles of children and scientists are similar because both groups learn by examining and investigating. Therefore, it would not be wrong to call children "little scientists." Children are more likely to learn by natural means of doing research, which are as valuable as those conducted by scientists (Büyüktaşkapu 2010; Desli and Dimitriou 2014). Children's curiosity and enthusiasm to make the world a more predictable place urges them to explore and make inferences through their experiences. However, guidance is needed to transform children's curiosity and activities into a scientific endeavor. It is a fact that science has to be applied to carry out rich scientific inquiries (Nayfeld et al. 2011; Worth 2010). Preschool science education activities cover all kinds of learning that students experience with

✉ Abdulhamit Karademir
a.karademir@alparslan.edu.tr

Ayça Kartal
a.kartal@alparslan.edu.tr

Cumhur Türk
cumhur.turk@samsun.edu.tr

[1] Department of Preschool Education, Faculty of Education, Muş Alparslan University, Muş, Turkey

[2] Department of Primary Education, Faculty of Education, Muş Alparslan University, Muş, Turkey

[3] Department of Communication Design and Management, Faculty of Economics, Administrative and Social Sciences, Samsun University, Samsun, Turkey

their senses, and teachers are responsible for guiding this process (Ayvacı et al. 2002).

According to Dewey, "Education is not preparation for life; education is life itself." Similarly, according to Piaget, the best way for children to learn is through their own experiences, and therefore, there should be activities in which children can participate (Senemoğlu 2011). These facts also indicate that the best way for children to learn science is learning by living and doing. Posing questions, conducting research, collecting data, and seeking answers are the main factors affecting the efficiency of the process (Alabay 2013; Doğan 2010; Kuru 2015). Performance of students in preschool science activities clearly shows that this is a natural process for learning science. Therefore, students should learn such science process skills as making observations, posing questions, conducting research, reviewing, classifying, applying trial and error method, solving problems, communicating, and establishing warm relationships. An acceptable science education for children aged 5–6 years consists of child-centered activities in which they actively participate (Olgan 2008; Ünal and Akman 2006). Science for young children is a process of doing and thinking, a process that anyone can participate in and contribute to, not just a list of facts and information discovered by other people (Brenneman and Louro 2008).

Recent research shows that children have the ability to use reasoning and questioning skills beginning in early childhood and beyond (NRC 2012). Teachers who guide children to science education through questions, research, and explanations can create a suitable environment for them by integrating the children's life experiences into the classroom (NAEYC 2009). Teachers who prepare the environment for exploration, allow for observations, and offer opportunities for trial and error and discussion, contribute to scientific learning and make it more meaningful for children. Enriching science education with games, making it more interesting through interactive learning, and adjusting its complexity and difficulty based on age and developmental stages are of paramount significance for learning outcomes. These processes point to future educational trends (Murray 2019).

Preschool children are in need of more sources and opportunities than other age groups to acquire scientific knowledge, learn scientific concepts, develop science process skills, and make scientific inquiries (Alabay 2013). Sense-triggering activities designed by teachers provide students with the opportunity to explore and enquire. Activities that have previously served different purposes but contain familiar, enriching, and well-planned materials allow students to explore science (UNESCO 2017). Such activities help them to learn about different perspectives, make observations and inquiries, and develop controlled trial and error skills. Based on children's enthusiasm to develop science process skills anytime and anywhere due to their interest and curiosity, they should be allowed to design their own unplanned activities and perform experiential learning (Brenneman and Louro 2008; NAAEE 2019).

It is sometimes the most effective method to leave natural learning to students' desire to explore freely (SOtC 2018; Kıldan and Pektaş 2009). The task of teachers is to bring together interesting tools and materials under the name of the "science center" and make them available to students, who can freely choose among those tools and materials and use them in their inquiries with the help of their experiences. Natural phenomena and events can also be regarded as educational opportunities used in science education to achieve creative results. Activities based on the science center and other educational opportunities can also help teachers increase students' curiosity, expand their knowledge, and make further explanations (Dubosarsky 2011). The use of out-of-class environments will increase children's natural creativity and interest (SOtC 2018). Teachers can work together by using outdoor (nature) activities to find new ways to offer children opportunities to develop key science competencies such as problem-solving, communicating, reasoning, estimating, testing, observing, measuring, comparing, grouping, classifying, evaluating, and asking and answering questions, while also building non-cognitive skills including resilience, perseverance, and confidence in outdoor contexts that promote their agency, physical activity and well-being (Murray 2019).

Actually it should be the duty of teachers to motivate students to study science, stimulate their curiosity, and encourage them to ask questions and do research, and thus, helping children to shape science concepts and phenomena in their minds (Toyama 2016). Teachers, regardless of their rank or grade, must fulfill this task (Ünal and Akman 2006). Preschool children tend to be suspicious of scientific facts, concepts, and natural events, because they tend to perceive things in a concrete way. Therefore, scientific phenomena and concepts should be presented to preschool children in a more concrete way (Dağlı 2014; Greenfield et al. 2009). To facilitate learning, teachers should use age and developmentally appropriate methods, strategies and techniques rather than didactic method to teach the concepts that are abstract or difficult to understand (Ünal and Akman 2006). Facilitated by educators, the students' natural curiosity drives their learning processes, and the overarching topics are integrated across the array of subject areas (NAAEE 2019). Activities that are easy to perceive entertain children and allow them to take pleasure in what they do. Thus, students learn and develop positive attitudes while having fun (Conezio and French 2002). Other factors that makes information more concrete are tools and materials. Science centers and materials used in pre-school education should contain stimuli that support students' development and improve their attitudes towards science (Trundle and Saçkes 2012). Activities in science centers allow students to develop various skills implicitly or explicitly. Science centers and materials, which help students develop skills that are necessary to explore, question, observe, research, define, classify, sort, group, and store and develop new ideas, should be stimulating and rich, and also allow students to interact with each other (Guo et al. 2015; Piasta et al. 2014).

The aim of this study is to determine preschool teachers' science education activities, the problems they encounter and solutions they devise, and the methods and techniques they use during those activities. The main question of the study is "What is the relationship between preschool teachers' views of science education activities and their actual science education activities in their classrooms?

Method

Design

Phenomenology, which is a qualitative research design, was used. People's perceptions of the world originate from their sensory experiences of things and personal interpretations of those experiences. Phenomenological research deals with how we bring together the facts that we experience in understanding the environment (Patton 2014). Phenomenology is a research design that aims to highlight perspectives, perceptions, and experiences (Ersoy 2016). Phenomenology was the design of choice in this study, as the aim was to understand and interpret preschool teachers' views of science education and their science education activities in reality.

Participants

The study sample consisted of female preschool teachers of primary schools in the central district of Muş, during the 2017–2018 academic year. Participants were recruited using criterion sampling, which is a purposeful sampling method. The basic concept of criterion sampling is to include appropriate situations according to predetermined criteria (Merriam 2013; Yildirim and Simsek 2012). Those teaching children aged 60–66 months, and whose teaching was observed, were included in the study. It was assumed that experience might also have an effect on results, and therefore, only those with at least 3 years of professional experience were included in the study. The final inclusion criterion was voluntary participation. The initial sample consisted of 15 teachers; however, 3 teachers were excluded from the study because they gave superficial answers to probe questions. Therefore, data were collected from 12 teachers through one-on-one interviews and observations. All participants were women and worked in kindergartens in the districts of the city of Muş. They had 3 to 15 years of professional experience. Of these teachers, 5 had 3 years of experience, 4 had 6 years of experience, and 3 had 10 or more years of experience.

Instruments, Procedures, and Data Analysis

Data were collected using a semi-structured interview form and through structured observations in the classrooms of the participants who were interviewed. The aim of qualitative research in which phenomena and related themes are defined in detail through in-depth analysis using multi-source data collection tools, is to highlight experiences and perceptions and meanings attached to them regarding a phenomenon or a case (Creswell 2007; Yildirim and Simsek 2012). Interviews provide people with the opportunity to express their behaviors, feelings, and insights in their own words, which allows others to understand their world views, perspectives, and experiences (Merriam 2013; Patton 2014). Observations help obtain a comprehensive and longitudinal image of behaviors and phenomena in determined environments (Yildirim and Simsek 2012). The researchers consulted with a preschool educator, a classroom educator, and a science educator to develop an interview form. Participants were interviewed at their convenience at their workplaces. Observations were conducted for 4 months once a week, on specific dates in the classrooms, and field notes were taken during each observation. Classroom observations were also videotaped, and each recording was repeatedly reviewed to enrich the field notes.

Data were analyzed using inductive content analysis. To get a general idea for data encoding, all interview transcriptions and field observation notes were read several times, and video recordings were examined again and again. Interview and observational data were coded in the light of the sub-objectives of the study. Sub-themes and themes were developed, and findings were defined and interpreted. For reliability, a fourth expert reviewed the codes and themes. Data were presented in tables after a consensus was reached.

Results

The themes, sub-themes, categories, and codes of each research question are presented in tables. Quotes from interviews and field notes are used for clarity and illustrative purposes.

Materials That Should be Available in Science Centers

The first subquestion investigated participants' views of ideal materials for science centers, while observations investigated what kind of materials were actually available in the science

Table 1 Materials that should be available in science centers

Theme	Subtheme	Category	Codes
Artificial	Real objects	Audio-visual materials	Strip of seasons (N = 12)
			Picture (N = 9)
			Calendar (N = 8)
			Graph (N = 7)
			Map (N = 4)
		Everyday life objects	Cup (N = 7)
			Drinking straw (N = 6)
			Plate (N = 3)
			Mirror (N = 3)
			Sugar (N = 2)
			Flour (N = 1)
			Glass jar (N = 1)
			Salt (N = 1)
			Tray (N = 1)
		Recyclable materials	Garbage bags (N = 6)
			Plastic containers (N = 3)
			Sea shells (N = 2)
			X-ray films (N = 1)
	Equipment	Measuring instruments	Clock (N = 10)
			Scales (N = 9)
			Ruler (N = 5)
			Thermometer (N = 3)
			Compass (N = 1)
		Instruments for observation	Magnifying glass (N = 4)
		Testing equipment	Magnet (N = 3)
	Toy	Dummies and models	Human dummy (N = 7)
			Dental model (N = 5)
			Eye model (N = 3)
			World model (N = 1)
		Educational Toy	Puzzles (N = 1)
Natural	Animate	Plant	Flower (N = 7)
			Leaf (N = 4)
			Seed (N = 3)
			Pine cone (N = 2)
		Animal	Fish (N = 5)
			Turtle (N = 1)
	Inanimate		Stone (N = 3)
			Water (N = 2)
			Earth (N = 1)
			Sand (N = 1)
			Fossil (N = 1)

centers in their classrooms. Table 1 presents participants' views of materials that should be available in science centers for science education.

The materials that participants thought should be available in science centers were grouped under the themes of "artificial" and "natural." Under the theme of "artificial," puzzles are under the category of "educational toy" while human dummies and dental, eye, and world models are necessary in science centers. They thought that magnets as testing equipment, magnifying glasses as instruments for observation, and scales, clocks, compasses, thermometers and rulers as measuring instruments should be available in science centers. They also pointed out that science centers should have such recyclable materials as garbage bags, X-ray

Table 2 Materials in science centers

Theme	Subtheme	Category	Codes	Notes from 4-month Observations
Artificial	Dummies and models		Human dummy (N = 7)	Five classrooms had human dummies to teach the functions of organs. Teachers did not use them.
			Dental model (N = 2)	Two classrooms had dental models. One of the teachers used it only for one activity related to oral health. Students did not use it in any other activity.
			World model (N = 1)	Only one classroom had a world model. The teacher used it to teach about the planets and the solar system. It was not actively used by students.
	Equipment	Measuring instruments	Clock (N = 8)	Many classrooms had analog clocks used in math activities. Only two classes had hourglasses, which were used in competition-style games prepared for students, and not in any other activities.
			Scales (N = 6)	Six classrooms had equal arm balance scales, which were, however, used only in two classes by teachers, or by students during free play time.
		Instruments for observation	Magnifying glass (N = 3)	Three classrooms had magnifying glasses. In one class, students stumbled upon the glasses and used them. Students looked through the magnifying glasses at the pictures that they drew. It was noted that the teacher did not provide further information.
		Testing equipment	U Magnet (N = 2)	Only two classrooms had magnets, which were not included in activities. In block games, students used the magnet as a tunnel through which cars passed. Teachers did nothing about it.
	Real objects	Everyday life objects	Drinking straw (N = 5)	Drinking straws were used to form shapes in art and mathematics activities, but not in any science activities.
			Cup (N = 5)	The science centers of five classrooms had cups, which were used by students as small flower pots for seed germination experiments.
			Flower pot (N = 3)	Only three classrooms had normal-sized pots with plants in them. They were in the restricted space on the window side allocated as the science center. Some of those flowers had been sent to teachers on special days.
			Balloon (N = 2)	There were balloons in most classrooms. However, they had been placed in the science centers of only two classrooms. Students used them in three or four activities except for science activities.
		Audio-visual materials	Strip of seasons (N = 9)	All classrooms had strips of seasons in different colors and patterns. They were used in 4 classrooms for 4 seasons activities.
			Graph (N = 1)	Only one classroom had a pie chart showing the gender distribution of students. It was, however, not used in any activity.
		Recyclable materials	Garbage bags (N = 3)	In three classrooms, garbage bags were used in art, drama, and movement activities, but not in science activities.
Natural	Animate	Plant	Flower (N = 3)	Three classrooms had flowers placed as ornaments on the window side allocated as the science center and cared for by teachers.
	Inanimate		Stone (N = 1)	Only one classroom had stones painted in different colors by students. They used them in an art activity, but did not touch them any other time.

Table 3 Factors affecting participants' use of materials

Theme	Category	Codes	Quotes
External factors	Child	Specific to developmental stages (N = 7)	Materials should be selected based on developmental characteristics regardless of age group. (O11) Attention should be paid to features as from simple to complex or from close to far, which varies from age group to age group. (T8)
		Cause and effect relationship (N = 5)	It is important for me that students can establish cause-effect relationships by using open-ended materials and materials. (T2) I would very much like them to make sense of things, to predict and produce ideas through trial and error. For this, everything should be related to each other, that is, they [students] should discover the why and the how… (D9)
		Skill development (N = 3)	I think that developing science process skills depends on learning by living and doing. (T2) We use observation skills in other activities, but I think they develop this skill in science education the best. (O3)
		Distrust (N = 2)	Students can be very careless sometimes, so I don't think we should use fragile materials. (P6)
	Material	Lack of materials (N = 10)	Unfortunately, schools have a serious lack of materials in classrooms. We get no support in that regard, especially in science education materials… (D1)
		Ease of access (N = 2)	I prefer to have easy-to-reach and science-related materials in my classroom. (P8) I bring as many materials as I can from my own home to my students… (T4)
	Curriculum	Outcomes and indicators (N = 4)	We can access some materials, if we check out the outcomes and indicators in the curriculum provided by the Ministry of National Education. (O12) You can also see examples of materials in sample activities in the curriculum book. (O7)
		Child-centered education (N = 4)	Child-centered curricula stipulate that we should teach students how to learn by living and doing. (C2)
		Flexibility (N = 1)	We make use of the flexibility of pre-school education as much as possible. (T3)
	Economy	High price (N = 5)	We cannot have every material in the classroom, because some of them are expensive. We work with what we have at hand. (T5) I wish we had all the materials, but we cannot afford them, and there is not enough support either. (T4)
		Lack of parents' support (N = 3)	The parents of my students do not support me at all, and I can't do everything by myself. It is harder when parents lack awareness. (T7)
Internal factors	Method selection	Objectify (N = 2)	The more sense organs one uses, the more one learns. This is my philosophy. I believe that all activities should be performed in a concrete way. (T8)
		Willingness to increase quality (N = 2)	The quality of education depends on the methods and tools that you choose. There is always something missing, if science activities are performed without using materials. (T2)
		Case (N = 1)	The kids are in the concrete stage of development. So, whatever is taught should be taught in a concrete way with examples. They should experience…(T3)
	Emotion	Sense of responsibility (N = 1)	I feel responsible for students regarding the activities that I design. So, I think that the science center should have a variety of materials. (T10)

films, sea shells and plastic containers, and such everyday life objects as glass jars, trays, plates, drinking straw, cups, flour, sugar, salt and mirrors. They pointed out the necessity of graphs, maps, a strip of seasons, a calendar, and pictures under the category of artificial audio-visual materials. The category of "plant" contains leaves, seeds, pine cones and

Table 4 Participants' views of methods and techniques for science activities

Methods and techniques	Observation	Classification	Measurement and comparison	Communication	Prediction	Inference
On-site observation (N = 10)	10					
Question-and-answer (N = 8)			2	2	2	2
Direct instruction (N = 8)				1	4	3
Experiment (N = 7)	1		1	1	2	1
Showing and getting it done (N = 4)	1	1	1	1		
Discussion (N = 3)		1			1	1
Inquiry (N = 2)	1		1			
Case (N = 2)				1	1	
Drama (N = 1)	1					
Play (N = 1)						1
Presentation (N = 1)				1		
Problem solving (N = 1)		1				

flowers. Fish and turtles were in the category of "animal" under the subtheme of "animate," while stone, earth, water, sand and fossils were under the subtheme of "inanimate." Table 2 shows the materials that are actually available in participants' classrooms and their use.

In describing the actual available materials, participants mentioned almost every material that they indicated should be in the science center. The classroom observations showed that there was a large difference between materials participants thought should be included in a science center and the materials that were actually available in the science centers in their classrooms, indicating that they did not put their beliefs into practice, and that likewise, they used very few of the materials that were in the science centers for science activities.

Factors Affecting Material Selection and Use

The second subquestion investigated participants' views of factors affecting their selection of materials for science centers and the use of those materials (Table 3).

All participants cited reasons under the themes of internal and external factors for the tools and materials they use for science education. Some participants stated that it was important for students to use scientific thinking, prediction, and observation skills. According to others, the outcomes and indicators in the preschool education curriculum could be used to choose materials according to the developmental characteristics of students, the flexibility of the curriculum should be utilized, and conditions allowing child-centered practices should be established.

Some participants expressed external factors such as lacking some materials due to high prices and not receiving enough support from students' parents. Some others stated that they did not supply some materials as they considered them to be safety hazards and elements with the potential to cause accidents in the classroom. Some others stated that educational settings facilitating learning by living and doing were effective in concretizing learning and providing sample experiences.

Methods and Techniques Considered to be Used in Science Activities

The third subquestion investigated participants' views and criteria for the selection of methods and techniques that they thought should be used in science activities. The observations regarding this subquestion also elicited information about what methods and techniques participants actually used in science activities. Table 4 presents participants' views of methods and techniques they think should be used in science activities.

For science activities, participants specified the following twelve methods and techniques: on-site observation, question-and-answer, direct instruction, experiment, showing and getting it done, discussion, inquiry, case, drama, play, presentation, and problem solving. In general, participants associated science process skills with these methods and techniques. They associated observation skills with inquiry, experiments, drama, showing and getting it done, while they associated on-site observation, and classification skills with showing and getting it done, discussion and problem solving. Having stated that communication skills were used in almost every technique, they associated prediction skills with question-and-answer and direct instruction. They also stated that child-centered question-and-answer, experiment and discussion techniques should be used to help students develop comparison and inference skills. Table 5 presents participants' views of factors they take into account before using the methods and techniques.

Table 5 Participants' views of factors they take into account when determining methods and techniques

Theme	Category	Codes	Quotes
I take into account	Child	Age (N = 10)	Methods and techniques depend on the age group. Students' cognitive skills are age-dependent, and so, you should definitely consider this factor. (T2) Age is an important factor in the selection of methods. The younger the students, the more visualization and play. The older the students, the more child-centered experiments and discussion. (T8)
		Developmental characteristics (N = 9)	As I have stated earlier, developmental characteristics are important. Age affects children's levels and lives directly, and so, I think it should be taken into consideration. (T11)
		Interest and willingness (N = 5)	I have difficulty involving students in activities they don't want to do or get bored of. They should want to be involved in them, and I should perform them, which makes me want to anyway. (T10)
		Individual differences (N = 5)	You know, no two people are alike. So, we must recognize the differences as much as possible. Everyone learns and understands in a different way. (T3)
		Readiness (N = 3)	There are poor families in the neighborhood where I work. Parents do not care much about their children, and so, children have low levels of educational performance. So, I mostly use methods in which the teacher is more active. (T4) Based on the principle of going from the known to the unknown, I focus on implementing activities that students might come across in their lives. I choose methods according to their readiness. (T7)
		Talent (N = 1)	I have talented kids in my classroom, they are more confident and assertive than the others. I sometimes assign them as leaders to help the others and provide peer learning. (T2)
	Reasons for use	Active engagement (N = 4)	Using methods that facilitate students' active engagement increases their self-confidence (T3)
		Outcomes (N = 4)	What concerns us most is the outcomes and indicators, so I think that they should be taken into account when choosing methods as well. (T12)
		Play (N = 3)	My strongest gun is that my students love playing games. Whichever method I use, I use it with games. So, they [students] have more experience. (T2)
		Learning by living and doing (N = 3)	You need to experience something first and then get your students to experience it so that they can learn by living and doing. I use such methods so that students can establish a cause and effect relationship. (T9)
		Objectify (N = 2)	Students at this stage use sensory organs to learn. So, objectify should be one of your techniques. (T8)
		Associating with life (N = 2)	We should teach students the information they will use in real life. If we choose methods and techniques accordingly, then that education becomes more realistic. (T2)
		From simple to complex (N = 1)	Techniques should move from simple to complex. (T8)
	Setting/physical conditions	Material (N = 6)	Students enjoy rich materials. This is true for any activity. They love dabbling in or fiddling with things they have never seen before. If you have the material, you'll also think differently, otherwise you'll have little interest in whatever it is. (T7)
		Environmental opportunities (N = 2)	I'm afraid none of the classrooms in this school have enough materials. But I like to take my students outside for lessons when the weather is nice. They get fresh air and relax. (T5)
		Classroom size (N = 2)	You also see that the classrooms in the schools in Muş are overcrowded. You cannot provide very effective and individual education in them. So, it is more teacher-centered. We cannot attend to each student's learning because we have to keep the classroom under control. So, I always take into account the number of students, when I choose methods

When choosing methods, participants stated that they took different factors into consideration under the categories of "child," "physical conditions" and "reasons for use." They stressed the importance of age, developmental characteristics, readiness, interest and willingness, and talent and individual differences under the category of "child." They emphasized the significance of materials, environmental opportunities, and classroom size under the category of "physical conditions." They highlighted the relevance of active engagement, outcomes, games, objectify, drama and the principle of moving from simple to complex with the way they chose methods. Table 6 presents the methods and techniques that participants actually actively use in science education.

Participants specified twelve methods and techniques that could be used in science activities. The 4-month observations showed that some participants used some of those methods and techniques in science activities. This results indicated that participants failed to put their ideas into practice.

Skills Expected to be Gained by Students through Science Activities

The fourth subquestion investigated participants' views of skills that they expected their students to develop through science activities. The observations regarding the subquestion also elicited information on what concepts and skills participants actually concentrated on in science activities that they implemented in their classrooms. Table 7 presents participants' views of the skills they expect their students to develop through science activities.

Participants argued that science activities provided students with the opportunity to develop observation, curiosity, objectify and active engagement skills, which are skills to access information. They were also of the opinion that science activities encouraged students to develop concentration, hand–eye coordination, recognition, memory-retention, prediction, transfer-association and comparison skills, which are mental skills. Finally, they maintained that science activities helped students become more self-confident,

Table 6 Methods and techniques that participants actively use in science education

Theme	Codes	Quotes from observation notes
Used	Presentation/instruction (N = 12)	All teachers used the direct instruction method at the beginning, middle or end of science activities. They used it to give information about the themes, to present examples and to describe the ways of accessing information. They used it in almost every activity. They overused it, which put students into a passive role, made them red of listening and prevented learning.
	Question-and-answer (N = 9)	Nine teachers actively used the question-and-answer technique in science activities. However, they did not give students enough time, tips, everyday life examples or compliment/praise to help them answer the questions. Students had difficulty listening to and concentrating on each other's answers, and therefore, they failed to benefit from the technique to the fullest.
	Showing and Getting It Done (N = 3)	Three teachers used the method of showing and getting it done. They used it to teach the life cycle of plants, properties of magnets and changing states of matter. It made a positive impression on students, who enjoyed performing the activity quite a lot.
	Demonstration experiments (N = 2)	Only two teachers used the experimental method. They preferred conducting closed-ended demonstration experiments, which are performed before the subject is taught. What students could only do was to watch those teacher-centered experiments. The interviews conducted regarding the observations showed that teachers decided to conduct demonstration experiments because they found the materials used in experiments dangerous for students. We got the impression that teachers did not have enough information about experiments that are safe enough for students and can be performed with natural materials.
Not used	Drama On-site observation Discussion Play Problem solving Case Inquiry	Teachers did not use drama, on-site observation, discussion, play, problem solving, case and research methods or related techniques in science activities. They did not provide students with sufficient opportunities to experience, to engage in trial and error learning, or to question. Students were passive receivers of information that was transmitted without any discussion, inquiry, or play. According to teachers' statements, techniques and methods that they used changed from activity to activity. Science activities are supposed to provide students with the opportunity to learn by living and doing and to achieve inquiry-based learning. However, the use of teacher-centered techniques prevents students from developing adequate outcomes and indicators. Wrong methods and techniques also prevent teachers and students from actively using the science centers. We, therefore, noted that teachers should be informed about this. Teachers integrated neither their classrooms nor natural settings in the learning process effectively. Therefore, efforts should be made to enable them to develop different perspectives.

Table 7 Participants' views of skills they expect their students to develop through science activities

Theme	Category	Codes	Quotes
Skills Gained	Means of access to information	Observation (N = 9)	On-site observations in the garden or outside definitely help them develop observation skills The method I'm trying to use most is actually observation, as long as I get the chance. It gives students the opportunity to develop observation skills. (T11)
		Curiosity (N = 8)	Kids are curious beings. They are curious about anything new that you bring to the classroom. Using application-oriented methods helps them develop curiosity skills. (T5)
		Objectify (N = 6)	Kids want to touch everything that is animate or inanimate. Science activities can make it even more attractive. Students at this stage use their senses much more than we do, which also develops their skills. (T8)
		Active engagement (N = 6)	Pleasant science activities provide students with active engagement, which helps them see their mistakes. (T1) It is necessary to discover and implement activities that are suitable for child-centered education. We should help students get used to learning by living and doing and to accessing information. (T7)
	Mental skills	Transfer-association (N = 7)	Science activities are activities that are closest to daily life. Students get the chance to apply what they see at home in the classroom and vice versa. (T9)
		Prediction (N = 5)	I focus on helping students develop prediction skills when we go out in the garden or before experiments. Sometimes it is fun to ask them to make a guess about something. (T3)
		Hand–eye coordination (N = 3)	I conduct experiments and implement activities to help students develop hand–eye coordination. Coordination in terms of timing and quantity is essential when moving something from A to B. (T3)
		Comparison (N = 2)	We did an experiment with the magnet to discover which objects it will attract or repel. Kids can make simple comparisons, of course. (T4)
		Recognition (N = 2)	Let's say you are having an activity about colors, if you ask students, they know the color orange, but in the experiment, they get to see what colors make orange, which makes them realize some things, or they meet an animal they haven't seen before and learn about its life. (T9)
		Concentration (N = 1)	Kids can really concentrate on something if they enjoy doing it. You can do it with properly-designed science activities. (T2)
		Memory-retention (N = 1)	We often use presentation and question-and-answer techniques in activities to test students' memory. I expect them to remember and keep information in their minds. (T2)
	Affective skills	Sensitivity to nature (N = 5)	Nature activities and trips make students more environmentally conscious. We need people who love nature. Kids can develop these skills at an early age. (T10)
		Self-confidence (N = 2)	If kids learn how to integrate play in what they do to enjoy doing it and if teachers guide them well, then they become more self-confident. (T3)
		Awareness (N = 2)	I saw it in a movie. A teacher and her students are planting tomatoes, onions, peppers etc. in a garden, and students water them every day and watch them grow. What a nice way of raising awareness, right? They are becoming more and more aware of the needs of plants. (T6)

aware and environmentally conscious. They stated that they mostly used experiment, question-and-answer, trip, showing and getting it done and inquiry methods to help students to develop those three skill sets. Table 8 presents the concepts and skills that participants actually concentrate on in science activities that they implement in their classrooms.

Participants associated skills with methods and techniques used in science activities. While some participants referred to the methods they tried to use, many referred to the methods that were supposed to use. For 4 months, we observed not only the methods that participants used, but also the concepts and skills on which they concentrated. Participants focused on people, animals, and health-hygiene under the category of life science, on the three states of matter under the category of physical science, and on weather conditions and seasons under the category of earth science. Participants wanted their students to develop skills to access information and scientific process skills. They used the question-and-answer technique in particular to help students develop skills to access information. In science activities, most participants did not pay much attention to curiosity, attention, or application skills, which are three of the skills

Table 8 Concepts and skills that participants actually concentrate on in science activities

Theme	Category	Codes	Quotes from observation notes
Concepts	Life science	Health-cleanliness-hygiene (N = 9)	In most classrooms, cleaning times, and health, cleaning and hygiene were addressed before breakfast. Instructions about hand washing and personal hygiene were presented. In some classes, "Mr. Microbe" experiment was performed. Students had the opportunity to practice and learn about the importance of handwashing in a comparative way.
		People (N = 8)	Teachers with a human dummy in their classroom tried to integrate in their activities the concepts related to organs, human life, bodily systems and their duties. Most classrooms had a human dummy, on which teacher-centered activities were carried out.
		Lifecycle (N = 5)	Water cycle was taught and was associated with weather conditions only in three classrooms. Students' questions were used to present information on death and decay in two classrooms.
		Animals (N = 4)	Animal documentaries were shown in four classrooms, and the subject of the struggle for survival was raised. Some teachers made use of opportunity education and informed the students looking out the window about the animals. However, no science activities about animals were designed in other classrooms.
	Earth science	Weather conditions and seasons (N = 12)	Almost all classrooms had a weather chart. Teachers talked about weather conditions and seasons whenever they could. Teachers taught their students about the changes that trees, leaves and grass go through, when they took them out in the garden for lessons. Some teachers asked the students to collect stones, leaves, tree branches, grass and flowers and bring them to the classroom after making observation and trip in the garden.
	Physical sciences	Liquids (N = 4)	Experiments on liquids and their properties were performed in four classrooms. Their viscosity, buoyancy and liquids taking the shape of any container were addressed. Students really used their observation and comparison skills to transfer water from one container to another and throw objects of different sizes into it.
		Solids (N = 2)	Solid state of matter and its properties were addressed, and experiments were carried out using the properties of the magnet only in two classrooms.
		Gasses (N = 1)	The properties of gasses were addressed in relation to weather conditions only in one classroom
Skills	Process skills	Communication (N = 12)	All students used their communication skills in activities. However, students who were exposed to play, inquiry, experiment, trip, observation, discussion methods more used communication skills more than those who were not.
		Prediction (N = 7)	The question-and-answer technique was used in five classrooms, and students' predictions were listened to with their peers. In the classrooms where experiments were conducted, teachers asked students to make predictions before the volcano and germ demonstration experiments. Students then enthusiastically checked the accuracy of their predictions
		Observation (N = 6)	Students (in four classrooms) who watched demonstration experiments and those (in two classrooms) who took a trip to the garden had more developed observation skills. Students' more open, enthusiastic and inquisitive attitudes increased the efficiency of the activities.

Table 8 (continued)

Theme	Category	Codes	Quotes from observation notes
	Skills to access information	Questioning (N = 8)	Students who were often exposed to the question-and-answer technique communicated better with their peers and their teachers. Some teachers gave hints after posing questions, which stimulated students' curiosity. It was noted that not all teachers provided students with hints after posing questions.
		Curiosity (N = 3)	Students of three classrooms, in which different methods and techniques were used, had increased curiosity. Especially the child-focused trip and observation method aroused students' curiosity, which led them to ask more questions to their teachers.
		Paying attention (N = 2)	Students of two hardworking teachers who did their best to use different methods and techniques were able to make more precise observations and had a longer attention span than those of other teachers. The two teachers extended their students' attention span through experiments and child-centered activities. Considering the developmental characteristics, students of other teachers have a very short attention span.
		Practice (N = 2)	The two teachers, who provided their students with means of learning by living and doing, allowed them to conduct the demonstration experiments again, which increased other students' enthusiasm and encouraged them to be involved in the activity

to access information. They focused on communication, prediction, and observation skills, which are three of the scientific process skills.

Problems that Participants Encounter in the Implementation of Science Activities and Their Solutions to Those Problems

The fifth subquestion investigated the problems participants encountered and solutions they devised when applying science activities (Table 9).

Most participants stated that they encountered problems due to the fact that classrooms were small and overcrowded and that they did not have the materials needed to perform science activities. Participants also complained about the lack of parental involvement in education and argued that ordinary science activities were enough to provide students with outcomes and indicators. As solutions to their problems, some participants were of the opinion that school management should be involved while others stated that the Internet, national and local projects or in-service courses could be used to learn about different perspectives and rich activities. Table 10 presents the problems that participants actually encounter in science activities and their solutions to those problems.

Observations showed that participants had problems under the categories of method, physical conditions, teacher, child and material categories. All classrooms were overcrowded and not in a very good condition. Most participants were unprepared, and therefore, uncreative with regards to their activities. Most students were bored because the science activities performed in their classrooms were dull, uninteresting, and uncreative. To overcome this problem, two teachers used out-of-class settings, which made science activities more fun and productive for students. Teachers can make up for the shortage of materials and parents can observe their children develop process skills in natural settings where parental involvement is achieved through good communication. The methodological problems were teachers' failure to arouse students' interest and curiosity, their insistence on using teacher-centered thinking and lack of parents' support. All kinds of activities performed in different natural environments that enabled active use of different senses were more efficient and productive for students. During this process, both teachers and students who had a chance to get fresh air and relax had a more enjoyable time.

Participants' Views of How Science Education Can be Improved

Table 11 presents participants' views of how science education can be improved.

All participants expressed their views on increasing the quality of science education activities. Their statements were grouped under the categories of method, material, and technique. Most participants stated that such methods as

Table 9 Problems participants encountered and solutions they devised during science education

Theme	Category	Codes	Quotes
Problems	Settings and conditions	Lack of materials (N = 12)	Science activities are carried out through experiments, right? But we have no materials, only a flower and a human dummy. Science centers are not the way we want them to be. What can you do when you do not have the materials that you need? Nothing… the school management might think about opening an experiment class with all the necessary materials in it. (T10)
		Overcrowded classrooms (N = 11)	Do you know how many kids are in my class? Twenty-seven. If I had to choose between this class and a class of fifteen students, I would, of course, choose the latter. Class size affects efficiency a lot. Class sizes should be smaller, there is no other choice. (T9)
		Physical obstacles (N = 10)	Our classrooms are too small. Although we have a lot of students, classrooms are too small. So, we cannot use different techniques… Classrooms should be larger. Schools and classroom should be larger. (T4)
	Child	Commotion (N = 4)	As you see, the number of male students in my class is high. So, you know, there is a lot of commotion and hustle… It may be wise to use the garden or get some help from students' parents. (T6)
		Individual differences (N = 3)	I have a crowded class and also inclusive students. I am unable to design activities for each students based on individual differences. I try to get my students to perform the most basic and general activities. Class size should not be over 20. The school management should see to it. (T2)
		Accident risk (N = 3)	The kids are restless, and I have a child in my class with autism, who just wouldn't listen to my instructions at all. I try not to involve him in activities that might hurt him, or I get the class sister to stay with him. We might contact the special education teacher or take more precautions. (T6)
		Inaptitude (N = 2)	We conducted different experiments with the kids. However, they are unable to perform every activity. So, I especially design my experiments in the form of "showing and getting it done." I want parental involvement at home as a solution, but they can't do it properly. It is important to convince parents. Meetings can be organized to achieve it. (T7)
		Getting bored easily-indifference (N = 2)	Students are easily bored due to their developmental characteristics and age. Actually, I use as many different techniques as I can, but some of them show no interest at all. To be honest, I am not that enthusiastic, when students are not interested. In such cases, I can use their disinterest and change the location. I know I am not making the best of the garden. (T7)
	Teacher	Making do (N = 6)	We provide almost all the outcomes and indicators in the curriculum book. …through ordinary activities. I also consult my colleagues. They don't do much, we usually go at the same speed. What do teachers in other schools do? It would be nice if the school management helped us find out about that. (T12)
		Lack of self-confidence (N = 2)	I can't say that my undergraduate years were very productive. I mean, we had no teachers who had graduated from our field. So, our classes were not as they should have been. I think I have low self-confidence. To overcome this problem, I try to find activities from the internet, especially from foreign sites. Attending to in-service courses or different projects in summer months can be a solution, but I need to be a bit more enthusiastic about it. (T10)
		Shyness-Fear (N = 1)	I am unable to arouse my students' enthusiasm and curiosity about science activities. So, I sometimes do not pay much attention and just brush over them. I believe that I should use different resources to overcome this problem. Sometimes I even try to perform some of the activities with my own children in the kitchen at home. First with my own children, then with my children here… (T6)
		Density and fatigue (N = 1)	You saw that the classrooms were very busy and crowded. There are 32 kids in my classroom. The physical conditions are not very good either, which comes back to me as density. I feel tired. I cannot go through my activities when I try to attend to each of my students. To overcome this problem, I suggest that class sizes be smaller. The fewer the students, the fewer the problems and the less the density. (T1)

Table 9 (continued)

Theme	Category	Codes	Quotes
	Method	Lack of parent involvement (N = 7)	There are daily encounters with parents when they bring or pick up their children. No parents, except for a few, participate in activities or anything. I have organized different activities several times. I just can't get them to come to school. The school management can make them come because I just could not do it. They are too careless. (T7)
		Failure to adjust level (N = 3)	Students need to think a little abstract in science education activities. Our students come from a not very good neighborhood of Muş and have very low readiness. I try to get down to their level as much as I can, but sometimes I just can't. (T11) Activities with daily life materials can be used to get down to students' levels. Maybe we can get some help from the Internet. (T4)

objectifying, integrating with play, using on-site observations, and associating science activities with real life could be used to adjust content according to the level of students. Participants who performed scientific experiments were of the opinion that open-ended experiments with simultaneous information should be used. All participants agreed that school management should help with the supply of materials and that out-of-class science activities with natural materials should be designed and implemented.

Discussion and Conclusion

This study investigated preschool teachers' views of science education activities and the science education activities that they actually carried out, and reached the following results.

According to the first subquestion regarding investigating participants' views of materials that should be available in science centers and materials that are actually available in science centers, participants stated that science centers should contain audio-visual materials, everyday life objects, and recyclable materials as artificial objects; measurement, observation, and test tools as equipment; dummies and models as toys; and animate (plants and animals) and inanimate objects (stone, water, soil, sand and fossil) as natural materials. Observations showed that the classrooms of participants mostly had artificial materials such as dummies and models (human, world, tooth), and measurement, observation, and equipment for experiments. Participants used audio-visual materials, everyday life objects, and recyclable materials less. Participants preferred plants and flowers as natural materials, and stones as inanimate objects. These results show that participants prefered artificial materials to natural materials. Although they stated that equipment and toys should be available, they preferred using dummies, models, equipment, and real objects in their classrooms. Although participants stated that they wanted to have plants and animals in their classrooms, they only had different types of plants (flowers) in their classrooms. This result shows that what participants imagine their science centers should be like does not match the science centers they actually have. This might be due to the fact that participants could not put their creative ideas into practice. There are some conflicting results in literature. Ayvacı, Devecioğlu and Yiğit (2002) reported that most teachers supplied materials necessary for activities either by themselves or by external aid. Doğan and Simsar (2018) pointed out that almost all teachers used similar materials in conducting science education activities. Brenneman and Louro (2008) stated that journals and books that can be used in classrooms help preschool students learn new words, ask new questions, and develop ideas about science. It is also reported that using an aquarium for scientific activities on floating and sinking improves the scientific thinking and curiosity of preschool children (Dubosarsky 2011; Eshach 2006; French 2004), and teachers also stimulate this curiosity by using activities from daily life (art, cooking etc.) (Kumar and Whyte 2018; Conezio and French 2002). For example each of these fundamental science process skills can be easily integrated into all areas of the arts (visual and performing arts including music, movement, and dance) in early childhood, and by this means children can feel themselves to be like artists or scientists (Morrison 2012).

According to the second subquestion investigating participants' views of factors affecting their selection of materials for science centers and the use of those materials, participants addressed the topics of the child, materials, the program, and the economy as external factors. The developmental characteristics of children and their related ability to establish a relationship between cause and effect, the development of science process skills, and a lack of self-confidence, affected the materials selection of participants. Lack of materials and ease of access to materials were also two external factors that affected the material selection of participants. The outcomes and indicators, flexibility and child-centered nature of the curriculum were other factors that affected the material selection of participants. The lack of family support and high price of

Table 10 Problems that participants actually encounter in science activities and their solutions to those problems

Category	Codes	Quotes from observation notes
Method	Failure to involve parents (N = 9)	Most teachers did not try to involve parents in their children's education. Only three teachers did. Students whose parents were involved in their education had increased motivation, interest and curiosity. Those teachers used the horizontal communication and bidirectional communication channels and met with parents at different times.
	Poor time management (N = 9)	In most classrooms, science activities could not be managed effectively, and teachers had time management problems. The main problem was that teachers lacked a certain plan and were unprepared. Three teachers who performed the activities effectively did not have time management problems.
	Teacher-centered thinking (N = 8)	Eight teachers used traditional methods and techniques, which put students into a passive role and rendered learning ineffective. It was inferred that teachers should take class size into account and divide it into small groups to use methods and techniques to make the learning process more child-centered.
	Failure to arouse curiosity and interest (N = 8)	Eight teachers used ordinary and common science activities. It was inferred that teachers should use different materials, methods and techniques to satisfy the interests, needs and curiosity of children. Teachers who used new methods and materials that stimulated sensory organs did not have such a problem in science activities
Physical conditions	Overcrowded classrooms (N = 12)	All classrooms were overcrowded, ranging from 2 to 35 students, which adversely affected all activities. Teachers, other than the two who used different techniques, unfortunately could not find a solution to this problem.
	Lack of space (N = 10)	Almost all classrooms had unfavorable physical conditions. Not only the science center but also other learning centers were below the standards. Only two teachers found a solution to this problem. For science activities, they used the garden, or the areas allocated by the school administration.
	Being confined to indoors (N = 10)	Ten teachers performed all activities indoors. Achieving efficient education in these crowded classrooms is difficult, except in situations where something special arouses students' interest and curiosity.
Teacher	Being unprepared (N = 9)	Most teachers were unprepared and unplanned with regards to science activities. Since there was no plan, there was no material preparation and no physical preparation either. Those that were prepared performed more planned and effective activities. When both the process and the activity are designed beforehand, It is easier to make use of students' interest and curiosity.
	Being uncreative (N = 8)	The activities performed in most classrooms were ordinary, simple, discouraging, non-curious, and teacher-centered. The students were, therefore, bored. Teachers who failed to arouse students' curiosity also had difficulty in class management. Four teachers using creative teaching strategies brought materials from the garden to the classroom and integrated them into their science activities.
	Indifference (N = 7)	Teachers' unpreparedness to science activities, their disinterest in making materials ready, and low number of science activities in their monthly plans are associated with their general indifference. Teachers who were properly planned and prepared were able to control the whole process, which was very productive for students as well.
Child	Commotion (N = 8)	All students were energetic due to their developmental characteristics and age. This was a problem in eight classrooms. To solve this problem, teachers changed the seating plan and made modifications in classroom arrangement according to the type of activity.
	Neglect (N = 8)	In eight classrooms, students become indifferent when they realized that the activity was ordinary. A lack of interest and curiosity was observed in students of non-creative teachers. Only four teachers developed different perspectives and used different methods and materials. Therefore, their students were not indifferent.

Table 10 (continued)

Category	Codes	Quotes from observation notes
Material	Failure to use nature (N = 10)	Only two teachers used the garden and different settings. Teachers took the necessary measures and took their students to the garden, where they used magnifying glasses to explore things and collected stones, insects, leaves and brought them to their teachers. Moreover, they used comparison, observation, prediction, communication and process skills more actively. During this activity, students did not get bored, on the contrary, they had a productive time. They communicated more easily with their peers and teachers.
	Lack of materials (N = 4)	Most classrooms lacked materials. Teachers don't keep science materials in their classrooms for certain reasons. Therefore, activities are alike, uninteresting and dull. Only four classrooms had different types of materials. In these classrooms, students had the opportunity to develop rich scientific thinking skills and learn about different perspectives. Classrooms which had daily-life natural recyclable materials resulted in a much more efficient learning.

materials also had a negative effect on the material selection of participants. Participants stated that they paid attention to method choices and developing a sense of responsibility for students as internal factors in material selection. This result shows that participants mostly take external factors into account when selecting materials. The developmental characteristics of students play an important role in the selection of materials. Moreover, inexpensive costs of materials and the financial support of students' parents are important in material selection. Participants choose methods by taking into account the development and interest of students. Dağlı (2014) reported that the most important criterion for effective learning is the teacher's awareness of students' interest and prior knowledge. Therefore, our result is consistent with the literature. On the other hand, there are some studies that argue that teachers should focus on new activities and methods while addressing the subjects of science or mathematics that students had difficulty comprehending before (Atkins 2018; Kumar and Whyte 2018; Desli and Dimitriou 2014). This result is different from ours. Simple outdoor trips and games can help to improve children's science process skills such as observation, exploration, inquiry, communication, and social skills (NAAEE 2019). Also such scientific studies play a more active role in early years education. STEM learning is a prominent and valued feature of twenty-first century early years education across the world (SOtC 2018).

The third subquestion investigated participants' views and criteria for the selection of methods and techniques they thought should be used in science activities. Observations elicited information on the methods and techniques participants actually used in their classrooms for science activities. They stated that on-site observation, question-and-answer, direct instruction, experiment, demonstration, inquiry, case, drama, play, presentation, and problem-solving methods should be used. They stated that when choosing these methods and techniques, they considered their students' ages, developmental characteristics, interests and willingness, individual differences, and readiness and skills. Moreover, they stated that the reasons (active engagement, outcomes, play, learning by living and doing, objectifying, associating with life, from simple to complex) for the use of methods and techniques were also important. According to them, environmental and physical conditions (material, environmental opportunities, classroom size) should also be taken into consideration. Class size is one of factors affecting the quality of education (Kalkan and Akman 2009). Normally 15–20 children is appropriate. However, the class sizes in which the research was conducted were far above normal. This situation affected teachers negatively. In practice, participants used presentation/instruction, question-and-answer, showing and getting it done, and demonstration experiments. However, they did not use drama, on-site observation, discussion, play, problem solving, or case methods. In theory, participants emphasized the methods that increased students' interest and curiosity and focused on questioning, but did not use those methods in their classrooms for science activities. This result shows that participants do not actually take into account the criteria that they claim they do when choosing methods and techniques. There are studies reporting that teachers take different variables into consideration when choosing methods and techniques (Alabay 2013; Dubosarsky 2011; Büyüktaşkapu 2010; Doğan 2010; Inan, Trundle and Kantor 2010; Brenneman and Louro 2008; Karamustafaoğlu and Kandaz 2006). Our result is not consistent with the literature. On the other hand, it is stated that familial background, readiness, and mathematics and language skills have a greater effect on knowledge of science among preschool children than do methods and techniques (Greenfield et al. 2009; Guo et al. 2015).

Table 11 Participants' views of what should be done to improve science education

Theme	Category	Codes	Quotes
Should be done	Method	Child-centered approach (N = 9)	Contrary to traditional approaches, you put the child at the center as a modern approach. It is also true for science activities. Children should be active and teachers passive in activities. (T2)
		On-site observation (N = 8)	I have witnessed many times that students learn much more from science activities and field trips. You see the "naughty kid" of the classroom doing observation quietly. (T3) Give them magnifying glasses or tweezers and let them out to the garden. They are so entranced and enthusiastic that you wouldn't believe. We need to get students out. (T2)
		Gamification (N = 8)	Kids love playing, so, we must use it. We can help students develop many skills by integrating them into games. I think that process skills are one of them. (T3) Kids enjoy every activity integrated with games and learn more quickly. Games and scientific content can be combined. (T8)
		Objectify (N = 7)	I think that kids should see some things in a concrete way, if they don't see, they can't perceive. It is true for most of my students. (T5) Most science activities involve abstract concepts, but our students are in the concrete stage of development. Therefore, themes and contexts should be presented in a concrete way. (T8)
		Active engagement (child) (N = 6)	One oneself should work on something to achieve learning by living and doing. Kids learn if they are active and understand if they try. (T8)
		Arousing curiosity (N = 5)	One way or another, one learns what one is curious about. This is true for kids, too. They learn because they are curious. Our task is to make use of that curiosity to the fullest… I have a suggestion to my colleagues: Make children curious! (T3)
		Taking into account age and developmental characteristics (N = 4)	The age and developmental characteristics of children should be taken into account. These are little kids, who need to be supported according to their developmental characteristics. (T11) If you are going to do scientific experiments, they will have to be simple or complex according to the age of students. (T8)
		Associating with life (N = 3)	The more associated the new knowledge with life, the more permanent it becomes. It is important to use daily life examples in science activities. (T10)
		Use of drama (N = 3)	Curiosity and interest arises, when you use drama to expand the imagination and horizon of children. Science activities are not far away from us and the use of drama provides learning by living and doing. (T9)
		Integrated activities (N = 1)	When you look at the types of activities…you can use simple and integrated activities. It is difficult to combine activities with appropriate transitions, but it is very effective. How nice it would be if you had a drama after a nice science activity! I wish they could experience what they learned. (T2)
	Material	Supply of materials (N = 12)	We have difficulty supplying materials. School management should give some support. If not, then natural settings should be used. Yes, science education materials are a bit expensive. But we should use recyclable materials and objects from our own home. (T12)
		Natural materials (N = 9)	We should use recyclable materials and natural objects in science activities. Science education itself comes from nature. There are applications in nature as science. Most of the time, we pay attention to the health of our children. Using natural materials and objects in activities and learning centers is not harmful to health. (T6)
		Designing out-of-class activities (N = 7)	I have to admit that we don't use the garden. If you bring whatever is natural in the garden to the classroom, it arouses students' interest and curiosity, right? (T1)
	Technique	Open-ended (N = 2)	Experiments with open-ended designs provide space for kids to think. Everybody knows that we need people who are capable of thinking. I don't like them memorizing everything. (T3)
		Simultaneous (N = 1)	Simultaneously explaining experiments to students through themes and allowing them to experiment reinforce new knowledge. (T9)

The fourth subquestion investigated participants' views of skills that they expected their students to develop through science activities. Observations elicited information on what concepts and skills participants actually concentrated on in the science activities they implemented in their classrooms. In terms of skills to access information, participants stated that they wanted their students to develop skills related to observation, curiosity, objectification, and active engagement. In terms of mental skills, participants expressed that they would like for their students to develop transfer-association, prediction, hand–eye coordination, comparison, recognition, concentration, and memory-retention skills. In terms of affective skills, participants stated that they wanted their students to develop sensitivity to nature, self-confidence, and awareness. Observations showed that participants focused on concepts including life science, earth science and physical sciences, and concentrated on process skills (communication, prediction, observation) and skills to access information (questioning, curiosity, paying attention, and application). Although, in theory, participants stated that they wanted their students to develop access to information, and mental and affective skills, their focus was limited to access to information skills in practice. Although participants did not present any theoretical explanation about concepts, they gave importance to concepts in practice. The observation note, "In most classrooms, cleaning times, and health, cleaning and hygiene were addressed before breakfast. Instructions about hand washing and personal hygiene were presented. In some classes, "Mr. Microbe" experiment was performed. Students had the opportunity to practice and learn about the importance of handwashing in a comparative way" (Table 8), is an example of this. It is stated that physics-, biology- and chemistry- based concepts can be perceived and understood by pre-school children (Guo et al. 2015; Toyama 2016; Dubosarsky 2011; Nayfeld et al. 2011). It is stated that science and mathematics education enables preschool children to have experiences with the world and that they can obtain outcomes that allow them to internalize scientific concepts through their mental process skills (Atkins 2018; Kumar and Whyte 2018; Kuru 2015; Veziroğlu 2011). Our results are not consistent with the literature. Participants' practice and theory differ, which might be due to the general culture and family structure of students, the city where teachers live, and creativity

The fifth subquestion investigated the problems that participants claimed they encountered and solutions they devised when applying science activities. Observations elicited information on what kind of problems participants actually encountered and solutions they devised when applying science activities. They expressed their opinions in the following areas: (1) settings and conditions (lack of materials, overcrowded classrooms, physical obstacles), (2) child-related problems (commotion, individual differences, accident risk, inaptitude, getting bored easily/indifference), (3) teacher-related problems (making do, lack of self-confidence, shyness-fear, density and fatigue), and (4) method-related problems (failure to involve parents, failure to adjust level). Unattended structured observations were conducted for 4 months once a week on specific dates in the classrooms of interviewers, at this period revealed method-based problems (failure to involve parents, poor time management, teacher-centered thinking, failure to arouse curiosity and interest), problems with physical conditions (overcrowded classrooms, lack of space, being confined to indoors), teachers-based problems (being unprepared, being uncreative, indifference), child-related problems (commotion, indifference), and material-related problems (failure to use nature, lack of materials). It was observed that the number of children in the classes in which the research was conducted varied between 24 and 32. This situation, which is more than the recommended 15–20 students, according to normal standards (MoNE 2013), leaves teachers in a difficult position. This situation also affects the quality of education negatively (Kalkan and Akman 2009). In addition, it has been noticed that there are more methodological problems. Although participants emphasized lack of self-confidence, density and fatigue as teacher-related problems, observations revealed that participants were unprepared, did not care about the activities they performed and did not use their creativity. We can, therefore, state that participants' theory and practice differ. There are some studies indicating that preschool teachers find it enough when they get their students to actively participate in the process, to establish cause and effect relationship, to have a sense of curiosity and to develop basic skills (Dönmez-Usta and Ültay 2017; Afacan and Selimhocaoğlu 2012; Özbey 2006). However, our results are not consistent with the literature. Studies that emphasize the role of teachers in preschool science education activities report that the preparedness of teachers has a great impact on students' attitudes towards science learning (Olgan 2008; Ünal and Akman 2006; Appleton 2003; Osborne et al. 2003; Abell and Roth 1992). This might be because (1) teachers do not pay attention to real field applications, (2) they are not enthusiastic about improving their practice and experimenting with new approaches, or (3) training on different methods and techniques is limited in the cities in which they work. In addition, it was seen that only two of the teachers were more interested in science activities and tried to find solutions to the problems encountered than the others. Based on interviews with teachers; these two teachers spent most of their childhoods in natural village settings with their families. In this case, it can be said that the past experiences of individuals may have affected their tendencies in the future.

The sixth subquestion investigated participants' views of what should be done to improve the quality of science education. Participants emphasized a child-centered approach, on-site observation, and gamification under the category of method. They also stated that integrative activities that enabled objectification and active student engagement, enhance their curiosity, associate new knowledge with life, and were appropriate for age and developmental characteristics of students were important. They particularly stated their views on the use of drama as a method. In terms of materials, they focused on supply of materials, natural materials and designing out-of-class activities. "We have difficulty supplying materials. School management should give some support. If not, then natural settings should be used. Yes, science education materials are a bit expensive. But we should use recyclable materials and objects from our own home" (Table 11) is an example to this. Participants emphasized the importance of open-ended and simultaneous design of experiments. There are studies on the effectiveness of such experiments (Atkins 2018; Kumar and Whyte 2018; Piasta et al. 2014; Alabay 2013; Büyüktaşkapu 2010). When there are more free learning environments in which natural educational resources can be used, children will be able to receive a higher quality science education (NAAEE 2019), and this will help to enhance the use of different and effective teaching methods among teachers (UNESCO 2017).

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