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| Research Article / Araştırma Makalesi |

Investigation of the Conceptual Knowledge of Preschool Teacher Candidates on Science Education

Okul Öncesi Öğretmen Adaylarının Fen Eğitimine Yönelik Kavramsal Bilgilerinin İncelenmesi

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Keywords

1. Preschool
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Abstract

Purpose: This study aims to investigate the conceptual knowledge of preschool teacher candidates toward science education.

Design/Methodology/Approach: Thirty-eight junior teacher candidates at a state university in the Black Sea Region of Turkey participated in the research. The study is a qualitative type of research, and Interviews and activity plans were used for data collection. The content analysis method was applied in the analysis of the data. After the responses of the teacher candidates were noted, they were coded and divided into categories. Then, themes were created according to these categories and the findings were interpreted under these theme headings.

Findings: The research findings revealed that preschool teacher candidates lack adequate conceptual knowledge toward science education, especially in using science process skills, determining the role of preschool teacher in science education.

Highlights: The education given in preschool teacher education undergraduate programs should not remain only at the theoretical level, teacher candidates should be allowed to practice in the preschool science education course, and it is believed that each teacher should be given information about current and different methods to use in their professional lives, and encouraged to use them in their teaching profession.

Öz

Çalışmanın amacı: Bu araştırmada, okul öncesi öğretmen adaylarının fen eğitimine yönelik kavramsal bilgilerinin incelenmesi amaçlanmıştır.

Materyal ve Yöntem: Araştırmaya, Türkiye'nin Karadeniz Bölgesi'nde bulunan bir devlet üniversitesinde 3.sınıfa devam eden 38 öğretmen adayı katılmıştır. Araştırma nitel bir araştırma olup, görüşme ve etkinlik planları veri toplama aracı kullanılmıştır. Verilerin analizinde içerik analiz yöntemi uygulanmıştır. Öğretmen adaylarının cevapları not edildikten sonra kodlanarak kategorilere ayrılmıştır. Daha sonra bu kategorilere göre temalar oluşturulmuş ve bu tema başlıkları altında bulgular yorumlanmıştır.

Bulgular: Okul öncesi öğretmen adaylarının özellikle bilimsel süreç becerilerini kullanmada ve fen eğitiminde okul öncesi öğretmenin rolünü ortaya koymada yeterli kavramsal bilgiye sahip olmadıkları görülmüştür.

Önemli Vurgular: Okul öncesi öğretmenliği lisans programlarında verilen eğitim yalnızca teorik düzeyde kalmamalı, okul öncesinde fen eğitimi dersinde öğretmen adaylarına uygulama yapma imkanları verilmeli, her öğretmene meslek yaşantılarında kullanabilmeleri için güncel ve farklı metotlar hakkında bilgiler verilerek, öğretim süreçlerinde kullanmalarının teşvik edilmesi önerilmektedir.

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INTRODUCTION

Science education can be considered the common area of interaction between human, science, and technology elements (Andaç, 2003). In general terms, it is possible to define science education as reflecting the ability to observe and think about actions and events (Alisinanoğlu et al.,2011). Science offers us opportunities to explore the world and understand the events that take place in nature. Starting from early childhood, children can explore the environment and gain experience through research, asking questions, thinking, observing, communicating, making inferences, and guesses, and experimenting in science activities. Children who have the desire to explore and develop a positive attitude toward science, and children who have a sense of discovery, and curiosity are motivated to learn more when they are offered an enriched environment (Arı & Çelebi-Öncü, 2005).

Thanks to their natural curiosity, children's efforts to recognize what is happening around them and to make sense of the world from the moment they are born constitute the first science experiences of their lives (Aktaş-Arnas et al., 2014). These experiences and achievements that children will acquire at an early age have the power to influence their later learning life as well as to direct their social and emotional life (Kesicioğlu, 2019). In this context, in early childhood, which is an important part of the education process, it is quite important to provide children with a love of science, successful experiences, and positive feelings about science activities for guiding the individual's experiences with science in later life and for the benefit of the society in general.

Science activities are important for children in terms of facilitating daily life and improving the existing skills of individuals (Nacar & Kutluca, 2020). These activities provide observation, communication, prediction, and inference, which form cognitive process skills. While learning, children can also transfer what they have learned to another topic, they carefully observe, guess, ask questions, explore, and interact with friends and teachers (Sak et al., 2018). Through interactions, teachers play a key role in the development of scientific thinking in children and, in their later years, in their positive attitude toward science (Thulin & Redfors, 2017). If children are not adequately supported by their teachers when they are new to science-related activities and have negative experiences, they will mostly avoid science-related activities for the rest of their lives and will prefer to stay away.

Science education in the preschool period should not be in the form of transferring basic information about science, but in a way that satisfies the child's curiosity and directs the child to explore and research. The task of the preschool teacher is not limited to planning and implementing science activities and providing the necessary materials on the subject (Simsar & Doğan, 2019). The teacher's task is not only to convey information to children but also to encourage them to research, to organize the learning environment in a way that supports children's development, to help them establish cause-and-effect relationships, and to guide them to make inferences from experiences by contributing to the development of basic science process skills (Bilaloğlu, 2014; Saçkes et al., 2011). In this process, for teachers to guide children correctly, they should know the importance and purpose of science education in the preschool period, they should have adequate knowledge about the methods and techniques that will make learning more effective and remarkable to ensure active participation of children in science activities, and they should try to improve children's skills in science through various methods and techniques (Demir & Şahin, 2015). Teachers should give importance to children's knowledge acquisition through observing and making sense of the events around them and encourage this natural sense of curiosity in children. In this context, it will be a good role model for children if teachers keep their sense of curiosity alive and effective (Ünal & Akman, 2006). The level of knowledge of teachers about science education, their opinions, attitudes, proficiency levels, and whether there are any disadvantages experienced in the previous learning process are very important in terms of science education. A teacher is expected to have information about the education to be given, to improve himself/herself by the following science, to give importance to new and alternative ideas, and to provide the foundation of science teaching to children (Nacar & Kutluca, 2020). Preschool teachers, who are the first teachers that have a lasting impact on children's lives, need to know about the learning and development of children, knowledge of the field and the objectives of the program, and teaching knowledge (Darling-Hammond & Baratz-Snowden, 2005). Therefore, the conceptual knowledge of preschool teachers about science education is important in terms of effective science teaching.

Teachers, together with information resources and curriculum, are among the most important factors affecting the success of students in the teaching process. In this context, how the teacher will use the information he/she has is very important for the healthy execution of the process. Teachers should have many competencies, such as correctly diagnosing and meeting student needs, providing problem-solving skills to their students as well as solving problems themselves, and ensuring that the objectives set in the curriculum are achieved by students to realize these factors that significantly affect the teaching process (Seferoğlu, 2004; Karacaoğlu, 2008). The competencies that teachers should have for science education to be given in the preschool period are listed as follows; (1) To understand the nature of scientific research and to know how to use scientific research processes and skills, (2) To understand the basic concepts and facts in the field of science, (3) To be able to establish a relationship between the concepts in mathematics, technology, and other fields as well as the conceptual relationship between science disciplines (physics, chemistry, biology), (4) To be able to use scientific research and skills in the approach to personal and social problems (Martin, 2001). Not having adequate conceptual knowledge in terms of science education or having various misconceptions about this field may cause teachers to transfer their misconceptions to children, or fail to notice the misconceptions in children or reinforce these misconceptions (Saçkes et al., 2012, Şenel & Aslan, 2014).

Concept is defined as a set of meanings which include similarities, differences and relationship concerning things observed (Koniceck-Moran & Keeley, 2015). Construction of a concept in human mind is associated with conceptual understanding. Koniceck-Moran and Keeley (2015) asserted that conceptual understanding provides people with thinking with the concept, using it in real life situations, describing it with their own words. In this study, conceptual understanding of preschool teacher candidates on science education which means what they know about teaching science was examined. One of the conceptual knowledge that preschool teacher candidates should have for science education is scientific processes skills which is defined as abilities that reflect how scientists think and act (Padilla, 1990). Studies on scientific process skills have especially emphasized that children should be introduced to these skills in the preschool period, raise their awareness of science, and learn to use scientific process skills effectively in their later life (Ayvacı, 2010). Especially in the studies carried out during the preschool period (Ayvacı et al., 2002; Akman et al., 2003; Karamustafaoğlu & Kandaz, 2006; Adak, 2006; Uysal, 2007; Kıldan & Pektaş 2009; Özbey & Alisinanoğlu, 2009; Özbek, 2009; Öztürk, 2010; Sansar, 2010; Ayvacı, 2010; İnan, 2011; Kandemir, 2011), the teacher factor is at the forefront in the acquisition of scientific process skills. The results of these studies also show that teachers who will provide scientific process skills to students should know "what" to provide "how" to provide scientific process skills to children, that is, they should have conceptual knowledge about the acquisition of scientific process skills (Özbey & Alisinanoğlu, 2009, 2010; İnan, 2010,2011; Kefi et al., 2013; Kefi & Çeliköz, 2014).

Considering the literature about the nature of science, it is seen that there are many studies with students, teacher candidates, and teachers. It is seen that some of these studies are conducted to reveal the views of teachers and teacher candidates about the nature of science, some of them are made to improve these views, and some of them are made to investigate the applications of these views in the classroom.

When the studies on teacher candidates were examined, it was seen that the opinions of teacher candidates were not at a sufficient level and they had various misconceptions (Abd-El-Khalick et al.,1998; Abd-El-Khalick & Akerson, 2004; Köseoğlu et al., 2010; Karaman, 2018; Korkmaz, 2018, Zhang et al., 2021). In their studies with preschool teacher candidates, Erdas-Kartal and Ada (2018) aimed to reveal the current understanding of teacher candidates about the nature of science. As a result of this study, it was realized that the majority of preschool teacher candidates have insufficient knowledge about the nature of science and various misconceptions. Türk, Yıldırım, Bolat, and İskeleli (2018) also investigated whether there was a difference in the views of preschool teacher candidates on the nature of science according to their grade levels. Freshman, sophomore, junior, and senior teacher candidates in the preschool teaching department participated in the research. According to the study results, it was found that there was no significant difference between the opinions of the teacher candidates about the nature of science and that their opinions were similar.

While there are studies in the science education conceptual knowledge literature that address the conceptual information of science teacher candidates from different angles, there is a limited number of studies on teacher conceptual knowledge in the science education process in the preschool context. In addition to being a gap that needs to be filled in the literature, the main purpose of this study is to evaluate the conceptual knowledge competence of preschool teacher candidates for science education. For this purpose, the following sub-problems were investigated:

- What is the status of the conceptual knowledge of preschool teacher candidates concerning science education?

METHOD/MATERIALS

Research Design

In this study, phenomenological research design, which is one of the qualitative research methods, was used. The phenomenological research design aims to reveal the experiences, perceptions, and meanings that individuals attach to a phenomenon (Fraenkel et al., (2011). The phenomenon to be investigated here is determined as the science education field knowledge. Qualitative studies adopt qualitative data collection techniques such as observation, interviewing, and document analysis, and follow a qualitative process to reveal existing events and phenomena realistically and holistically in their natural environment without any intervention (Yıldırım & Şimşek, 2021). Interviews were carried out with preschool teacher candidates. After the interview, the teacher candidates were asked to design an activity plan with five of the scientific process skills and the dimensions of the nature of science. Activity plans designed by teacher candidates were examined.

Study Group

In the study, teacher candidates who can be reached by the researcher with an easily accessible sampling method were included in the study group. Easily accessible, convenient sampling relies on entirely available, quick, and easy-to-access items (Baltacı, 2018). The study group consists of 38 junior (34 females, 4 males) preschool teacher candidates, studying at a state university located in the Black Sea Region of Turkey.

Data Collection

The study data were collected by interview and activity plans. An interview allows the interviewees to express themselves first-hand and allows the researcher to understand their sense of meaning, perspectives, feelings, thoughts, and experiences of the interviewees with the help of their expressions (McCracken, 1988). As the data collection tool, a semi-structured interview form prepared by the researcher in line with the literature and purpose of the research was used. The interview form consists of 5 items to determine the knowledge of teacher candidates about science education. The interview form includes items about the importance of science education, the dimensions of the nature of science, scientific process skills, misconceptions, and methods and techniques used in science education. These questions are determined according to the textbooks of preschool teacher candidates (e.g. Alisinanoğlu et al., 2011; Ayvacı & Ünal, 2021). These textbooks generally include the headlines that the preschool teacher candidates should learn to teach science in the future. Therefore, there is a variety of questions regarding different areas. In the application part, individual interviews were made with teacher candidates and the data were recorded by taking notes. At the end of the interviews with the teacher candidates, they were asked to design an activity plan by using scientific process skills and the nature of science. These activity plans were used as another data source for the research. In addition to interview questions, the researchers asked the preschool teacher candidates to prepare one activity plan related to science education by using scientific process skills. Before the preparation, the researchers tried to help them write lesson plan by answering their questions and showing the format of activity plan which includes some headlines such as objectives, materials, learning process, evaluation.

Data Analysis

In the analysis of the data, the interview records and lesson plans were analyzed by content analysis. Content analysis is "the objective and systematic classification of the message contained in verbal, written, and other materials in terms of meaning and/or grammar, transforming it into numbers and making inferences" (Tavşancıl & Aslan, 2001). After the responses were noted, they were coded and divided into categories. Then, themes were created according to these categories and the findings were interpreted under these theme headings. In the interpretation of the findings, it was tried to provide validity by including direct quotations from the opinions of the teacher candidates. Expert opinion was taken in developing the interview form to ensure the validity of the study. Collaboration was made with an assistant researcher who specialized in the subject area and qualitative analysis of the research. Ten percent of the data obtained in the study were analyzed by this researcher. A consistency of 80% was found between the analysis results of the researchers. In addition, the categories that the researchers created differently were compared. In the comparisons, the reliability of the research was calculated using the formula of Miles and Huberman (1994) (Reliability = consensus / (consensus + disagreement) × 100) by determining the number of "consensuses" and "disagreements". The fact that a consensus of 96% was reached in this study is considered sufficient in terms of the reliability of the study.

FINDINGS

The qualitative findings obtained as a result of determining the knowledge of preschool teacher candidates about science education were evaluated and analyzed based on the questions asked. The findings obtained through the thoughts and opinions of the teacher candidates are presented below in the tables. Responses of the teacher candidates to the question "Why is science education important in preschool?" are shown in Table 1. When we look at Table 1, the majority of the teacher candidates (f=18) believe that science education is important since it improves children's curiosity and exploration feelings. For example, the statement of the TC13 regarding the question is as follows: "Children have a curiosity about the environment and want to explore their environment. That's why science education should be provided."

Table 1. The Importance of Science Education for Preschool Teacher Candidates

The Importance of Science Education	*f*
Developing feelings of curiosity, and discovery	18
Providing transfer of knowledge to everyday life	14
Developing a positive attitude toward the science	13
Preparation for primary school	11
Improving language skills	9
Achieving development potential	9
Improving creativity	7
Enabling them to learn by experimenting and doing	7
Improving mathematical skills	3
Finding a solution to the language problem	3
Ensuring scientific literacy readiness	3
Providing embodying	2

In addition, it is understood that they also mention the importance of science education, transferring to daily life, developing a positive attitude toward science, and preparing for primary school. There are also opinions that science education is important in terms of improving language skills and reaching the potential for development. Stating that science education is important since it provides solutions to the language problem, TC5 stated the following: "Science education is important for children with language problems. Communication during science education will be important to solve the problem." Teacher candidates also expressed the importance of science education in terms of providing learning opportunities by living, doing, and developing creativity.

However, very few teacher candidates emphasized the importance of science education since it embodies abstract concepts (*f*=2), and solves the language problem in the science education process (*f*=3).

Responses to the question "What is the role of the preschool teacher in science education?" are presented in Table 2. It is seen that teacher candidates address mostly the roles of a preschool teacher in providing the necessary environment and material (*f*=14), guidance (*f*=13), and enabling the child in the process (*f*=12). In addition, it is understood that they include roles of not causing misconceptions, directing, supporting, and encouraging. In this regard, the statement of the TC5 is as follows: "The teacher should assume a guiding role, this should be done unemphatically. A teacher should enable children to find by experimenting, allowing them to explore, and guiding them by asking questions. A teacher should encourage children by asking why not, and let's try."

Table 2. The Role of Preschool Teacher in Science Education for Preschool Teacher Candidates

The Role of Preschool Teacher	*f*
Providing the necessary environment and material	14
Guidance	13
Active engagement of children in the process	12
Avoiding misconceptions	9
Directing, supporting, encouraging	8
Keeping children's curiosity active and attracting their interest	6
Knowing the level of development, knowing the developmental characteristics	6
Popularizing science, developing a positive attitude toward science	4
Teaching scientific process skills	4
Triggering the desire to explore, and discover	4
Improving creativity	4
Supporting their questioning, revealing knowledge by asking questions	3
Teaching a subject that is well-known by the teacher, teaching after having a good command of the subject.	2
Providing means for observation	2
Using a variety of teaching methods and techniques	2

Expressions that emphasize drawing the attention of children by placing importance on their curiosity, and knowing the development levels and developmental characteristics of children are also noteworthy. In addition, it is seen that teacher candidates equally address the roles of popularizing science, developing a positive attitude towards science (*f*=4), triggering their desire to explore/discover (*f*=4), developing their creativity (*f*=4), and providing scientific process skills (*f*=4). Apart from these, teacher candidates stated that the preschool teacher has roles such as being a role model in science education, creating a science-related infrastructure, providing a discussion environment with the help of experiments, encouraging a sense of curiosity, self-development by following the science, and ensuring the development of science-related skills by using different method techniques. Supporting the teacher's role of self-development, the TC12 states as follows: "A teacher should teach what he or she knows well. If a teacher does not have a good level of knowledge, the teacher should first improve himself/herself and then do activities with children." TC7, however, addressed the role of providing a collaborative learning environment. "A teacher should create a collaborative learning environment through group work. A teacher should enable children to think together and put forward a common product."

The responses of teacher candidates to the question "What are the dimensions of the nature of science? Explain briefly. By discussing approaches to teaching the nature of science, which is more appropriate for use in the preschool period?" are given in Table 3 and Table 4.

Table 3. Teacher Candidates' Knowledge of the Dimensions of the Nature of Science

Dimensions of the Nature of Science	*f*
Scientific knowledge is subjective/theory-laden.	34
Scientific knowledge is experimental.	30
It depends in part on imagination and creativity.	30
Scientific knowledge is not conclusive.	29
Scientific knowledge consists of a combination of observations and inferences.	26
Scientific knowledge is socially and culturally established.	24
There is a difference between scientific law and theory.	24

While it was seen that 16 of the teacher candidates knew all the dimensions of the nature of science, it was determined that 11 of the same teacher candidates did not know the teaching approaches for the nature of science teaching. It is seen that some teacher candidates know the name of the approaches incorrectly or do not know one or more of the approaches. For example, the TC20 expressed the nature of science as "it explains to us what science is, how science is, and to who is called a scientist, and what their role is." The approaches to teaching the nature of science were divided into 3 types: natural, direct, and historical.

When the dimensions of the nature of science are known in individual answers, it is seen that 34 of the teacher candidates know the dimension of "scientific knowledge is subjective/theory-laden". The most well-known dimension of the nature of science is the "scientific knowledge is subjective/theory-laden" dimension, while the least known dimensions are "scientific knowledge is socially and culturally established" and "there is a difference between scientific law and theory".

Very few teacher candidates included the dimensions of "scientific knowledge contains a combination of observations and inferences", and "scientific knowledge is experimental" in the same item (*f*=2). While 22 teacher candidates explained the dimensions of the nature of science, 8 teacher candidates failed to explain the dimensions. It was determined that teacher candidates generally know the dimensions of the nature of science, but did not address the teaching approaches and evaluated the dimensions of the nature of science according to the suitability for use in the preschool period.

It was determined that very few teacher candidates responded to the question incorrectly and had a misconception about the subject (*f*=2). TC4 has addressed the dimensions of the nature of science as the "physical dimension, the cognitive dimension, the space dimension". The TC13 divided the dimensions of the nature of science into basic process skills and integrated process skills. It is understood that this teacher candidate confuses scientific process skills with the dimensions of the nature of science.

Table 4. Teacher Candidates' Knowledge about the Approaches to Teaching the Nature of Science

Approaches	*f*
Direct	13
Historical	13
Indirect	12
Multiple Unified Approach	9

While 11 of the teacher candidates knew all the approaches to teach the nature of science, it was determined that one candidate did not know the multiple unified approach. Another teacher candidate, however, knows only the direct and historical approach. It is seen that the three teacher candidates call the multiple unified approach integrated, holistic, or multi-dimensional. It was determined that these teacher candidates knew that there were four approaches, but they confused the name of one of them.

Five of the teacher candidates believe that it is appropriate to use the indirect approach, one multiple unified, and three of them believe that it is appropriate to use the indirect and historical approaches in the preschool period. Considering the use of the indirect approach in the preschool period, TC11 states that "Mostly the indirect approach should be used in the preschool period. This is because, the aim is to enable the child to explore and question, without memorized information." TC26, however, stated that "The indirect approach should be used in the preschool period. It is more effective since the child will actively access information and see it by experimenting.

If we examine the responses of the teacher candidates who consider it appropriate to use the multiple unified approach in the preschool period, TC18 states, "In my opinion, the multiple unified approach in the preschool period is the most appropriate. This is because the combination of multiple approaches completes the lack of a single approach.", he responded. It was determined that one of the teacher candidates wanted to express the multiple unified approach, called the holistic approach.

Of the teacher candidates who consider it appropriate to use indirect and historical approaches at the same time, TC7 stated that "Indirect and historical approaches can be used. This is because the nature of science can be given by the indirect approach, children can observe how an invention is made and what are the processes in the course of an invention with the help of the historical approach."

Table 5. Teacher Candidates' Use of Scientific Process Skills in the Activity Planning

Scientific Process Skills	*f*
Observation	28
Inference	23
Communication	17
Classification	12
Experimenting	12
Prediction	10
Measurement	8
Hypothesizing and testing	3
Comparison	1
Definition and control of the variables	-

The responses of the teacher candidates to the statement "Write an activity plan using the scientific process skills and the dimensions of the nature of science" are presented in Table 5. Teacher candidates used mostly the observation skills in the activity plan, and minimally the comparison skills in the activity plan. Very few teacher candidates used hypothesizing/testing (*f*=3) and comparison (*f*=1) skills in the activity plan. Advanced scientific process skills, such as the ability to identify and control the variables, were not addressed well. Some of the teacher candidates included problem-solving (*f*=1), problem setting (*f*=1), interpreting the data (*f*=2), and collecting the data (*f*=1) skills in the activity plan. Referring to the problem-solving skills in the activity plan, TC11 stated: "The teacher tells stories. At the end of the story, the teacher asks 'they wanted to cross the stream in the picnic area, but how can they pass, let's help Ayşe and her friends together? How can we help them? ..." Referring to the ability to interpret the data, TC4 said, "After the experiment, the teacher proceeds to the evaluation. A teacher should ask what they did today and what they learned, what they thought of what they learned.", she noted. Referring to the problem-setting skills, TC25 stated: "Teacher wants to help children to identify the problem by asking 'in your opinion what problems arise if our water becomes dirty?'"

Table 6. Teacher Candidates' Correct Use of Scientific Process Skills

Scientific Process Skills	*f*
Observation	23
Inference	19
Communication	14
Classification	12
Experimenting	10
Prediction	8
Measurement	7
Hypothesizing and testing	3
Comparison	1
Definition and control of the variables	-

Teacher candidates often used basic, intermediate, and advanced process skills together in their activity plans. When Table 5 and Table 6 were compared, it was found that the teacher candidates correctly explained comparison, classification, and hypothesizing skills. It is seen that they cannot use observation (*f*=5), inference (*f*=4), communication (*f*=3), estimation (*f*=2), experimentation (*f*=2), and measurement (*f*=1) skills correctly in the activity plan. Some students seem to confuse the predictive skill and inference skills. In the activity plan, TC9 said, "The teacher first goes out to the garden with the children and talks about the weather. He/she then asks how the rain is formed." The candidate named this statement as a prediction. On the other hand, it is observed that he uses his inference skill since it is a question of how rain is formed. This suggests that TC9 confuses predictive skills and inference skills.

When communication in scientific process skills is considered a skill in which students share their knowledge, and produce feedback to each other, that is, establish scientific communication, it is understood that teacher candidates perceive communication skills as "creating a conversation environment with the questions directed by the teacher to the children". For example, TC8 stated, "Teacher creates a conversation environment by asking questions, such as 'Why are our teeth important to us? Do you brush your teeth? What foods are unhealthy for our teeth? ..." The candidate named this statement as communicating.

It is seen that teacher candidates also explain the prediction skill incorrectly. In their statements, teacher candidates did not mention the situations that children could predict by establishing cause-and-effect relations. It was determined that teacher candidates explained the predictive skills in the sense of reaching conclusions by using random information about something unknown. For example, TC11 denoted the sentence "The teacher asked the children how the car with a magnet glued to the top is on the moon now, which was first on the ground in the world..." sentence as a prediction. This shows that some teacher candidates are mistaken in this regard.

Table 7. Teacher Candidates' Knowledge about the Steps in Eliminating Misconceptions

Steps	*f*
Those Who Know the 1st Step	38
Those Who Know the 1st and 2nd Steps	32
Those Who Know the 1st, 2nd, and 3rd Steps	32
Those Who Know the 1st and 3rd Steps	6

Responses of the teacher candidates to the question "What is a misconception? What should be done to eliminate misconceptions?" are presented in Table 7. Thirty-one of the teacher candidates responded with an explanation of the misconception and 30 people responded with the way to eliminate the misconceptions correctly. Some made an explanation of the misconception incomplete (*f*=3) and those who could not answer the question (*f*=4). Three steps should be followed in eliminating misconceptions. The first is to identify children's preconceptions or misconceptions, the second is to provide a suitable environment for children to become aware of their preconceptions or misconceptions, and the third is to help children restructure and internalize their knowledge based on scientific models. All the teacher candidates knew the first and third of these steps. However, one teacher candidate misrepresented the second step and one teacher candidate misrepresented all three steps. Six teacher candidates knew the first and last steps but did not specify the second step.

Responses of the teacher candidates to the question "What are the methods or techniques used in science education in the preschool period? Specify these methods together with the implementation stages." are presented in Table 8. Teacher candidates stated the methods or techniques used in science education as analogy, argumentation, drama, experimentation, problem-solving, project-based learning, concept maps/cartoons, and STEM studies. Of the methods and techniques, the most known is the analogy and the least known is the problem-solving technique. Many of the teacher candidates expressed the analogy technique in the form of explaining abstract concepts by comparing them to concrete concepts and explaining an unknown phenomenon with a known fact. It was seen that the teacher candidates were adequate in explaining the analogy technique and that they were inadequate in the application stages and points to be considered. For example, TC1 states, "A concept from simpler everyday life is used to describe a concept. It has 3 dimensions: simple, story-oriented, and play." The question was considered as correctly answered when the explanation of the analogy technique was made when the types and the points to be considered while applying the technique were mentioned. It was also seen that teacher candidates make wrong and incomplete explanations about the analogy technique. The TC16 explained the analogy technique as follows: "A discussion is formed by using hypotheses for the ideas defended on a particular topic." If the technique of analogy is defined as explaining an unknown phenomenon by comparing it to a familiar phenomenon, it can be stated that TC16's explanation of the technique is wrong.

Table 8. Teacher Candidates' Knowledge of the Methods or Techniques Used in Science Education

Method or Technique	*f*
Analogy	36
Argumentation	35
Drama	35
Experimenting	35
Concept Map and Cartoons	35
Project Based Learning	34
STEM	34
Problem Solving	32

While 23 teacher candidates mentioned the methods given in the table in their responses, nine teacher candidates failed to mention only one method, four teacher candidates failed to mention two methods, and one teacher candidate failed to mention three methods. Teacher candidates never mentioned observation, field trips, and brainstorming methods, which are one of the methods used in preschool science education. It was found that some of the teacher candidates did not mention the problem-solving method (*f*=5), project-based learning approach and STEM studies (*f*=3), concept maps/cartoons, experimentation, drama and argumentation methods/techniques (*f*=2), and analogy technique (*f*=1).

It was seen that teacher candidates mostly made the explanation of drama technique and project-based learning approach inadequate. While explaining the drama technique, the teacher candidates addressed the term animation, creativity, improvisation, and role-playing. It is seen that they know that there are 3 stages of application of the drama technique, but they do not know the contents of the stages. TC8 stated, "In the drama method, there is learning without any stereotyping for the children. There are stages of warm-up, foundation, and evaluation. The important point here is to enable the child to learn by having fun using imagination and creativity." When the statement of the teacher candidate is examined, it is understood that he/she knows the stages but does not know what to do within the stages.

While explaining the project-based learning approach, the teacher candidates mentioned that it is a method that includes discovery, research, and in-depth examination, which leads to a product as a result. It was found that some teacher candidates name the stages differently when it is known that planning, implementation, and finalizing the project are the implementation stages of the project-based learning approach. It is seen that the TC10 lists the stages as "Determination of the project subject, calculating the schedule and cost, collecting information, choosing the method, application, writing the report". TC18 said, "A project needs to emerge to solve the identified problem. He explained the stages as "to make observations, to classify, to communicate, to measure, to evaluate for finding solutions."

DISCUSSION

This study aims to reveal the conceptual knowledge levels of preschool teacher candidates toward science education. According to the studies examined, there were not many studies on conceptual knowledge in the preschool period, and there were no available findings regarding the conceptual knowledge of teachers about science education in the preschool period. For this reason, to reveal the conceptual knowledge of the teacher candidates, their interactions with each other, and the relationships between them, the participants' activity plans and conceptual knowledge interview questions were evaluated together. In the literature, the relationship between these components is revealed to define the quality of conceptual knowledge for science education in the preschool period, which sheds a light on the conceptual information that teacher candidates should have (Lankford & Hepworth, 2010).

Considering the level of familiarity of teacher candidates with scientific process skills, it was found that they were more familiar with basic scientific process skills, but less familiar with high-level scientific processes. In his study, Miles (2010) showed that teacher candidates were highly familiar with basic scientific process skills. Similar results are also found in other studies. In their studies with teacher candidates, Aydoğdu and Buldur (2013), and Laçin-Şimşek (2010) stated that teacher candidates were successful in using basic scientific processes, but this success was lower in high-level scientific skills. This result is in line with the results of the research. In addition, Laçin-Şimşek (2010) determined that some teacher candidates had misconceptions and incomplete information. In this study, it was found that teacher candidates confused the scientific process skills of prediction and inference with each other. In similar studies, Kefi et al.,(2013), Batı et al.,(2010), Karslı et al.,(2009), Aydoğdu (2006), Cho et al., (2003), and Kallery and Psillos (2001) concluded that teachers do not know the names and meanings of some scientific process skills.

The fact that preschool teacher candidates do not know the methods and techniques used in science education such as observation, field trips, and brainstorming techniques indicates the inadequacy of their conceptual knowledge. The inadequacy of these methods leads to the fact that teachers cannot use these methods and techniques in science lessons.

Another important finding obtained in the study is that it was concluded that teacher candidates consider it more appropriate to use historical and indirect approaches in teaching the nature of science, but they emphasize traditional teaching approaches while using these methods. From this point of view, it is understood that there is no relationship between the knowledge of teacher candidates on the nature of science and their conceptual knowledge. This result is in line with the results of many other studies in the literature (Brickhouse, 1990; Mellado 1997; Abd-El-Khalick et al., 1998; Tobin & McRobbie 1997; Lederman 1999).

Harrison and De Jong (2003) believe that children's prior knowledge and concepts of science are beneficial for the teacher in the planning phase of the applications, and argue that this is related to the conceptual knowledge of the teachers that can ensure effective learning. In this context, it is necessary to have adequate knowledge of strategies, methods, and techniques and to determine the strategy, method, and technique specific to the subject area selected during the teaching. It is seen that teacher candidates know the methods/techniques used in science education, analogy, argumentation, drama, experiment, problem-solving, project-based learning, concept map/cartoons, and STEM studies. From this, it was concluded that the knowledge of the participants about the teaching strategies was sufficient.

CONCLUSION AND RECOMMENDATIONS

It is seen that the level of teachers' conceptual knowledge about science education, and therefore their level of knowledge in the subject area is an important factor in terms of science education. This is because teachers having insufficient knowledge can convey misinformation and misconceptions to students. During the undergraduate period, instructors are required to take into account the misconceptions of teacher candidates. If the preliminary concepts and misconceptions of the students are known, the curriculum can be designed more appropriately. In this way, the misconceptions of teacher candidates can be minimized before starting their professional life.

If the concepts of science education, the teaching of scientific process skills, and the nature of science cannot be included in the preschool education undergraduate program, the course hours of the "Science Education in Preschool" course in the current preschool teacher education undergraduate program can be increased, and teaching of scientific process skills and the nature of science can be included into the content of this course.

According to the results obtained, it was seen that teacher candidates did not have adequate conceptual knowledge. The reason for this situation may be that preschool teacher candidates do not process science education courses effectively during their undergraduate education. For this reason, it is considered important to make the necessary arrangements in the content of the "Science Education" course, the methods-techniques, and materials used to ensure that the conceptual knowledge of the teacher candidates for science education is at a high level.

For the conceptual knowledge levels of preschool teacher candidates in science education to reach an adequate level, it may be recommended to use activities that will make them love science and give them a positive attitude throughout their undergraduate education. Instructors who teach science education courses in undergraduate education can help teacher candidates gain a perspective on what kind of activities they should use, especially through activities that embody abstract concepts.

This study is limited to preschool teacher candidates studying at a university in the Black Sea Region. Considering the various socio-economic and cultural structures of Turkey, studies can be carried out with preschool teacher candidates from different regions and universities to generalize the results of the study.

Teacher candidates were studied in this research, but in future studies, similar applications can be carried out with teachers who have just started their profession and with experienced teachers. In this way, a generalization can be made about the state of their conceptual knowledge of science education.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Researchers' contribution rate

The study was conducted and reported with equal collaboration of the researchers.

Ethics Committee Approval Information

Ethical approval for the current study was taken from the Social Sciences & Humanities Ethics Committee at the University of Kastamonu (07/09/2022).

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