International Journal of Early Childhood
https://doi.org/10.1007/s13158-026-00490-4

ORIGINAL RESEARCH

Preschool Teachers' Views on Scientific Inquiry and their Use of Science Teaching Opportunities

Beril Cigdem[1] · Sinem Güçhan-Özgül[1]

Received: 23 May 2025 / Accepted: 23 January 2026

Abstract

This study explores preschool teachers' views on scientific inquiry and their utilization of science teaching opportunities. Scientific inquiry and science education play a crucial role in fostering children's cognitive development, problem-solving skills, and curiosity. Teachers' pedagogical competencies and engagement with scientific inquiry significantly impact the effectiveness of early science education. Using an embedded mixed-method design, the study collected data from 60 preschool teachers through the online Views About Scientific Inquiry (VASI) Scale, 12 preschool teachers through Science Walk Interviews. The findings reveal that while most teachers possess informed perspectives on scientific inquiry, some hold naïve or mixed understandings in specific areas. Teachers recognize the importance of science education in preschool settings but face challenges such as limited resources, restricted access to outdoor learning environments, and insufficient training in scientific inquiry methods. The study emphasizes the need for targeted professional development, improved access to science teaching materials, and strategies for integrating science into daily learning experiences. By addressing these challenges, preschool education can foster scientific thinking and inquiry skills, providing a strong foundation for lifelong learning.

Keywords Preschool teachers · Scientific research · Science teaching · Inquiry-based learning · Early childhood education · Teacher perceptions

✉ Sinem Güçhan-Özgül
sinemguchan@gmail.com

Beril Cigdem
berilcigdem83@gmail.com

[1] Department of Preschool Education, Necatibey Faculty of Education, Balikesir University, Balikesir, Turkey

Published online: 19 February 2026

Introduction

Equipping individuals with scientific thinking is a fundamental goal for Turkey, as in many countries, with skills like accessing information, analysis, organization, learning management, and collaboration becoming increasingly vital for national development, competitiveness, and innovation. In this context, the Türkiye's Ministry of National Education (MEB) emphasizes a production, design, and skills-based education model, considering early childhood education as the foundation (MEB, 2018).

In Türkiye, early childhood education is centrally regulated by the Ministry of National Education (MEB), which is responsible for designing, updating, and disseminating the national Preschool Education Program. Curriculum revisions occur regularly and are often driven by broader educational reforms, changing societal needs, and policy priorities—making programme updates a routine and expected part of the system. The preschool curriculum is implemented universally across all public and private early childhood institutions, ensuring nationwide consistency in learning outcomes, instructional approaches, and pedagogical expectations. MEB also provides teacher guidelines, professional development frameworks, and implementation resources, positioning the national curriculum as the primary reference point for early childhood pedagogy in Turkey.

Consistent with widely accepted international early childhood education principles, the 2024 Turkish Preschool Education Program similarly emphasises active learning and the development of scientific process skills through child-centred approaches that foster inquiry, research, independent decision-making, and discussion (MEB, 2024). In preschool, children acquire skills such as observation, classification, communication, measurement, and prediction, all supported by play-based learning (Akman & Güçhan Özgül, 2015; Kahraman et al., 2015).

Teachers' pedagogical competencies and approaches to science teaching are crucial for the success of education, as innovative programs rely on their ability to promote inquiry and curiosity (Yılmaz, 2021). MEB's [2023] vision highlights the importance of enhancing teacher qualifications for sustainable educational development (MEB, 2023). MEB 2023 Vision places strong emphasis on enhancing teacher competencies, particularly through continuous professional development focused on inquiry-based learning, STEM education, and sustainability. The document highlights the need for teachers to integrate science, technology, and environmental awareness into early learning experiences and encourages training programs that strengthen teachers' ability to guide children's scientific thinking. Although these policy goals signal a national commitment to improving early childhood science education, our findings suggest that many preschool teachers still lack adequate support, resources, and training to fully enact these expectations in practice. This gap between policy aspirations and classroom realities underscores the importance of examining teachers' views on scientific inquiry and their ability to utilise science teaching opportunities. Teachers' engagement with scientific research and effective use of science teaching opportunities significantly contribute to students' scientific thinking skills (Sackes et al., 2012; Ünal & Akman, 2006).

This study examines preschool teachers' perspectives on scientific inquiry and their utilization of science teaching opportunities, analyzing how they support scientific thinking and providing recommendations for educational practice.

Scientific Inquiry

Scientific inquiry fosters scientific thinking, ignites curiosity, and guides individuals toward discovery from early childhood. Science activities that encourage questioning, observation, and problem-solving support the development of scientific process skills such as classification, measurement, data collection, and prediction, enhancing both cognitive and analytical abilities (MEB, 2024).

Beyond individual experiences, structured, teacher-guided activities in science learning centers play a crucial role in fostering inquiry. Teachers must have sufficient knowledge of scientific process skills and the nature of science to effectively guide these processes (Lederman et al., 2013; Schwartz et al., 2004). Scientific inquiry extends beyond observation and data collection to include hypothesis formation, experiment design, and interpretation, aiming to develop systematic, evidence-based problem-solving skills (Lederman et al., 2014, 2019).

While scientific inquiry focuses on how knowledge is acquired, the nature of science concerns how it is produced, validated, and evolves over time. Both are fundamental to scientific literacy, shaping a critical perspective on science (Lederman, 2006; Schwartz et al., 2008). Scientific literacy today goes beyond knowledge acquisition, emphasizing understanding how knowledge is constructed, allowing individuals to think critically and approach science-related issues more consciously (Anderson, 2002).

Scientific inquiry develops both process skills and conceptual understanding, as highlighted by international education standards (Mesci & Erdas Kartal, 2021). These skills are not limited to science but also support an analytical and systematic approach to everyday problem-solving. Teachers play a key role in implementing scientific inquiry, helping students grasp the nature of science and apply its processes effectively (Bostan Sarioğlan, 2018). However, effective classroom integration requires teachers to fully understand scientific inquiry and its stages, making teacher education a priority in strengthening scientific literacy (Roehrig & and Luft, 2004).

In conclusion, scientific inquiry is essential for developing critical thinking, problem-solving, and knowledge generation through scientific methods. Supporting this process from an early age enhances scientific literacy and lifelong learning, making it crucial to prioritize scientific inquiry in education and improve teachers' competencies in this field.

Science Teaching in Preschool Education

Preschool education plays a crucial role in children's cognitive, emotional, social, and physical development, helping them explore the world and develop scientific thinking skills (Bahçeci Sansar, 2010). Science education, as a key component, nurtures curiosity and fosters scientific process skills from an early age (Dogan & Simsar, 2018). A primary goal of science education is to cultivate scientific literacy—the ability to understand scientific knowledge, think critically, and solve problems—laying a strong foundation for future learning (MEB, 2018; Mesci & Erdas Kartal, 2021; Olgan, 2008).

Through science activities, children develop skills such as exploration, observation, data collection, and analysis, contributing to both cognitive growth and an enjoyable learning experience (Dubosarsky, 2011; Saçkes et al., 2011). Additionally, science education enhances children's interest in nature, encouraging them to experiment, ask questions, and engage in inquiry-based learning (Gültekin Akduman, 2013; Karademir et al., 2020; Medicine & Council, 2015).

Science education in early childhood also plays a vital role in fostering sustainability awareness and environmental responsibility. Early scientific exploration helps children develop an understanding of ecological systems, supporting their ability to make sense of natural phenomena and human–environment interactions. Research shows that nature-based inquiry nurtures children's curiosity, resilience, and care for the environment (Ernst & Burcak, 2019), while also strengthening their environmental agency—an important dimension of Education for Sustainability (Borg & Samuelsson, 2022). These perspectives align with the MEB 2023 Vision, which highlights sustainability, environmental awareness, and STEM competencies as key developmental priorities. Situating science education within the broader framework of Early Childhood Education for Sustainable Development (ECEfSD) underscores the importance of integrating inquiry, nature experiences, and environmental understanding into preschool curricula. Involving parents and educators in introducing children to science early on further reinforces this process (Yus, 2017).

Based on Dewey's philosophy that "education is life itself" and Piaget's theory of cognitive development, science education should focus on active learning experiences, allowing children to explore and interact with their environment (Pramling Samuelsson & Kaga, 2008; Senemoğlu, 2023). Beyond fostering curiosity, science education strengthens critical thinking and problem-solving skills, preparing children to access and evaluate information critically (Baykara & Yakar, 2020; Dogan & Simsar, 2018).

Teachers play a vital role in fostering scientific inquiry, designing appropriate learning environments, and addressing children's individual needs (Babaroglu & Okur Metwalley, 2018; Çelik & Demirbaş, 2023). The preschool education program (MEB, 2013) includes activities such as nature walks, observing living and non-living things, weather charts, scientific documentaries, and hands-on experiments to support scientific exploration (Uğraş et al., 2013). However, studies indicate that teachers often allocate insufficient time for science activities due to a lack of confidence, experience, and awareness in teaching science to young children (Garbett, 2003; Olgan, 2015; Roehrig et al., 2011; Saçkes, 2014).

To enhance preschool science education, activities should align with children's developmental levels, nurturing their curiosity in a structured yet engaging environment (Zion & Mendelovici, 2012). Teachers must thoughtfully plan and implement scientific activities using diverse teaching methods to make abstract concepts accessible (Güçhan-Özgül, 2021; Özbek & Sığırtmaç, 2011; Vural & Kılıç Mocan, 2022). Supporting teachers' professional development and raising awareness about the importance of science education are essential for improving instructional quality and fostering children's scientific inquiry skills (Lederman et al., 2013, 2014).

Ultimately, preschool science education should be systematic, child-centered, and based on scientific research, ensuring active participation in the learning process. Strengthening teacher qualifications and integrating inquiry-based approaches into preschool curricula will be key to enhancing the quality of science education (Dağlı & Dağlıoğlu, 2020).

Purpose and Rationale

This study examines preschool teachers' views on scientific research and how these perspectives influence science teaching in early childhood education. Scientific literacy enhances cognitive development, problem-solving, and curiosity (MEB, 2018), yet science is often underrepresented in preschool curricula due to teachers' limited confidence and training (Garbett, 2003; Olgan, 2015). Since educators' attitudes can either support or hinder science integration (Zion & Mendelovici, 2012), understanding their perspectives is crucial. This research identifies the challenges and opportunities teachers face in science instruction, offering insights for professional development programs to enhance scientific inquiry in preschool settings. Based on this aim, the following questions have been addressed:

1. What are preschool teachers' views on scientific inquiry?
2. To what extent and in what ways do preschool teachers with informed levels of understanding identify and utilise science teaching opportunities in their educational environments?
3. To what extent and in what ways do preschool teachers with mixed levels of understanding identify and utilise science teaching opportunities in their educational environments?
4. To what extent and in what ways do preschool teachers with naïve levels of understanding identify and utilise science teaching opportunities in their educational environments?

Method

Research Design

This study employed an embedded mixed-method design to investigate preschool teachers' views on scientific inquiry and their use of science teaching opportunities. All data collection procedures were completed during the 2023–2024 academic year between November 2023 and April 2024. Qualitative methods, such as observation, interviews, and document analysis, provide a holistic understanding of perceptions in their natural context (Yıldırım & Şimşek, 2013). According to Creswell and Plano Clark (2018), the embedded design integrates quantitative and qualitative data within a primary research framework, allowing secondary data collection before, during, or after the main analysis.

Research Context and Participants

This study was conducted with 60 preschool teachers working in schools affiliated with the Ministry of National Education in the central districts of Balıkesir province. Among the teachers, 4 (6.7%) have associate degrees, 36 (60%) have bachelor's degrees, and 20 (33.3%) have master's degrees or higher.

Data Collection Tools

Qualitative research employs diverse data collection tools, including observations, interviews, and documents, allowing a comprehensive understanding of phenomena (Yıldırım & Şimşek, 2013). This study utilized the Views About Scientific Inquiry (VASI) Scale and Science Walk Questions.

Views about Scientific Inquiry (VASI) Scale

The VASI scale, revised by Lederman and Lederman (2004) and Lederman et al. (2014), assesses preschool teachers' views on scientific inquiry through seven open-ended questions covering eight key themes. Previous research (Schwartz et al., 2004) highlights the inadequacy of multiple-choice and Likert-type scales in capturing teachers' perspectives, emphasizing the value of open-ended responses. The scale categorizes responses as naïve (1 point), mixed (2 points), or informed (3 points), ensuring a structured analysis (Karışan et al., 2017).

In this study, we used the Turkish adaptation of the VASI instrument, which was previously validated by Karışan et al. (2017) and later revised for online administration during the pandemic (Mesci et al., 2020). Permission to use the Turkish version was obtained from the authors. The scale was administered online via Google Forms (Appendix A), and participants completed the instrument independently, without the researcher being physically present during the process. The alignment between scale responses and interview data reported in earlier studies (approximately 90%) supports the reliability and consistency of the adapted instrument (Lederman et al., 2014). The eight sub-dimensions of the scale are presented in Table 1.

Table 1 Dimensions of scientific enquiry and scale questions related to dimensions

Dimensions of scientific inquiry	Related question no
1. Scientific investigations all begin with a question, but do not necessarily test a hypothesis.	1a, 1b ve 2
2. There is no single set or sequence of steps followed in all investigations.	1b ve 1c
3. Inquiry procedures are guided by the question asked.	5
4. Not all scientists performing the same procedures may get the same results.	3a
5. Inquiry procedures can influence results.	3b
6. Research conclusions must be consistent with the data collected.	6
7. Scientific data and scientific evidence are not the same thing.	4
8. Explanations are developed from a combination of collected data and what is already known	7

Science Walk Interview Protocol

For the Science Walk interviews, the researcher accompanied each teacher through their school environment, while ensuring that the teacher's observations and interpretations guided the process.

The Science Walk is an unstructured interview method where teachers identify scientific opportunities in their preschool environment while walking with the researcher (Gomes, 2019). This approach captures real-world teaching practices that might be overlooked in traditional interviews (Fleer et al., 2014). Video recordings or photographs document the teachers' descriptions, ensuring a richer analysis (Gomes & Fleer, 2020).

Data Analysis

This study's data analysis involved organizing, interpreting, and drawing conclusions from the collected data using qualitative and statistical techniques (Corbin & Strauss, 2014). Rigorous analysis ensured the reliability and validity of findings (Çelik et al., 2020).

Analysis of VASI Form Responses

Teachers' responses to the VASI scale were analyzed using Lederman et al.'s (2014) framework, categorizing answers as naïve (1), mixed (2), or informed (3) (Schwartz et al., 2008). Frequency and percentage calculations determined the distribution of responses.

Analysis of Science Walk Interviews

A total of 12 teachers (4 from each category: naïve, mixed, informed) participated in Science Walk interviews, where observations, photos, and voice recordings documented their perspectives. To maintain confidentiality, teachers were coded as N (naïve), M (mixed), and I (informed).

Data Analysis Techniques

Descriptive analysis, as outlined by Miles and Huberman (1994), was used, involving three stages: data reduction, visualization, and conclusion drawing. Creswell (2014) five-step approach—transcription, theme identification, data connection, conflict evaluation, and presentation—guided analysis.

Data were categorized using the Miles-Huberman Model, where responses were coded, linked to themes, and interpreted. The most frequently occurring codes were highlighted in the analysis tables. Direct quotes were included to support findings, ensuring alignment with the theoretical framework (Yıldırım & Şimşek, 2013). The coding process was conducted by the researcher and an expert to ensure validity. Raw data were transcribed, and participant responses were analyzed with direct quotes. Inter-coder reliability was calculated using Miles & Huberman's (1994) formula, resulting in an 82% agreement.

Content Analysis

Interviews on teachers' science teaching methods were analyzed using content analysis, where data were categorized into themes (Yıldırım & Şimşek, 2013). The process followed four stages: coding, category creation, organization, and interpretation.

Validity & Reliability

Ensuring accuracy involved participant validation, expert review, triangulation, and prolonged engagement (Creswell, 2014). Internal validity was strengthened by using multiple data sources (VASI, Science Walk), while external validity was addressed through detailed descriptions and sampling strategies (Merriam, 2014).

Reliability in qualitative research emphasizes consistency and confirmability (Yıldırım & Şimşek, 2013). Strategies such as triangulation, peer review, detailed documentation, and inter-rater consistency analysis were employed to enhance trustworthiness. Raw data were stored for verification, and coding consistency was ensured through expert consultation.

Results

Findings Related to VASI

To support readers unfamiliar with the VASI instrument, each dimension is briefly summarised below. These dimensions represent core aspects of scientific inquiry and were used to classify teachers' responses as naïve, mixed, or informed:

1. **Scientific investigations begin with a question but do not always require hypothesis testing**: Scientific inquiry may involve exploration, observation, or descriptive work rather than formal hypothesis testing.
2. **There is no single scientific method**: Scientists use diverse approaches—experimental, observational, descriptive—depending on the research question.
3. **Inquiry procedures are guided by the question asked**: The structure of an investigation (methods, tools, data collection) depends directly on the nature of the research question.
4. **Different scientists may reach different results even when following the same procedures**: Variations in interpretation, measurement, or context can naturally lead to differing outcomes.
5. **Inquiry procedures can influence results**: Choices in data collection, tools, or methodological steps affect the nature of the findings.
6. **Research conclusions must be consistent with the data collected**: Scientific claims must be supported by evidence, and conclusions cannot contradict collected data.
7. **Scientific data and scientific evidence are not the same**: Data consist of raw observations, while evidence is data interpreted within a theoretical or conceptual framework.
8. **Scientific explanations combine collected data with existing knowledge**: Scientists interpret findings by integrating empirical data with prior scientific understanding.

These short explanations make the VASI framework more accessible and help clarify how teachers' responses were classified across naïve, mixed, and informed categories.

The results of the analyses of the answers given by a total of 60 preschool teachers are shown in Table 2.

Table 2 Distribution of VASI scores as percentage (%) for each dimension

Dimension	Question number	Naïve (1)	Mixed (2)	Informed (3)
1. Scientific investigations all begin with a question, but do not necessarily test a hypothesis.	1a	15	38.3	46.7
	1b	46.7	20	33.3
	2	48.4	28.3	23.3
	1a, 1b ve 2	36.7	28.9	34.4
5. There is no single set or sequence of steps followed in all investigations.	1b	46.7	20	33.3
	1c	8.3	46.7	45
	1b ve 1c	27.5	33.3	39.2
8. Inquiry procedures are guided by the question asked.	5	70	1.7	28.3
9. Not all scientists performing the same procedures may get the same results.	3a	25	21.7	53.3
10. Inquiry procedures can influence results.	3b	16.7	53.3	30
11. Research conclusions must be consistent with the data collected.	6	46.7	0	53.3
12. Scientific data and scientific evidence are not the same thing.	4	5	35	60
13. Explanations are developed from a combination of collected data and what is already known	7a, 7b	18.3	20	61.7
Ölçek Toplam (1a,1b,1c,2,3a,3b,4,5,6,7a,7b)		29	26	45

Table 2 shows that teacher candidates have a mixed understanding of scientific inquiry, with responses in the Naïve category for two dimensions, Mixed for one, and Informed for five dimensions.

Regarding the VASI scale, nearly 45% of responses from preschool teachers were categorized as informed, while 29% were naïve and 26% were mixed.

The least informed (naïve) views were ranked from least to most knowledgeable:

- **Dimension 3**: "The question guides the inquiry process" (70%).
- **Dimension 6**: "Research results must be consistent with collected data" (46.7%).
- **Dimension 1**: "All scientific research starts with a question and doesn't always test a hypothesis" (36.7%).

The most mixed view was found in **Dimension 5**: "The inquiry process affects the results" (53.3%).

The most informed views were in:

- **Dimension 8**: "Conclusions are based on collected data and prior knowledge" (61.7%).
- **Dimension 7**: "Scientific data and evidence are not the same" (60%).

- **Dimension 4**: "Different scientists may reach different conclusions from the same process" (53.3%).
- **Dimension 6**: "Research results must be consistent with collected data" (53.3%).
- **Dimension 2**: "There is no single scientific method followed in all research" (39.2%).

Findings Related to the Dimension: "All Scientific Research Begins with a Question and Does Not Always Test a Hypothesis".

Scientific research questions can emerge in various ways, sometimes driven by curiosity and sometimes based on theoretical predictions. While scientific inquiry starts with questions, it does not necessarily require testing a hypothesis.

Quote: "Scientific research involves data collection and observations. It does not always require hypothesis testing." (T38).

Findings Related to the Dimension: "There Is No Single Scientific Method Followed in All Research".

Scientific research can follow multiple methods, including qualitative, quantitative, experimental, and observational approaches. Teachers generally recognized that different research designs apply depending on the nature of the study.

Quote: "A research study can be conducted using surveys, observations, or controlled experiments, depending on the research question." (T8).

Findings Related to the Dimension: "The Research Question Guides the Inquiry Process".

The research question shapes the direction of an investigation by determining the most appropriate method for data collection and analysis. Many teachers struggled to select the correct experimental procedure, indicating gaps in understanding how questions guide scientific inquiry.

Quote: "A well-defined research question determines the variables to be measured and the methodology to be used." (T15).

Findings Related to the Dimension: "Scientists Following the Same Procedures May Not Reach the Same Conclusion"

Even when using the same methods, different researchers can reach different conclusions due to variations in data interpretation, measurement precision, or external influences. Most teachers acknowledged that scientific findings are influenced by human interpretation and experimental conditions.

Quote: "The same experiment can yield different results due to variations in measurement conditions, sample differences, or researcher perspectives." (T12).

Findings Related to the Dimension: "The Inquiry Process Influences the Results"

Using different methods to investigate the same question can lead to varying outcomes due to differences in data collection techniques and analysis. While some teachers believed all research would yield the same results, others recognized that methodology shapes findings.

Quote: "If scientists use different data collection methods, their results might differ, even if they investigate the same topic." (P38).

Findings Related to Science Teaching Opportunities

Teachers participating in the Science Walk interview protocol were randomly selected, with four teachers from each category. All selected teachers were women with at least ten years of professional experience. During the Science Walk interviews, the researcher asked a series of eleven separate, sequential open-ended questions. In the original transcript, some of these questions appeared near one another, which may have created the impression of multi-part prompts. To ensure clarity, each question is presented below as an independent item, accompanied by its thematic analysis and integrated participant quotations.

Question 1: What do you think about children's play and imagination?

In response to the question, *"What do you think about children's play and imagination?"*, most teachers emphasized the positive impact of play on children's holistic development, noting that it significantly nurtures imagination. As Teacher M2 observed, *"Play is essential for children's cognitive, physical, and social development, and it also fosters their imagination."* However, some teachers expressed concerns that technological advancements have limited children's opportunities for creative play. For example, Teacher M4 noted that *"technology has restricted children's imagination in recent years, though some still have strong creativity and learn easily through play."*

Question 2: "What do you think about play and science in children's daily lives?"

Before the Science Walk, teachers were asked, *"What do you think about play and science in children's daily lives?"* Most teachers agreed that science is embedded in many aspects of children's everyday experiences and that play naturally supports scientific exploration. As Teacher I2 explained, *"Science exists everywhere in children's daily lives. Through play, they constantly discover and learn."* Similarly, Teacher M4 highlighted the close relationship between the two domains, noting that *"science and play are intertwined. Whether at home or outside, children engage with scientific concepts through exploration."* Some teachers added further nuance, observing that boys often incorporate scientific or mechanical elements into their play more frequently, while one teacher criticised parents for not providing children with enough opportunities to connect science with play in their daily routines.

Question 3: How would you briefly define science?

In response to the question, 'How would you briefly define science?', teachers offered a range of descriptions. These responses formed the basis for the thematic classification presented in the following question.

Question 4: Please briefly explain what you understand by science

The content analysis of responses to the question *"Please briefly explain what you understand by science"* revealed three main categories: Importance, Discovery and Research, and Learning Process.

In the first category, Importance, teachers described science as fundamental to understanding the world, closely connected to daily life, and essential for fostering children's research and problem-solving skills. For example, Teacher N2 stated that science is *"the basis of our world,"* while Teacher M1 associated it directly with everyday experience, explaining that it is *"part of daily life."* Teacher I1 further highlighted its educational value, noting that science *"supports children's ability to solve problems."*

The second category, Discovery and Research, reflected definitions of science as a process of exploring the unknown through curiosity, experimentation, and systematic inquiry. Teacher I4 described science as *"curiosity and research,"* whereas Teacher I2 emphasised its experimental nature, noting that science involves *"understanding nature through experiments."* Similarly, Teacher I3 explained that scientific thinking *"emerges from children's curiosity and interest."*

The final category, Learning Process, emphasised science as an experiential and self-directed learning pathway, particularly through observation and interaction with natural environments. Teacher N1 characterised science as *"self-directed learning,"* and Teacher N3 connected it to *"curiosity, observation, and experimentation."* Teacher N4 also underlined its experiential nature, stating that children *"learn through hands-on exploration in nature."*

Overall, teachers with informed VASI profiles were more likely to define science in terms of discovery and research, whereas those in the naïve category tended to emphasise learning-through-experience and observation. This distinction suggests that teachers' conceptualisations of science are linked to their broader understandings of scientific inquiry.

Question 5: How do young children experience science in daily life? Can you give an example?

In response to the question *"How do young children experience science in daily life?"*, teachers described a wide range of everyday situations in which children naturally engage with scientific concepts. Their responses were clustered into three themes: Nature and Observation, Daily Events and Science, and Activities and Experiments.

In the first theme, Nature and Observation, teachers emphasised that children frequently encounter science through direct interactions with natural environments. They explained that children observe natural events, animal behaviour, and plant growth during outdoor play, and extend this learning to the home environment when watching activities such as cooking. Several teachers noted that simple moments—such as watching soil absorb water in the school garden—serve as powerful opportunities for developing early scientific understanding.

The second theme, Daily Events and Science, highlighted the role of everyday routines and environmental changes in shaping children's scientific thinking. Teachers pointed out that seasonal transitions, weather patterns, and household play scenarios provide meaningful contexts for inquiry. For example, they observed that children learn science while engaging in imaginative play such as "playing house," or when experiencing events like snowfall, helping them relate scientific ideas to familiar aspects of daily life.

The third theme, Activities and Experiments, captured teachers' views on the structured opportunities provided through curriculum-based science activities. Teachers explained that planned experiments and hands-on tasks allow children to explore abstract concepts in concrete ways. They emphasised that such activities spark curiosity, promote exploration, and motivate children to ask further questions about scientific phenomena.

Teachers' responses to Question 5 were organised into three main themes to enhance clarity and to illustrate the different ways in which children experience science in daily life. These themes and representative quotations are summarised in Table 3.

Question 6: Can scientific concepts be taught to children through play? How?

In response to the question *"Can scientific concepts be taught to children through play? If yes, how?"*, teachers expressed two distinct viewpoints. The majority held a positive stance, explaining that play provides an effective medium for introducing scientific ideas. They noted that drama-based science activities, hands-on exploration, and imaginative scenarios help children engage with scientific concepts in a meaningful and enjoyable way, making it easier for them to retain new knowledge.

A smaller number of teachers expressed uncertainty, pointing out that while many scientific ideas can be naturally embedded into play, some abstract concepts may be more difficult to convey through play-based methods alone. One teacher, for example, noted that certain scientific ideas might require more explicit guidance or structured explanation.

Overall, teachers viewed play as a highly beneficial approach to science teaching in early childhood, recognising its potential to combine enjoyment with learning while also acknowledging the limitations associated with more complex or abstract concepts.

Question 7: Do you conduct any science activities with preschool children? If yes, can you give a recent example?

In response to the question *"Do you conduct any science activities with preschool children? If yes, can you give a recent example?"*, teachers described a wide range of instructional practices that they use to introduce scientific concepts. Their responses clustered around three themes: Experiments, Natural Events, and Energy and Technology.

Under the first theme, Experiments, teachers highlighted the importance of hands-on, child-centred activities. Many reported using simple experiments—such as the Germ Experiment to teach hygiene and microbiology, demonstrations of blood circulation, air pressure activities, and small-scale rocket launches—to foster direct participation and engagement. These activities were seen as highly motivating and effective in helping children make sense of scientific processes.

Table 3 Themes identified in responses to question 5: "How do young children experience science in daily life?"

Theme	Description	Example teacher quote
Nature and observation	Children observe natural events, animal behavior, and plant growth both at school and at home.	"They observe soil-water interactions in the garden." (I3)
Daily events and science	Children learn science through daily routines and environmental phenomena, such as weather and seasons.	"They learn science while watching snowfall or playing house." (M4)
Activities and experiments	Structured science activities and experiments help children engage with abstract concepts.	"Curriculum experiments increase their curiosity." (I1)

The second theme, Natural Events, focused on teachers' efforts to help children understand everyday scientific phenomena. They described using visuals, models, and interactive demonstrations to explain concepts such as volcanic eruptions, day–night cycles, and seasonal changes. For instance, one teacher recounted using an interactive model to illustrate how the Earth's tilt creates different seasons, noting that such demonstrations make abstract ideas more accessible for young learners.

Finally, the Energy and Technology theme captured the ways in which teachers introduced concepts related to energy use, conservation, and technological systems. Teachers mentioned activities that involved explaining how electricity works, engaging children in discussions about saving energy, and using educational technologies such as robotics, coding kits, and videos to support children's understanding of scientific and technological ideas.

Together, these examples illustrate that teachers employ a diverse array of science activities—from simple experiments to technology-supported lessons—to enrich children's scientific understanding and to create engaging, developmentally appropriate learning experiences.

Question 8: Do you conduct any informal science activities with preschool children? If yes, can you give a recent example?

In response to the question *"Do you conduct any informal science activities with preschool children? If yes, can you give a recent example?"*, teachers described a wide variety of everyday practices through which they introduce scientific ideas. Their responses were grouped into six themes: Classroom Observations, Outdoor Activities, Story-Based Activities, Material Use, Student Participation, and Experimental & Visual Activities.

The first theme, Classroom Observations, highlighted teachers' use of brainstorming and questioning routines to foster children's scientific thinking. Teachers explained that they often guide children in discussions about observable events such as the weather, encouraging them to make predictions and explain what they notice.

The second theme, Outdoor Activities, reflected teachers' emphasis on nature-based exploration. They described taking children outside to observe ants, leaves, soil, or other elements of the natural environment, sometimes incorporating environmental cleaning activities to promote curiosity, awareness, and responsibility toward nature.

In the third theme, Story-Based Activities, teachers used books and narratives to introduce scientific concepts such as global warming, air movement, and environmental change. Stories allowed children to make connections between scientific ideas and real-life situations in an accessible and engaging way.

The fourth theme, Material Use, involved activities in which children explored scientific ideas through hands-on interaction with simple materials. Teachers gave examples such as using watercolors to investigate color mixing, enabling children to observe change and cause–effect relationships.

The fifth theme, Student Participation, captured teachers' efforts to create opportunities for children to ask questions, experiment with materials, and independently explore topics of interest. Teachers noted that children frequently initiated informal science discussions about topics such as bees, frogs, or insects they encountered in their environment.

Table 4 Themes identified in responses to question 8: "Do you conduct any informal science activities?"

Theme	Description	Example teacher quote
Classroom observations	Brainstorming and questioning activities about topics like weather.	"We discuss the weather every morning." (M3)
Outdoor activities	Observing ants, leaves, or doing environmental cleaning.	"We watched ants carrying food." (I2)
Story-based activities	Using books to introduce science concepts (e.g., global warming).	"We read a story about air movement." (N1)
Material use	Using simple materials like watercolor for color mixing.	"We mixed colors using water." (N4)
Student participation	Children ask questions and explore topics with hands-on materials.	"They asked about bees and frogs." (M1)
Experimental & visual activities	Using smart boards or visual tools to explain scientific ideas.	"We used the smart board to show day–night." (I3)

Finally, the theme of Experimental & Visual Activities included teachers' use of digital tools and visual supports—such as smart boards or videos—to explain natural phenomena like the day–night cycle or the structure of leaves. These visual and interactive tools helped make abstract concepts more concrete for young learners.

Collectively, the teachers' responses illustrate a rich array of informal science experiences embedded in daily routines, spontaneous interactions, and child-led inquiries—demonstrating how science learning extends well beyond structured classroom lessons.

To provide a clearer overview of teachers' informal science practices, responses to Question 8 were grouped into six themes. These themes, along with illustrative quotations, are presented in Table 4.

Question 9: Have you ever conducted an unplanned science activity with preschool children? If yes, can you provide an example?

In response to the question *"Have you ever conducted an unplanned science activity with preschool children? If yes, can you provide an example?"*, teachers described two types of spontaneous science learning experiences: Event-Based Activities and Spontaneous Interest-Based Activities.

In the first category, Event-Based Activities, teachers explained that unexpected occurrences in the school environment frequently served as rich opportunities for scientific exploration. They recounted moments such as a bee entering the classroom, sudden rainfall, or children discovering an unusual plant outdoors. Rather than dismissing these moments as disruptions, teachers used them to stimulate observation, questioning, and discussion—helping children connect real-life events to scientific ideas.

The second category, Spontaneous Interest-Based Activities, reflected instances in which teachers built upon children's immediate curiosity. Teachers described situations where children's questions about hair static electricity, thunderstorms, or other naturally occurring phenomena opened the door to impromptu explanations and exploratory conversations. These moments allowed teachers to model scientific thinking by encouraging children to observe closely, make predictions, and consider possible explanations.

Together, these examples illustrate how unplanned events and child-initiated curiosity can become powerful catalysts for early scientific inquiry, enabling teachers to integrate science learning seamlessly into everyday classroom life.

Question 10: Are there places/materials in your school that provide opportunities for science teaching? Can you give examples?

In response to the question *"Are there places or materials in your school that provide opportunities for science teaching? If yes, can you give examples?"*, teachers identified a variety of physical spaces and resources that support science learning. Their responses fell into three categories: Use of Natural Spaces, Classroom Science Rooms and Materials, and Creative Activities with Limited Resources.

The first category, Use of Natural Spaces, highlighted the importance of school gardens and outdoor areas as rich environments for scientific exploration. Teachers explained that these spaces allowed children to observe fungi, examine plants, and engage in sensory experiences such as mud play. Such interactions provided meaningful opportunities for children to develop observational skills and explore natural phenomena.

The second category, Classroom Science Rooms and Materials, reflected teachers' use of dedicated indoor science spaces and tools. They mentioned employing microscopes, magnifying lenses, and robotic coding kits to support hands-on learning. These materials enabled children to explore scientific concepts through guided experimentation and to interact with technology in developmentally appropriate ways.

Finally, the theme of Creative Activities with Limited Resources demonstrated teachers' adaptability in contexts where materials were scarce. Several teachers described using natural items such as pinecones, leaves, or stones to design simple yet meaningful science activities. These examples illustrate how teachers creatively transform ordinary objects into tools for inquiry, ensuring that science learning remains accessible even in resource-limited settings.

Together, these categories show that teachers draw on a wide range of physical spaces and materials—both structured and improvised—to facilitate science learning across diverse early childhood environments.

Question 11: What science learning opportunities can you identify in your school's indoor and outdoor spaces?

In response to the question *"What science learning opportunities can you identify in your school's indoor and outdoor spaces?"*, teachers described a wide range of physical environments and materials that support children's scientific exploration. Their responses were grouped into three key themes: Outdoor Natural Spaces, Indoor Science Rooms and Materials, and Creative Activities with Limited Resources.

The first theme, Outdoor Natural Spaces, highlighted the value of schoolyards, playgrounds, and nearby parks as naturally occurring science environments. Teachers explained that these areas enabled children to observe plants, insects, soil, and small ecosystems, offering rich opportunities for inquiry-based learning. Through regular outdoor exploration, children were able to develop early understanding of ecological relationships and natural processes.

The second theme, Indoor Science Rooms and Materials, focused on the dedicated spaces and tools available within schools. Teachers emphasized the usefulness of microscopes, anatomical models, magnifying glasses, and experiment kits for creating hands-on, visually engaging science experiences. These materials allowed children to investigate scientific concepts in a structured and developmentally appropriate manner.

Finally, the theme of Creative Activities with Limited Resources illustrated how teachers designed meaningful science learning opportunities even when specialised materials were limited. Many described using natural items—such as stones, pinecones, leaves, or classroom collections—to support observation, classification, and comparison activities. These examples demonstrate teachers' creativity in transforming simple, readily available objects into tools for scientific investigation.

Together, these themes reveal the diversity and adaptability of teachers' approaches to integrating science into preschool education. Whether through structured lessons, spontaneous exploration, or resourceful adaptations, teachers drew on both indoor and outdoor environments to enrich children's scientific learning.

A comparison of Science Walk findings across VASI categories revealed clear patterns in how teachers identified science learning opportunities. Teachers with informed VASI profiles consistently recognised a wider range of inquiry-rich affordances, such as opportunities related to cause–effect relationships, natural phenomena, and experimentation. Mixed-profile teachers identified several opportunities but tended to focus on more concrete or partially developed inquiry moments without elaborating on underlying scientific reasoning. In contrast, teachers with naïve profiles primarily pointed to superficial or observational elements (e.g., colours, shapes, visible objects) and often overlooked deeper inquiry possibilities. These patterns indicate that teachers' conceptual understanding of scientific inquiry influences the nature and depth of science teaching opportunities they can identify and utilise in their environments.

Conclusion and Discussion

Conclusion

Early childhood education serves as the foundational step in formal education, with its significance increasingly recognized. Scientific research and science education are integral parts of this period, enabling children to understand the world and develop cognitive skills that will help them navigate future challenges. Early childhood institutions not only contribute to children's overall development but also aim to foster inquiry and observational skills by integrating science and nature activities into their daily programs.

This study examined the perspectives of preschool teachers on scientific inquiry and their utilization of science teaching opportunities. The findings emphasize that science education can be conducted in various ways during early childhood and high-light the importance of nurturing children's scientific curiosity and skills. Teachers play a critical role in guiding students through scientific experiences, helping them engage with inquiry-based learning, and providing meaningful opportunities for exploration.

Teachers' Views on Scientific Inquiry

The analysis of preschool teachers' views on scientific inquiry, based on the "Views About Scientific Inquiry (VASI)" scale, revealed a complex understanding of scientific research. Most teachers demonstrated Informed perspectives in five dimensions, while they had Naïve views in two and a Mixed understanding in one.

Contrary to some studies in the literature that found participants to hold predominantly Naïve views (Lederman & Lederman, 2004), the teachers in this study exhibited a more informed understanding overall. These findings align with prior research (Karışan et al., 2017; Şenler, 2017), which suggests that teachers' views on scientific inquiry are generally informed and complex. However, other studies (Baykara et al., 2018; Bostan Sarioğlan, 2018; Dogan, 2017; Mesci et al., 2020; Mesci & Erdas Kartal, 2021) have reported a greater prevalence of naïve and mixed perspectives among participants.

The findings suggest that preschool teachers may require additional support and training to fully grasp fundamental principles of scientific inquiry, particularly in relation to how research questions shape investigations and how inquiry processes impact outcomes.

Discussion on Science Teaching Opportunities

The study also examined how preschool teachers perceive and utilize opportunities for teaching science. Based on interviews with 12 teachers across eight different schools, the findings revealed varying approaches to integrating science into the classroom, as well as challenges related to resources, instructional methods, and environmental constraints.

Overall, teachers demonstrated a positive attitude toward science teaching, acknowledging that science is deeply embedded in daily life. This aligns with previous research by Babaroglu and Okur Metwalley (2018), which also found that preschool teachers generally hold favorable attitudes toward science education. However, despite their enthusiasm, teachers faced difficulties due to limited scientific knowledge and a lack of resources for creating instructional materials (Ayvacı et al., 2002; Demiriz & Ulutaş, 2000).

A key finding was that teachers preferred classroom-based science activities over outdoor learning experiences. This supports findings by Yıldız (2022), who reported that teachers often lack sufficient knowledge about using outdoor learning environments and are constrained by financial limitations, transportation difficulties, and parental restrictions. The finding that teachers preferred classroom-based science activities over outdoor learning experiences is particularly important, as it reflects both structural and pedagogical dynamics within early childhood education. This preference may be shaped by limited access to well-maintained outdoor spaces, large class sizes, safety concerns, and the perception that classroom activities are easier to plan, manage, and align with curricular expectations. However, the predominance of indoor science experiences also has broader implications. International research highlights that outdoor environments play a crucial role in fostering children's inquiry skills, ecological awareness, and hands-on engagement with natural phenomena. When outdoor learning is underutilised, opportunities for spontaneous science inquiry—such as observing weather changes, plant growth, or animal behavior—are reduced. This finding therefore points to a need for increased professional development focused on outdoor science pedagogy, as well as institutional support to improve the accessibility and safety of outdoor environments. Strengthening these areas could help teachers integrate more balanced indoor–outdoor science experiences that support both inquiry-based learning and sustainability education.

Teachers primarily employed hands-on methods such as experiments, modeling, and dramatization to teach scientific concepts. These approaches have been found to enhance student engagement and conceptual understanding (Karamustafaoğlu & Kandaz, 2006). However, the effective implementation of these activities was hindered by a shortage of laboratory equipment and teaching materials (Güler & Bikmaz, 2002). Similar challenges have been noted in previous studies, where teachers cited material shortages and inadequate physical spaces as barriers to effective science education (Parlakyıldız & Aydın, 2004).

Despite these challenges, teachers emphasized the importance of experiential learning and actively encouraged students to observe natural phenomena. Some teachers reported integrating science into spontaneous classroom moments, such as discussing bees when one entered the classroom or using a power outage as an opportunity to explore light and electricity through candle experiments. These examples illustrate how real-life situations can be leveraged to foster scientific curiosity and critical thinking skills.

When interpreting these findings, it is important to distinguish between results that are specific to the Turkish early childhood education system and those that reflect broader international patterns. Some challenges—such as limited outdoor learning spaces, restricted material resources, and high emphasis on classroom-based activities—appear closely tied to structural conditions of Turkish public preschools and align with previous studies conducted within Turkey (Olgan, 2015; Yıldız, 2022). However, several patterns observed in our study, including teachers' varying comfort levels with inquiry-based practices and their reliance on hands-on activities, are consistent with international literature reporting similar challenges in early science education (Garbett, 2003; Roehrig et al., 2011). By distinguishing these local and global trends, the study contributes a clearer understanding of how national context and universal pedagogical issues intersect in preschool science teaching.

The findings also have implications for sustainability education in early childhood. Many of the science teaching opportunities identified by teachers—particularly those involving nature observation, spontaneous outdoor events, and discussions of natural phenomena—align closely with principles of Early Childhood Education for Sustainable Development (ECEfSD). Early inquiry experiences help children develop awareness of ecological relationships, build connections with the natural world, and foster environmental agency (Borg & Samuelsson, 2022; Ernst & Burcak, 2019). These outcomes are particularly relevant given the MEB 2023 Vision's emphasis on sustainability, environmental awareness, and STEM competencies. Strengthening teachers' understanding of scientific inquiry may therefore contribute not only to improved science instruction but also to broader educational goals related to sustainability and children's future-oriented environmental understanding.

Final Remarks

In conclusion, the study highlights that preschool teachers generally hold informed views about scientific inquiry but exhibit some naïve understandings in certain areas. Their perspectives are mixed, suggesting the need for continued professional development in scientific inquiry methods. Additionally, while teachers demonstrate enthusiasm for science education, they face challenges in effectively utilizing science teaching opportunities due to limitations in resources, infrastructure, and instructional strategies.

These findings underscore the importance of supporting teachers with targeted training programs, improved access to teaching materials, and opportunities for professional development. By addressing these challenges, educators can better facilitate inquiry-based learning, enrich students' scientific experiences, and foster a strong foundation for lifelong scientific literacy.

Sugesstions

Suggestions on Scientific Research;

- Teachers can be provided with more guidance and training on scientific research.
- Collaboration and experience sharing among teachers can be encouraged to develop scientific inquiry skills.
- By emphasising the importance of scientific research in preschool education, students can be supported to gain scientific thinking and inquiry skills.

Suggestions for Science Teaching;

- Educators and parents should use the natural areas around them for children to experience science and provide opportunities for exploration.
- Frequent use of play-based learning methods enables children to learn science by having fun and increases their scientific curiosity.
- Teachers should combine different teaching strategies, taking into account children's individual learning styles. This helps each student learn science in the most effective way.
- Education programmes should include practical experiences and scientific activities linked to everyday life to strengthen children's engagement with science.
- Teachers should teach science concepts in a way that takes them out of the abstract and relates them to everyday situations. This allows students to better understand the topics.

Limitations

While this study provides valuable insights into preschool teachers' views on scientific inquiry and their utilization of science teaching opportunities, certain limitations should be acknowledged:

The study was conducted with a relatively small sample of preschool teachers. Although the findings provide in-depth perspectives, they may not be fully representative of all preschool teachers. A larger and more diverse sample, including teachers from different regions and school types (e.g., public vs. private schools), would enhance the generalizability of the results.

The study was conducted within a specific educational and cultural context. Different countries or educational systems may have distinct approaches to early childhood science education. Comparative studies across different contexts could provide broader insights into how cultural and systemic factors shape teachers' views and practices.

Although the study assessed teachers' understanding of scientific inquiry, it did not specifically measure their overall scientific knowledge or confidence in teaching science concepts. Future research could include knowledge assessments to better understand the relationship between teachers' content knowledge and their instructional practices.

By acknowledging these limitations, future studies can build upon the findings and further explore ways to enhance science education in early childhood settings.

Acknowledgements We extend our appreciation to the participants of this study for their time and cooperation. Their involvement was instrumental in gathering the data necessary for our research.

Funding This research received no external funding.

Data availability The dataset generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Conflict of interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

References

Akman, B., & Güçhan Özgül, S. (2015). Role of Play in Teaching Science in the Early Childhood Years. In K. Cabe Trundle & M. Saçkes (Eds.), *Research in Early Childhood Science Education* (pp. 237–258). Springer Netherlands. https://doi.org/10.1007/978-94-017-9505-0_11

Anderson, R. (2002). Reforming science teaching: What research says about inquiry. *Journal of Science Teacher Education*, *13*, 1–12. https://doi.org/10.1023/A:1015171124982

Ayvacı, H. Ş., Devecioğlu, Y., & Yiğit, N. (2002). *Okul öncesi öğretmenlerinin Fen ve doğa Etkinliklerindeki yeterliliklerinin belirlenmesi V*. Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi, Ankara.

Babaroglu, A., & Okur Metwalley, E. (2018). Okul Öncesi Öğretmenlerin Fen Eğitimine İlişkin Tutumlarının İncelenmesi(Çorum İli Örneği). *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (33), 1–15. https://doi.org/10.30794/pausbed.425633

Bahçeci Sansar, S. (2010). *Okul öncesi öğretmenlerin Fen öğretimine yönelik tutumları Ile Fen etkinliklerinde kullandıkları yöntemler arasındaki Ilişkinin incelenmesi (Kütahya Ili örneği*. Abant İzzet Baysal Üniversitesi]. Bolu.

Baykara, H., & Yakar, Z. (2020). Preservice science teachers' views about scientific inquiry: The case of Turkey and Taiwan [Fen Öğretmen Adaylarının bilimsel Araştırmaya Yönelik Görüşleri: Türkiye ve Tayvan Örneği]. *Turkish Online Journal of Qualitative Inquiry*, *11*(2), 161–192. https://doi.org/10.17569/tojqi.618950

Baykara, H., Yakar, Z., & Liu, S. Y. (2018). Preservice science teachers' views about scientific inquiry. *European Journal of Education Studies*.

Borg, F., & Samuelsson, I. P. (2022). Preschool children's agency in education for sustainability: The case of Sweden. *European Early Childhood Education Research Journal*, *30*(1), 147–163. https://doi.org/10.1080/1350293X.2022.2026439

Bostan Sarioğlan, A. (2018). Fen bilgisi Öğretmen Adaylarinin Öğretim Deneyimlerinden sonra bilimsel sorgulama Hakkındaki Görüşlerinin Değerlendirilmesi. *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi*, *48*, 136–159.

Çelik, Ö., & Demirbaş, A. (2023). Öğretmen Görüşlerine Göre Okul Öncesi Dönem Çocuklarının Tanıma ve Değerlendirme Süreçlerinin incelenmesi: Nitel Bir Araştırma [Examining the recognition and evaluation processes of preschool children according to teacher opinions: A qualitative Research]. *Uluslararası Temel Eğitim Çalışmaları Dergisi*, *4*(3), 170–183. https://doi.org/10.59062/ijpes.1400279

Çelik, H., Baykal, N. B., & Memur, H. N. K. (2020). Nitel veri analizi ve Temel Ilkeleri. *Eğitimde Nitel Araştırmalar Dergisi*, *8*(1), 379–406.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*. Sage.

Creswell, J. W. (2014). *Research design: Qualitative, Quantitative, and mixed methods approaches*. SAGE.

Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE.

Dağlı, H., & Dağlıoğlu, H. E. (2020). Okul Öncesi Öğretmenlerinin Fen Eğitiminin İçeriği ve Standartlarına İlişkin Görüşlerinin incelenmesi. *OPUS International Journal of Society Researches*, *15*(23), 1885–1919. https://doi.org/10.26466/opus.631378

Demiriz, S., & Ulutaş, İ. (2000). *Okul öncesi Eğitim Kurumlarındaki Fen ve Doğa etkinlikleri Ile İlgili Uygulamaların belirlenmesi IV*. Fen Bilimleri Eğitimi Kongresi, Ankara.

Dogan, N. (2017). Blending problem based learning and history of science approaches to enhance views about scientific inquiry: New wine in an old bottle. *Journal of Education and Training Studies*, *5*(10), 99–112.

Dogan, Y., & Simsar, A. (2018). Preschool teachers' views on science Education, the methods they Use, science Activities, and the problems they face. *International Journal of Progressive Education*, *14*(5), 57–76.

Dubosarsky, M. D. (2011). *Science in the eyes of preschool children: Findings from an innovative research tool* University of Minnesota].

Ernst, J., & Burcak, F. (2019). Young children's contributions to sustainability: The influence of nature play on Curiosity, executive function Skills, creative Thinking, and resilience. *Sustainability*, *11*(15), 4212. https://www.mdpi.com/2071-1050/11/15/4212

Fleer, M., Gomes, J., & March, S. (2014). Science learning affordances in preschool environments. *Australasian Journal of Early Childhood*, *39*(1), 38–48. https://doi.org/10.1177/183693911403900106

Garbett, D. (2003). Science education in early childhood teacher education: Putting forward a case to enhance student teachers' confidence and competence. *Research in Science Education*, *33*(4), 467–481. https://doi.org/10.1023/B:RISE.0000005251.20085.62

Gomes, J. J. (2019). *A Cultural-Historical Study of Scientific Concept Formation Possibilities for Preschool Children in Everyday Environments* Monash University].

Gomes, J., & Fleer, M. (2020). Is science really everywhere? Teachers' perspectives on science learning possibilities in the preschool environment. *Research in Science Education*, *50*(5), 1961–1989. https://doi.org/10.1007/s11165-018-9760-5

Güçhan-Özgül, S. (2021). Integration of inquiry and play: Young children's conceptual change in astronomy. *Journal of Inquiry Based Activities*, *11*(1), 1–15.

Güler, D., & Bikmaz, F. (2002). Anasınıflarda Fen Etkinliklerinin gerçekleştirilmesine ilişkin öğretmen görüşleri. *Eğitim Bilimleri Ve Uygulama*, *1*(2), 249–267.

Gültekin Akduman, G. (2013). Okul Öncesi Eğitimin Tanımı ve Önemi. In G. U. Balat (Ed.), *Okul Öncesi Eğitime Giriş* (pp. 2–15). Pegem Akademi.

Kahraman, Ö. G., Ceylan, Ş., & Ülker, P. (2015). Bilimi Yaratan duygu: Çocuklarin Fen ve Doğaya Ilişkin Konulardaki bilgi ve Merakları. *Türkiye Sosyal Araştırmalar Dergisi*, *19*(1), 207–230. https://doi.org/10.20296/tsad.50725
Karademir, A., Kartal, A., & Türk, C. (2020). Science education activities in turkey: A qualitative comparison study in preschool classrooms. *Early Childhood Education Journal*, *48*(3), 285–304. https://doi.org/10.1007/s10643-019-00981-1
Karamustafaoğlu, S., & Kandaz, U. (2006). Okul Öncesi Eğitimde Fen etkinliklerinde Kullanılan Öğretim Yöntemleri ve Karşılaşılan Güçlükler [Using teaching methods in the science activities and difficulties encountered in pre school Education]. *Gazi Eğitim Fakültesi Dergisi*, *26*(1), 65–81. https://dergipark.org.tr/tr/pub/gefad/issue//90810
Karışan, D., Bilican, K., & Şenler, B. (2017). Bilimsel sorgulama hakkında görüş anketi: Türkçeye uyarlama, geçerlik ve güvenirlik çalışması. *İnönü Üniversitesi Eğitim Fakültesi Dergisi*, *18*(1), 326–343.
Lederman, N. G. (2006). *Research on nature of science: Reflections on the past, anticipations of the future*. Asia-Pacific Forum on Science Learning and Teaching.
Lederman, N., & Lederman, J. (2004). 01/01). *Project ICAN: A professional development project to promote teachers' and students' knowledge of nature of science and scientific enquiry* 11th Annual SAARMSTE Conference, Cape Town, South Africa.
Lederman, N. G., Lederman, J. S., & Antink, A. (2013). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. *International Journal of Education in Mathematics Science and Technology*, *1*(3), 138–147.
Lederman, J., Lederman, N., Bartos, S., Bartels, S., Antink-Meyer, A., & Schwartz, R. (2014). Meaningful Assessment of Learners' Understandings About Scientific Inquiry-The Views About Scientific Inquiry (VASI) Questionnaire. *Journal of Research in Science Teaching*, *51*. https://doi.org/10.1002/tea.21125
Lederman, J., Lederman, N., Bartels, S., Jimenez, J., Akubo, M., Aly, S., Bao, C., Blanquet, E., Blonder, R., Bologna Soares de Andrade, M., Buntting, C., Cakir, M., EL-Deghaidy, H., ElZorkani, A., Gaigher, E., Guo, S., Hakanen, A., Al-Lal, H., Han-Tosunoglu, S., Hattingh, C., Hume, A., Irez, A., Kay, S., Dogan, G. K., Kremer, O., Kuo, K., Lavonen, P. C., Lin, J., Liu, S. F., Liu, C., Liu, E., Lv, S. Y., Mamlok-Naaman, B., McDonald, R., Neumann, C., Pan, I., Picholle, Y., Rivero, E., García, A., Rundgren, C. J., Santibáñez-Gómez, D., Saunders, K., Schwartz, R., Voitle, F., von Gyllenpalm, J., Wei, F., Wishart, J., Wu, Z., Xiao, H., Yalaki, Y., & Zhou, Q. (2019). An international collaborative investigation of beginning seventh grade students' Understandings of scientific inquiry: Establishing a baseline. *Journal of Research in Science Teaching*, *56*(4), 486–515. https://doi.org/10.1002/tea.21512
MEB. (2013). *Okul öncesi eğitim programı*. T.C. Milli Eğitim Bakanlığı, Temel Eğitim Genel Müdürlüğü.
MEB. (2018). *Fen bilimleri Dersi Öğretim Programı*. T.C. Milli Eğitim Bakanlığı.
MEB. (2024). *Okul Öncesi Eğitim Programı*. T.C. Milli Eğitim Bakanlığı.
MEB. (2023). *2023 Eğitim Vizyonu* T.C. Milli Eğitim Bakanlığ&#305.
Medicine, I., & Council, N. R. (2015). *Transforming the workforce for children birth through age 8: A unifying foundation*. National Academies. https://doi.org/10.17226/19401
Merriam, S. B. (2014). *Qualitative research: A guide to design and implementation*. Wiley.
Mesci, G., & Erdas Kartal, E. (2021). Science teachers' views on nature of scientific inquiry [Fen bilimleri Öğretmenlerinin bilimsel Sorgulamanın Doğası Görüşleri]. *Bartın University Journal of Faculty of Education*, *10*(1), 69–84. https://doi.org/10.14686/buefad.797246
Mesci, G., Çavuş-Güngören, S., & Yesildag-Hasancebi, F. (2020). Investigating the development of preservice science teachers' NOSI views and related teaching practices. *International Journal of Science Education*, *42*(1), 50–69. https://doi.org/10.1080/09500693.2019.1700316
Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. SAGE.
Olgan, R. (2008). *A longitudinal analysis of science teaching and learning in kindergarten and first-grade* The Florida State University]. ABD.
Olgan, R. (2015). Influences on Turkish early childhood teachers' science teaching practices and the science content covered in the early years. *Early Child Development and Care*, *185*(6), 926–942. https://doi.org/10.1080/03004430.2014.967689
Özbek, S., & Sığırtmaç, A. (2011). Okulöncesi Öğretmenlerinin Fen Eğitimine Ilişkin Görüşleri ve Uygulamalarinin incelenmesi. *Education Sciences*, *6*(1), 1039–1056.
Parlakyıldız, B., & Aydın, F. (2004). *July). Okulöncesi dönem Fen eğitiminde Fen ve doğa köşesinin kullanımına yönelik Bir inceleme XIII*. Ulusal Eğitim Bilimleri Kurultayı.

Pramling Samuelsson, I., & Kaga, Y. (2008). *The Contribution of early childhood education to a sustainable society* https://unesdoc.unesco.org/notice?id=p::usmarcdef_0000159355
Roehrig, G. H.,and, & Luft, J. A. (2004). RESEARCH REPORT. *International Journal of Science Education*, *26*(1), 3–24. https://doi.org/10.1080/0950069022000070261
Roehrig, G., Dubosarsky, M., Mason, A., Carlson, S., & Murphy, B. (2011). We look More, listen More, notice more: Impact of sustained professional development on head start teachers' Inquiry-Based and Culturally-Relevant science teaching practices. *Journal of Science Education and Technology*, *20*(5), 566–578. https://doi.org/10.1007/s10956-011-9295-2
Sackes, M., Akman, B., & Trundle, K. (2012). Okulöncesi Öğretmenlerine Yönelik Fen Eğitimi dersi: Lisans Düzeyindeki Öğretmen Eğitimi için Bir model Önerisi. *Necatibey Eğitim Fakültesi Elektronik Fen Ve Matematik Eğitimi Dergisi*, *6*(2), 1–26.
Saçkes, M. (2014). How often do early childhood teachers teach science concepts? Determinants of the frequency of science teaching in kindergarten. *European Early Childhood Education Research Journal*, *22*(2), 169–184. https://doi.org/10.1080/1350293X.2012.704305
Saçkes, M., Trundle, K. C., Bell, R. L., & O'Connell, A. A. (2011). The influence of early science experience in kindergarten on children's immediate and later science achievement: Evidence from the early childhood longitudinal study. *Journal of Research in Science Teaching*, *48*(2), 217–235. https://doi.org/10.1002/tea.20395
Schwartz, R. S., Lederman, N. G., & Crawford, B. A. (2004). Developing views of nature of science in an authentic context: An explicit approach to bridging the gap between nature of science and scientific inquiry. *Science Education*, *88*(4), 610–645. https://doi.org/10.1002/sce.10128
Schwartz, R., Lederman, N., & Lederman, J. (2008). *An instrument to assess views of scientific inquiry*. The VOSI Questionnaire.
Senemoğlu, N. (2023). *Gelişim öğrenme ve öğretim: Kuramdan Uygulamaya*. Anı Yayıncılık.
Şenler, B. (2017). Fen bilgisi öğretmen adaylarının Fen öğretimine yönelik öz-yeterlik inançları Ile bilimsel Sorgulamaya ilişkin görüşlerinin incelenmesi. *Eğitim Kuram Ve Uygulama Araştırmaları Dergisi*, *3*(2), 50–59.
Uğraş, H., Uğraş, M., & Çil, E. (2013). Okulöncesi Öğretmenlerinin Fen Eğitimine Karşı Tutumlarının ve Fen Etkinliklerine İlişkin yeterliliklerinin incelenmesi. *Bitlis Eren Üniversitesi Fen Bilimleri Dergisi*, *2*(1), 44–50.
Ünal, M., & Akman, B. (2006). Okul Öncesi Öğretmenlerinin Fen Eğitimine Karşı Gösterdikleri tutumlar. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *30*(30), 251–257.
Vural, D., & Kılıç Mocan, D. (2022). Fen Etkinliklerinin Okul öncesi dönem çocuklarında çevre Bilinci kazandırılmasına Etkisi. *Erken Çocukluk Çalışmaları Dergisi*, *6*, 402–423. https://doi.org/10.24130/eccdjecs.1967202262331
Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde Nitel araştırma yöntemleri*. Seçkin Yayıncılık.
Yıldız, E. (2022). Okul Öncesi Öğretmenlerinin Okul Dışı Öğrenme Ortamlarını Kullanma Durumlarının Değerlendirilmesi. *Bayburt Eğitim Fakültesi Dergisi*, *17*(33), 94–127. https://doi.org/10.35675/befdergi.826566
Yılmaz, M. M. (2021). *Okul öncesi öğretmenlerinin bilim eğitimine özgü pedagojik Alan Bilgileri Ile çocukların Kavram ve beceri düzeyleri arasındaki ilişki: Bir aracılık modeli çalışması*. Çukurova Üniversitesi]. Adana.
Yus, A. (2017). 2017/09). The Ability Of Teachers To Organize Science Learning For Early Childhood. Proceedings of the 9th International Conference for Science Educators and Teachers (ICSET 2017).
Zion, M., & Mendelovici, R. (2012). Moving from structured to open inquiry: Challenges and limits. *Science Education International*, *23*(4), 383–399.