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| Research Article / Araştırma Makalesi |

Thematic Review of Studies about Preschool Astronomy Education in Turkey[1]

Türkiye'de Okul Öncesi Astronomi Eğitimine İlişkin Yapılan Çalışmaların Tematik İncelenmesi

Ebru Ezberci Çevik[2], Nagihan Tanik Önal[3]

Keywords

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Abstract

This study aimed to examine thematically the articles and dissertations made in Turkey about preschool astronomy education. In the research, a descriptive study was conducted, and the survey model was used. The study covered researches of preschool astronomy education that can be accessed in the national databases. Studies in analyzing data were; the type of publication, the distribution of the studies according to the years and the indexes in which they are included, the keywords used, the subject/concept of astronomy, the purpose of the studies, and the distribution according to the provinces, the methodologies used in the studies, the basic results achieved in the studies and the suggestions. The studies were first coded separately by researchers, and the reliability of the coding was ensured by forming a common opinion. As a result, most of the studies determined were articles of the year 2015 and above, and these studies are generally published in ULAKBIM indexed journals. Most repetitive keywords in research; preschool, astronomy, and mental model. The concept of astronomy focuses on studies of the Sun, Earth, and Moon. The studies mostly aimed to reveal the students' level of knowledge, misconceptions, and mental models related to basic astronomy concepts. The most preferred research method in the studies was the qualitative paradigm; the most preferred research designs were case studies and survey models. The researches were mostly carried out with the children in preschool age and the provinces of Balıkesir and Trabzon with samples smaller than 100 people. In most of the studies, interviews, drawings, and observations were used as data collection tools, and the content analysis technique was used in the analysis of the data. The general results of the studies showed that the mental models of preschool children about astronomy consist of concrete concepts and the participants lack knowledge on astronomy. In the studies, suggestions were made to researchers and practices.

Öz

Bu çalışmanın amacı, okul öncesinde astronomi eğitimiyle ilgili Türkiye'de yapılan makale ve tezleri tematik olarak incelemektir. Araştırma ulusal veri tabanlarından erişilebilen okul öncesinde astronomiye yönelik çalışmaları kapsamaktadır. Verilerin çözümlenmesinde çalışmalar farklı temalara göre incelenmiştir. Araştırmacılar tarafından çalışmalar öncelikle ayrı ayrı kodlanmış, daha sonra ortak görüş oluşturulmuştur. Sonuçta, incelenen çalışmaların çoğunluğunun 2015 yılı ve sonrasına ait makale çalışmaları olduğu ve bu çalışmaların genellikle ULAKBİM tarafından indekslenen dergilerde yayımlandığı tespit edilmiştir. Araştırmalarda en çok yinelenen anahtar kelimeler; okul öncesi, astronomi ve zihinsel modeldir. Çalışmaların yoğunlaştığı astronomi kavramı/konusu ise Güneş, Dünya ve Ay olmuştur. Yapılan çalışmalar çoğunlukla öğrencilerin temel astronomi kavramlarına ilişkin bilgi düzeylerini, kavram yanılgılarını ve zihinsel modellerini ortaya çıkarmayı hedeflemektedir. Çalışmalarda en fazla tercih edilen araştırma yöntemi nitel paradigma; en fazla tercih edilen araştırma desenleri ise durum çalışması ve tarama modeli olmuştur. Araştırmalar çoğunlukla Balıkesir ve Trabzon illerinde okul öncesi dönemdeki çocuklarla ve 100 kişiden küçük örneklemlerle çalışılarak gerçekleştirilmiştir. Gerçekleştirilen çalışmaların çoğunda veri toplama aracı olarak görüşme, çizim ve gözlemlerden yararlanılmış olup verilerin analizinde en çok içerik analizi tekniğinden yararlanılmıştır. Çalışmaların genel sonuçları okul öncesi dönem çocuklarının astronomi zihinsel modellerinin somut kavramlardan oluştuğunu ve katılımcıların astronomi konusunda bilgi eksikliklerinin olduğunu göstermektedir. Çalışmalarda genellikle araştırmacılara ve uygulamalara yönelik önerilerde bulunulmuştur.

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[2] **Corresponding Author,** Erciyes University, Education Faculty, Science Education Department, Kayseri, TURKEY; https://orcid.org/ 0000-0003-4219-3296

[3] Niğde Ömer Halisdemir University, Education Faculty, Primary Education Department, Niğde, TURKEY; https://orcid.org/ 0000-0002-5926-521X

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INTRODUCTION

Preschool children examine and search everything around them through their innate curiosity, desire for discovery, and interest in their environment. In other words, children in this period begin to do their own science and learn science by acting as a scientist. For this reason, they start to learn many science concepts in the preschool period (Kallery & Psillos, 2001). Students performing science activities at an early age enable them to develop a positive attitude towards science and make it easier for them to understand scientific concepts in the future. The use of a scientific language at an early age accelerates the development of scientific concepts in children. Children understand science concepts and their reasons scientifically. In this way, their scientific thinking skills develop. This point of view clarifies the rationale and importance of science education to be carried out in the preschool period (Eshach & Fried, 2005).

In the preschool period, children begin to see or identify the concepts related to science primarily in their natural environment (at home, street, school, etc.). Among the science concepts that children in this period encounter and curiously search for answers are concepts related to astronomy, such as stars, the Moon, the Sun, clouds, and weather events. Concepts such as astronauts and satellites that children see or hear through communication tools also attract their attention (Türk, 2018). According to Tunca (2000), astronomy can be considered a laboratory of quality and size unreachable on Earth. Therefore, astronomy has a special place among science subjects. Astronomy education supports the development of individuals' correct and logical thinking skills, helps them to love and orient themselves to science, and increases their motivation to learn science by creating interest in them with new discoveries (Trumper, 2006). In addition, astronomy helps students gain conceptual knowledge and better understand other science subjects and contributes to the improvement of their three-dimensional thinking skills (Tunca, 2000; Trumper, 2006). Application studies such as observational astronomy support children's cognitive development, affect their acquisition of scientific thinking skills, and improve their ability to establish cause and effect relationships between events (Vosniadou & Brewer, 1992). On the other hand, both adults and children consider astronomy subjects difficult due to their nature. Moreover, some false beliefs among the public and experiences in formal or informal learning environments may cause misconceptions about astronomy. In this regard, it is recommended to start astronomy education at an early age to prevent misconceptions and create correct mental structures about the subject (Ayvacı et al., 2018; Türk, 2018). Otherwise, misconceptions that occur in the preschool period continue at later ages. (Vosniadou, 1992). For such reasons, Chalufour & Worth (2003) state that children should know astronomy subjects and concepts in the preschool period. However, the extent to which astronomy education is carried out in preschool education institutions in Turkey is a separate topic of discussion. From this perspective, it is important to conduct academic studies on preschool astronomy education to guide the educational policies of Turkey.

National (i.e. Turkish) and international literature on preschool astronomy education includes limited research; yet, it has gained momentum in recent years. For example, the analysis of the full-text papers presented at “The International Astronomical Union” meetings in the 1988-2006 period indicated that the least number of studies on the subject pertained to the preschool and elementary school periods (Bretones & Nego, 2011). Similarly, in Turkey, just a limited number of studies have been conducted on preschool astronomy education, and they all seem to be recent (Aksan & Çelikler, 2017; İzgi Onbaşılı & Siper Kabadayı, 2019; Saçkes & Korkmaz, 2015; Türk, 2018). As a matter of fact, studies conducted on preschool science education in Turkey have not paid much attention to subjects such as astronomy and ecology (Güneş, 2018; Ormancı & Çepni, 2019). The scarcity of studies on preschool astronomy education despite its importance above-mentioned can be considered as a problem. To solve this problem, first of all, it would be appropriate to look at the issue holistically by analyzing the studies done so far. Based on the thematic analysis of the studies on the subject, comprehensive information will be provided to teachers, families, and education policy experts. Examining the studies on preschool astronomy education by associating them with each other will make it easier to follow the literature and enrich the field. In a similar vein, Cohen, Manion, & Morrison (2007) point out that the determination of general research trends through a periodic examination of studies on education will guide new researchers who will work on the same subject. In this context, it can be stated that thematic analysis research can lead to new original studies on the subject, allow researchers to follow current situations in their field, and provide convenience to researchers since many studies on the subject are examined holistically. In this respect, the national literature contains some thematic analysis studies covering studies on preschool education (Çifçi & Ersoy, 2019; Güneş, 2018; Karaca, Uzun & Yaşar, 2019), preschool science education (Ormancı & Çepni, 2019; Özen Uyar & Ormancı, 2016; Özpir Mantaş, 2018; Yılmaz & Altınkurt, 2012) and astronomy education (Ayvacı & Sezer, 2018; Bozdemir, Ezberci Çevik, Altunoğlu, & Kurnaz, 2017; Ezberci Çevik & Kurnaz, 2016; Doğru, Satar, & Çelik, 2019; Kurnaz, Bozdemir, Altunoğlu, & Ezberci Çevik, 2016). However, to the best of our knowledge, there is no research covering studies on preschool astronomy education among these thematic analysis studies. This being the case, there is a need for a thematic analysis of Turkish studies on preschool astronomy education in terms of purpose, methodology (sample, data collection tool, analysis method, etc.), main findings, and so on. Therefore, we believe that the current research will fill this gap in the literature, besides all the benefits of the thematic studies mentioned above. Departing from this, this study aimed to make a thematic analysis of articles and theses on preschool astronomy education published in Turkey. Sub-problems for which answers are sought for this purpose are as follows:

About preschool astronomy education;

1. Which types of published studies have been done?
2. What is the distribution of the studies done by years?
3. What is the distribution of the studies according to the indexes in which they take place?
4. Which keywords are used in the studies?
5. What is the distribution in terms of the astronomy concept/subject dealt with in the studies?
6. What is the distribution of the work done according to the purpose?
7. What is the distribution of the studies according to the provinces?
8. Which methodologies (participants, data collection tools, analysis methods, etc.) were used in the studies?
9. What are the main results obtained from the studies?
10. Which recommendations have been made in the studies?

METHOD

Research Design

A systematic literature search technique was used in this study to examine the thematic articles and theses held in Turkey about preschool astronomy education. This technique is preferred to examine studies conducted on a research subject in a certain period within the framework of certain predetermined criteria (Jesson et al., 2011). Thus, it is recommended to follow a three-stage process of planning, conducting, and reporting the research (Kitchenham, 2004). These stages are introduced below.

Planning Stage

The planning stage of the research includes the steps of determining the need and creating research questions. The present study aimed to determine research trends at the national scale through a systematic analysis of the articles and theses about preschool astronomy education. The study conducted for this purpose has sought answers for the 10 basic sub-problems mentioned above.

Conducting the Research

The stage of conducting the research includes the steps of searching for the documents to be examined, selecting the publications, analyzing the publications, and summarizing the results by reaching a synthesis from the analyses. This research includes studies on preschool astronomy education that can be accessed from the databases of Google Scholar, ULAKBIM, and YOK (The Turkish Council of Higher Education) Thesis Center. These databases were scanned by using the keywords "preschool science," "preschool astronomy," "early childhood science," "early childhood astronomy" for the studies carried out until 2019, without limiting the starting year. The scanning yielded 20 studies on preschool astronomy education.

The data were collected through document analysis. This method refers to the process of collecting existing documents related to the addressed subject and reviewing them based on certain criteria (Yıldırım & Şimşek, 2011). The present study applied document analysis in that the articles and theses on preschool astronomy education were collected and reviewed. In this process, the researchers created an article review form in MS EXCEL within the framework of the research questions to examine the studies on preschool astronomy education. While creating this form, Bacanak, Değirmenci, Karamustafaoğlu, & Karamustafaoğlu (2011), Çalık, Ayas, & Ebenezer (2005), Ünal, Çalık, Ayas, & Coll (2006), Kurnaz and Çalık (2009), Kurnaz & Sağlam-Arslan (2011), İslamoğlu, Ursavaş & Reisoğlu (2015) and Ezberci Çevik, & Kurnaz (2016) matrices were used. To investigate the content validity of the matrix, opinions of two science education experts, one assistant professor in science education and one in preschool education, were taken. The domain experts did not recommend making any changes, stating that the created matrix was suitable for the research.

As a result, using this matrix consisting of different basic elements, all studies were analyzed according to 10 basic themes: type of publication, year of publication, indexing, keywords, the addressed astronomy subject/concept, purpose, the province of implementation, methodology, main results, and recommendations). Thus, general trends, differences, and common points were revealed.

The collected data were prepared for analysis before the analysis step. First of all, the researchers entered and edited the 20 studies in a matrix prepared in the MS EXCEL format. Then, the two researchers subjected the data to content analysis. The researchers were in constant agreement during the coding, and they coded based on a common view. The findings that emerged after the reliability was provided are presented through tables and graphs. The research is reported in the following sections.

Validity and Reliability

•To ensure the validity of the study:

Detailed explanations on data collection and analysis methods were provided.

Analyses stored in the computer environment were preserved for possible confirmation in the future.

•To ensure the reliability of the study:

The results of the data analysis were first given directly without interpretation. This forms a basis for interpretations and explanations to be made later on.

For data analysis, the categories were determined based on the theoretical structure.

To help researchers who will conduct similar studies, the situation focused on and the methods used in the study were presented in detail in the relevant sections.

FINDINGS

Distribution of Studies on Preschool Astronomy Education in According to the Type of Publication

Table 1 presents the studies conducted on preschool astronomy education and the distribution by type of publication.

Table 1. Distribution of the studies examined in the research by publication type

Author(s)	Publication Type
Aksan & Çeliker (2017)	Article
Aydın & Güney (2017)	Article
Ayvacı (2010)	Article
Ayvacı, Bülbül, Özbek, & Ünal (2018)	Article
Baysan & Aydoğan (2016)	Article
Çetin, Yavuz, Tokgöz, & Güven (2012)	Article
Doğru & Şeker (2012)	Article
Güçhan Özgül, Akman, & Saçkes (2018)	Article
İyibil (2010)	Master thesis
Kalkan, Ustabaş, & Kalkan (2007)	Article
Kaya (2018)	Master thesis
Kurnaz, Kıldan, & Ahi (2013)	Article
Küçüközer & Bostan (2010)	Article
Küçük & Laçin Şimşek (2017)	Article
Saçkes (2015)	Article
Saçkes & Korkmaz (2015)	Article
Saçkes, Smith, & Trundle (2016)	Article
Sağlam Arslan & Durukan (2016)	Article
Türk (2018)	Article
Saka (2018)	Master thesis

As shown in Table 1, three studies were master thesis, and 17 studies were national articles, and there was no doctoral thesis on the subject.

Distribution of Studies on Preschool Astronomy Education by Years

Figure 1 shows the distribution of the studies on preschool astronomy education by type of publication and year.

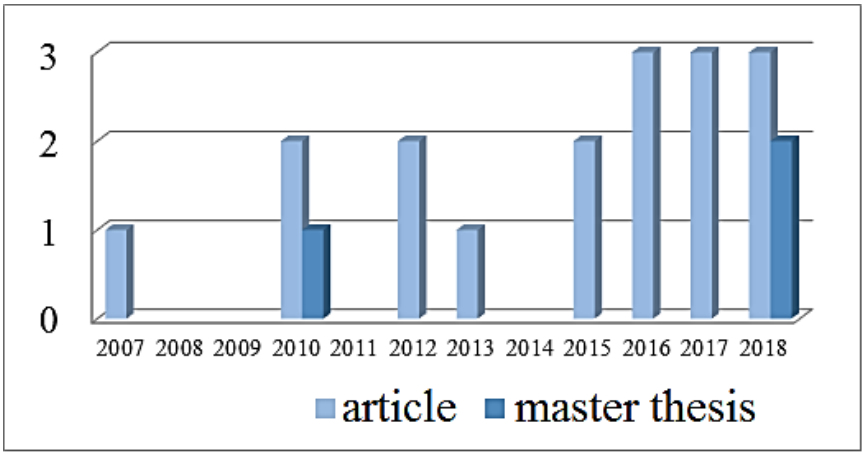

Figure 1. Distribution of the studies examined in the research by publication type and years

Figure 1 indicated that the studies on the subject started in 2007 but gained speed as of 2015. It is also noteworthy that there were few master thesis and no doctorate thesis on the subject. The first master thesis on this subject was published in

2010, and then two more thesis studies were conducted in 2018. Considering the absence of doctoral theses on the subject and the time elapsed between the years when the limited numbers of the master thesis were written, it can be said that the subject of preschool astronomy education is an area that has not yet been focused on in postgraduate studies.

The Distribution of the Articles on Preschool Astronomy Education by Indexes

Figure 2 presents the distribution of the articles on preschool astronomy education by indexing.

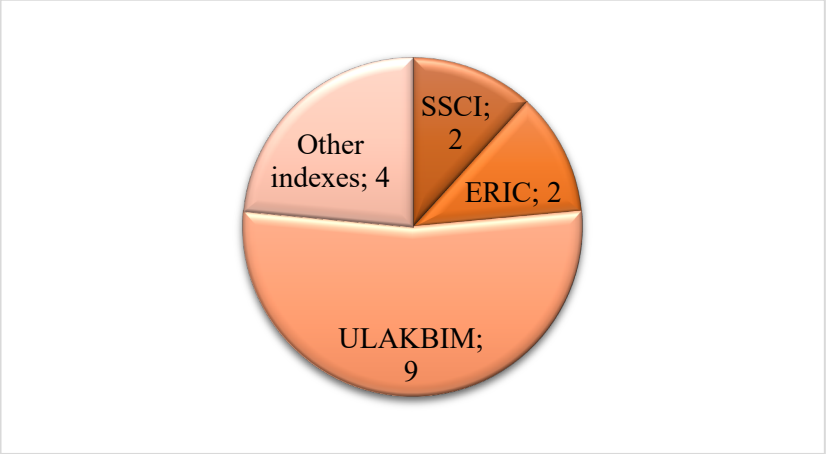

Figure 2. The distribution of the articles examined in the research according to the indexes in which they take place

Figure 2 indicated that nine of the articles on preschool astronomy education had been published in journals indexed by ULAKBIM, two in those indexed by ERIC, two in those indexed by SSCI, and four in those indexed by others.

Distributions of Keywords Used in Studies on Preschool Astronomy Education

Keywords are also among the examined themes as they provide information about the content of the studies and are used in the literature review. Figure 3 gives the distribution of the keywords used in the studies on preschool astronomy education.

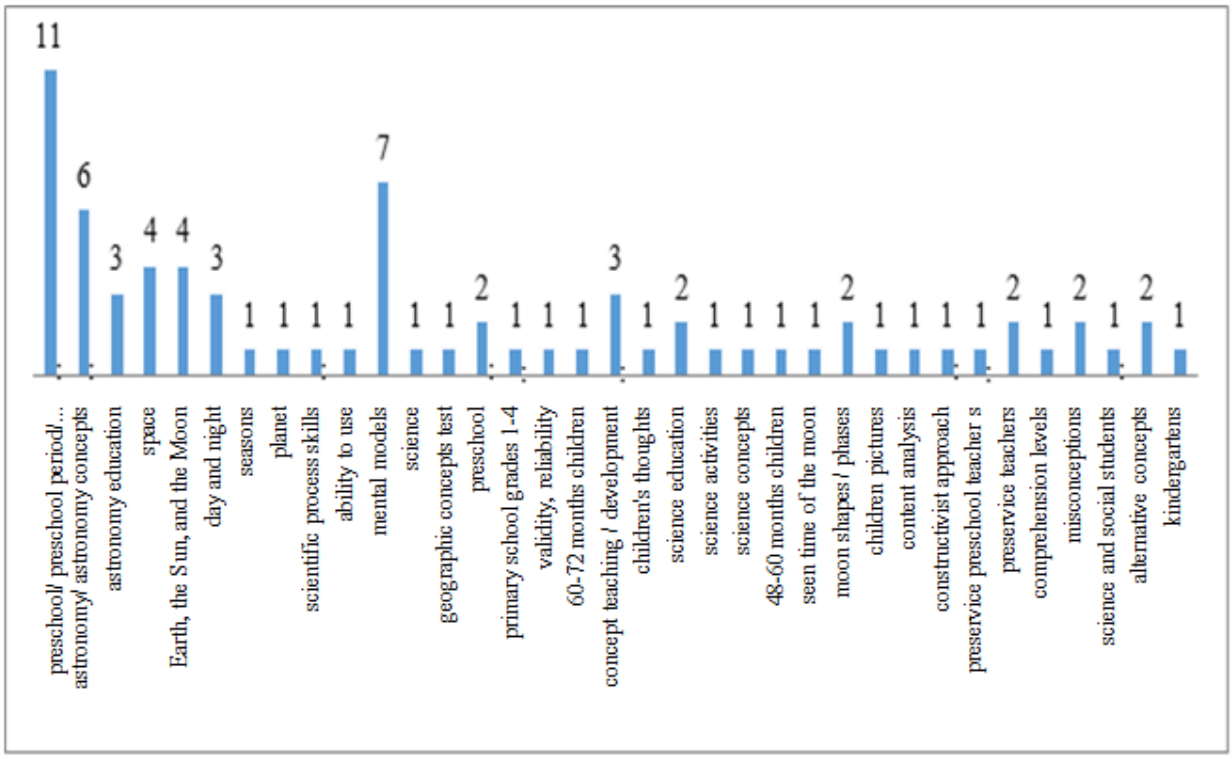

Figure 3. Distributions of the keywords used in the studies examined in the research

As shown in Figure 3, the most frequently used keywords in the examined studies were "preschool"/"preschool period"/ "preschool education"/ "early childhood" (f=11), "mental models" (f=7), "astronomy" / "astronomy concepts" (f=6), "space" (f=4), "Earth, the Sun, and the Moon" (f=4), "astronomy education" (f=3), and "day and night" (f=3).

Distribution of Astronomy Concepts and Subjects Considered in the Studies on Preschool Astronomy Education

Figure 4 gives the distribution of the astronomy concepts and subjects considered studies on preschool astronomy education.

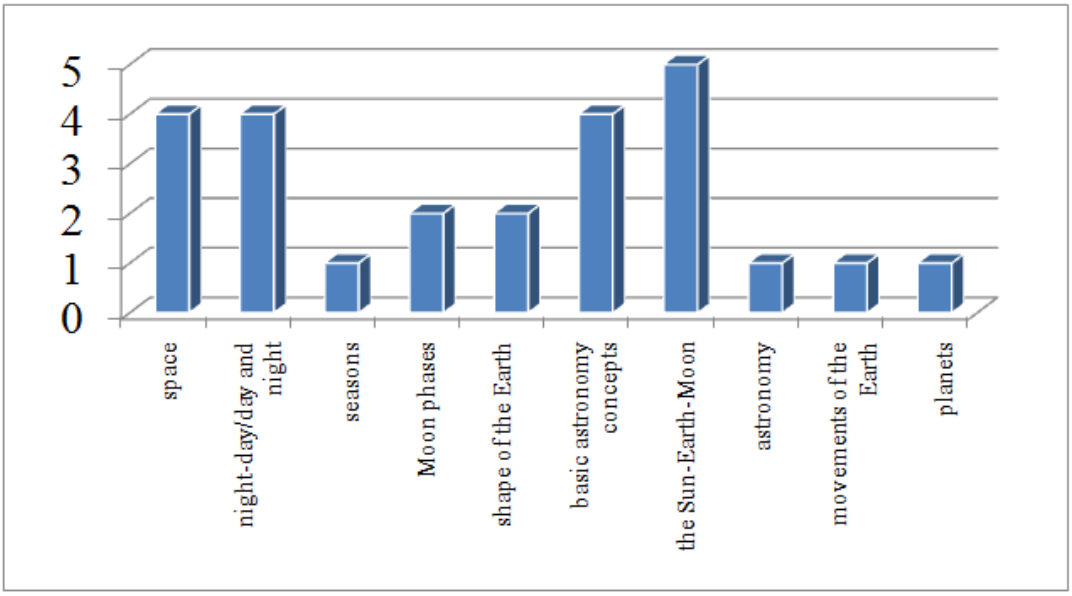

Figure 4. Distribution of astronomy concepts and topics considered in the studies examined in the research

Figure 4 showed that the examined studies were mostly about the Sun-Earth-Moon (f=5), followed by basic astronomy concepts (f=4), space (f=4), and day and night (f=4).

Distribution of Studies on Preschool Astronomy Education According to the Purpose

Table 2 presents the distribution of the studies according to the purpose.

Table 2. Distribution of the studies examined in the research according to the purpose

Category	Author(s)	Purpose(s)
Activity-Based Studies	Aksan & Çeliker (2017)	Planning an activity for astronomy education for preschool children, implementing it, and determining its effect on children
	Ayvacı (2010)	To determine whether the scientific process skills of children are developed by planning activities suitable for preschool children
	Çetin, Yavuz, Tokgöz, & Güven (2012)	To compare the effect of enriched activities prepared according to the student-centered teaching approach on student achievement in teaching space concepts and the effect of teacher-centered teaching on student achievement
	Doğru & Şeker (2012)	To determine the effect of scientific activities on the development of the concept of "Earth, Sun and Moon" in preschool children aged 5-6
	Kaya (2018)	Examining the teaching situations of the concept of the moon with the help of activities
	Aydın & Güney (2017)	Determining the effect of the activities developed in accordance with the constructivist approach on the science concept achievement of preschool teacher candidates, determining the knowledge level of science concepts, determining and eliminating the missing/erroneous knowledge
Studies on Determining Mental Model	Ayvacı, Bülbül, Özbek, & Ünal (2018)	To determine the mental models of preschool children and primary school students for the concept of space and to examine the change they show according to grade level
	Güçhan Özgül, Akman, & Saçkes (2018)	To reveal the mental models of 60-72 month-old children regarding the shape of the Earth and the concepts of Day and Night
	Kurnaz, Kıldan, & Ahi (2013)	To determine the mental models of preschool children regarding the concepts of the Sun, Earth, and Moon
	İyibil (2010)	To determine the understanding levels and mental models of preservice teachers studying in different programs about basic astronomy concepts
	Sağlam Arslan & Durukan (2016)	To determine preservice teachers' mental models about basic astronomy concepts
	Saçkes & Korkmaz (2015)	Examine children's conceptual understanding of the shape of the world and their cognitive representation
	Saçkes (2015)	To examine the mental models of kindergarten students regarding the day and night cycle and to make suggestions aimed at pedagogical practices regarding concepts related to space in preschool classes

Category	Author(s)	Purpose(s)
Studies on Misconceptions / Alternative Ideas	Kalkan, Ustabaş, & Kalkan (2007)	To identify astronomy concepts and misconceptions about these concepts
	Saka (2018)	To identify alternative ideas of preschool teachers regarding basic astronomy concepts
Studies on Developing Measurement Tool	Baysan & Aydoğan (2016)	To develop a valid and reliable measurement tool that reveals its achievements regarding geographical concepts
Studies on determining existing knowledge	Türk (2018)	To investigate the current situation of preschool teachers in the field of astronomy from various perspectives
	Saçkes, Smith, & Trundle (2016)	The purpose of this cross-cultural study is to describe and compare observational knowledge of the US and Turkish children about the day and night cycle, as well as to identify the similarities predicted by the frame theory
	Küçüközer & Bostan (2010	Identifying preschool students' ideas about day and night, the seasons, and the phases of the Moon
	Küçük & Laçin Şimşek (2017)	Determining children's thoughts about space

Table 2 indicated that seven of the 20 studies examined in the study were for determining mental models, six were activity-based, and four aimed to determine existing knowledge. Also, one study aimed to determine the misconceptions/alternative ideas, and another study was for developing a measurement tool. In general, it can be stated that the general tendency of the studies conducted so far had been to determine how astronomy concepts were understood and to test the effect of activities related to astronomy.

The Distribution of Studies on Astronomy in Preschool According to the Provinces

As to the distribution of the studies on preschool astronomy by the province of implementation, most studies have been conducted in Trabzon (f=3) and Balıkesir (f=3), but one study has also been conducted in Antalya, Aydın, Muş, Sakarya, and Samsun. On the other hand, a study was also conducted in the USA and a comparative study involving the USA and Turkey. Six studies gave no information about the province of implementation. Thus, it can be said that the studies on this subject were not widespread across Turkey.

Distribution of Studies on Preschool Astronomy Education According to Research Methods and Designs

The distribution of the studies on preschool astronomy education according to the research methods is presented in Figure 5, and the distribution according to the research designs is presented in Figure 6.

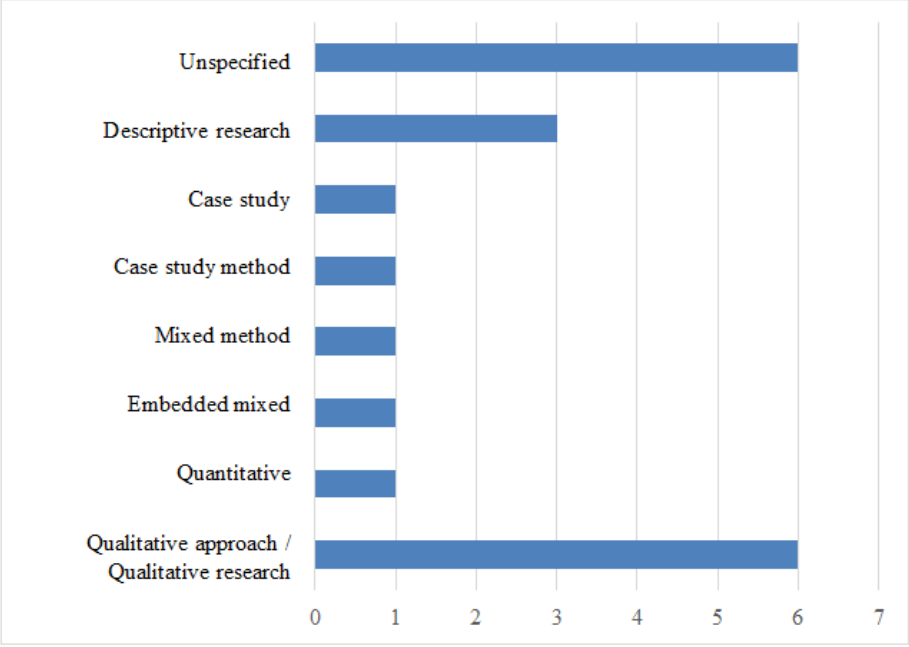

Figure 5. Distribution of the studies examined in the research according to research methods

As shown in Figure 5, six of the 20 studies specified the method as qualitative research, one as quantitative research, and another as mixed research. Six studies gave no information about methodology.

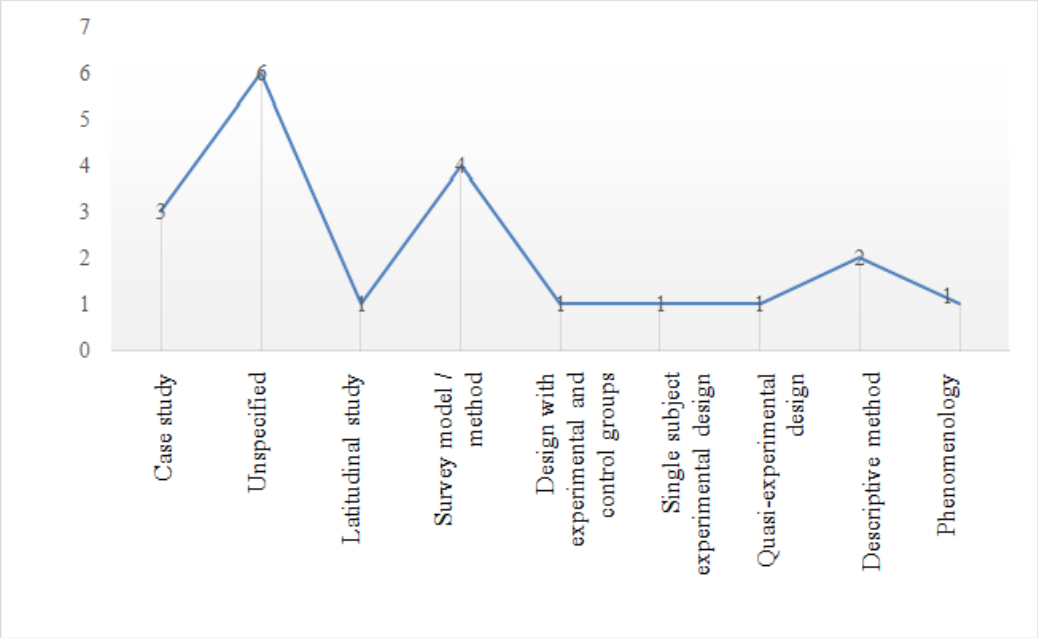

Figure 6. Distribution of the studies examined in the research according to research design

Figure 6 shows that the studies had frequently been designed in a survey model (f=4), case study (f=3), experimental design (f=3), and descriptive method (f=2).

Distribution of Participants in Studies on Preschool Astronomy Education

Figure 7 shows the distribution of the studies on preschool astronomy education according to the participants.

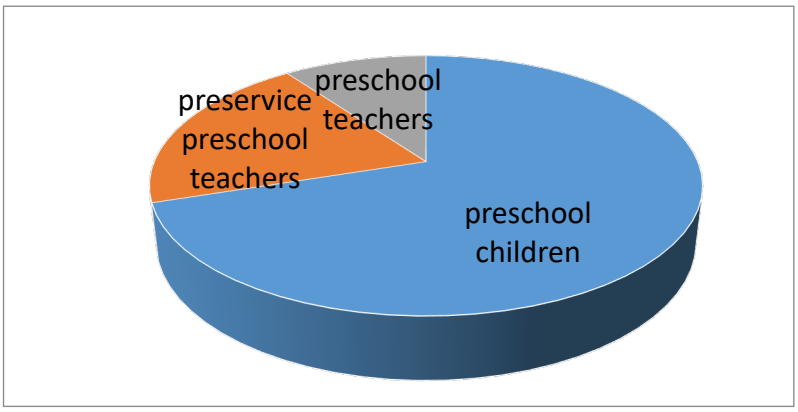

Figure 7. Distribution of participants in studies examined in the research

Figure 7 indicated that most of the studies had been conducted with preschool children (f=14). There were also studies conducted with preservice preschool teachers (f=4) and preschool teachers (f=2). Thus, it is clear that the studies have generally been carried out with preschool children, followed by the studies carried out with preservice teachers.

Information about the sample size in the studies examined in the research is shown in Table 3.

Table 3. Information on the sample size of the studies examined in the research

Author(s)	Sample size
Aksan & Çeliker (2017)	12
Ayvacı (2010)	15
Ayvacı, Bülbül, Özbek, & Ünal (2018)	113 (17 preschool)
Baysan & Aydoğan (2016)	743 (200 preschool)
Çetin, Yavuz, Tokgöz, & Güven (2012)	39
Doğru & Şeker (2012)	48
Güçhan Özgül, Akman, & Saçkes (2018)	56
Kaya (2018)	27

Author(s)	Sample size
Kurnaz, Kıldan, & Ahi (2013)	200
Türk (2018)	20
Aydın & Güney (2017)	74
İyibil (2010)	293
Kalkan, Ustabaş, & Kalkan (2007)	100
Sağlam Arslan & Durukan (2016)	293
Saçkes, Smith, & Trundle (2016)	29 (Turkish preschool children)
Saçkes & Korkmaz (2015)	20
Saçkes (2015)	46
Küçüközer & Bostan (2010)	52
Küçük & Laçin Şimşek (2017)	9
Saka (2018)	36

As shown in Table 3, 15 studies had been conducted with less than 100 people. This may be considered normal considering that the examined studies are mostly based on a qualitative paradigm.

Distribution of Studies on Preschool Astronomy Education According to Data Collection Tools

The distribution of studies on preschool astronomy education according to data collection tools is given in Figure 8.

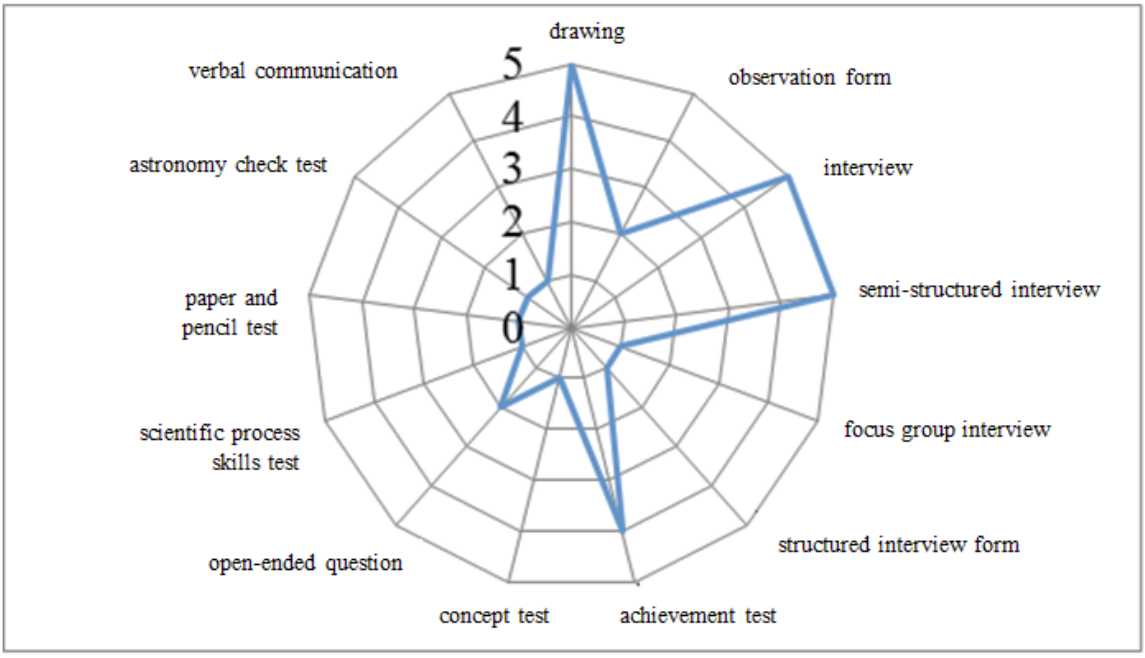

Figure 8. Distribution of the studies examined in the research according to data collection tools

Figure 8 indicated that the examined studies had employed various data collection tools: interview (f=12), drawing (f=5), achievement test (f=4), observation form (f=2), concept test (f=2), open-ended question form (f=2), astronomy control test (f=1), scientific process skills test (f=1), paper and pencil test (f=1), and verbal communication (f=1).

Distribution of Studies on Preschool Astronomy Education According to Data Analysis Method

The distribution of studies on preschool astronomy education according to the data analysis method is given in Figure 9.

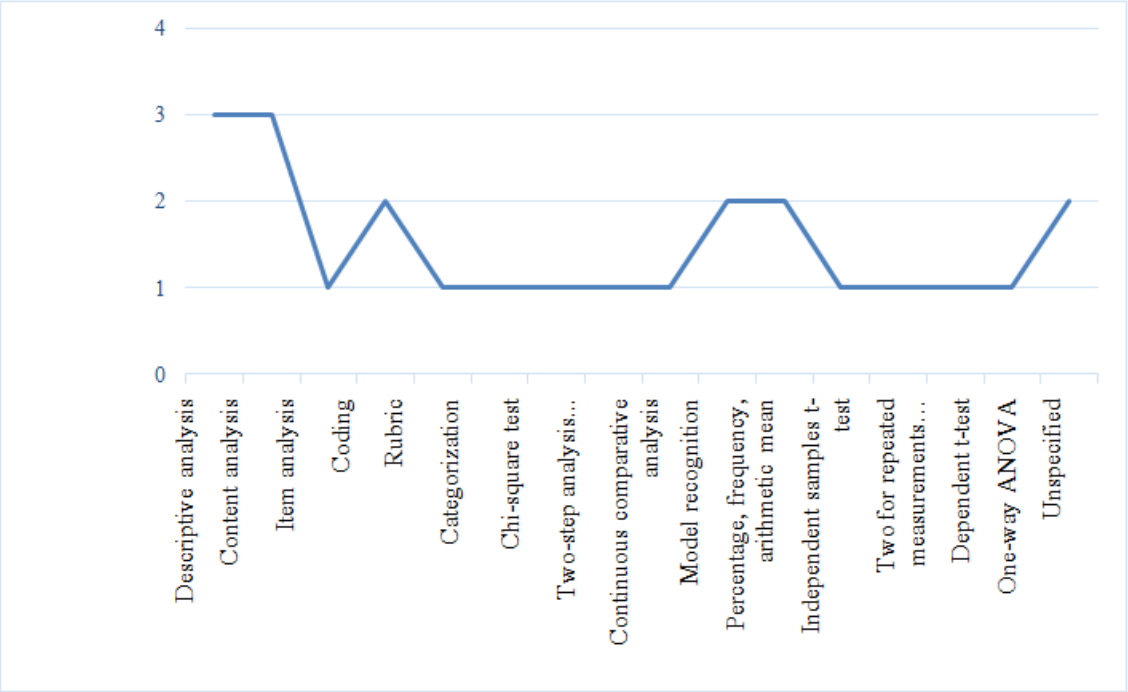

Figure 9. Distributions of data analysis methods used in studies examined in the research

Figure 9 shows that descriptive analysis and content analysis were the most frequently used analysis methods in the examined studies (f=3), followed by coding, model recognition, and percentage/frequency/arithmetic mean calculations (f=2). Other data analysis methods such as item analysis, rubric, chi-square test, and tests based on differences between means had been used in one study each.

Main Results Obtained From Studies on Preschool Astronomy Education

The main results obtained from the studies on preschool astronomy education are given in Table 4.

Table 4. Main results obtained from studies examined in the research

Category	Author(s)	Main Result(s)
Activity-Based Studies	Aksan & Çeliker (2017)	The combination of various teaching methods and techniques in the planned activity increased the interest, desire, and curiosity levels of the children and positively affects their active participation in the activity.
	Ayvacı (2010)	There was a positive relationship between the activities organized and the ability to gain scientific processes.
	Çetin, Yavuz, Tokgöz, & Güven (2012)	51.3% of the children stated that they first learned the concepts of space from their parents.
	Doğru & Şeker (2012)	Science / scientific activities were an effective technique in the acquisition of basic concepts related to the Earth, Sun, and Moon, as well as positively affect the development of existing concepts in children.
	Kaya (2018)	Some basic features of the Moon can be learned through activities organized according to the ages of 48-60 months old children.
	Aydın & Güney (2017)	There was a significant difference in favor of the science concepts achievement test post-test with the activities aimed at eliminating the participants' missing information.
Studies on Determining Mental Model	Ayvacı, Bülbül, Özbek, & Ünal (2018)	Concrete concepts made up the mental models of preschool students.
	Güçhan Özgül, Akman, & Saçkes (2018)	Findings regarding the formation of day and night showed that children mostly attribute these concepts and phenomena to the movements of the Sun, and a limited number of children associate these concepts with God.
	Kurnaz, Kıldan, & Ahi (2013)	The attributes of the child's drawings were basically divided into two categories, scientific and non-scientific. There was no significant difference between the gender of the children, the correct drawing of the entire Sun, Earth, and Moon, and other variables.
	İyibil (2010)	The preservice teachers could not explain the concepts adequately, the science and physics teacher candidates' level of understanding is better, and the mental models of these branches were more scientific.
	Sağlam Arslan & Durukan	None of the pre-service teachers was an ideal model for the astronomy concepts in

	(2016)	question, the most common model was not the appropriate model, the preservice teachers from different branches had similar mental models.
	Saçkes & Korkmaz (2015)	Most of the children had naive models of the shape of the world.
	Saçkes (2015)	More than half of the children had the naive model, and the distance model was also common.
Studies on Misconceptions / Alternative Ideas	Kalkan, Ustabaş, & Kalkan (2007)	Preservice teachers had persistent misconceptions.
	Saka (2018)	It has been observed that preschool teachers had alternative ideas for the concepts of Star, Planet Satellite, Earth, Sun, Moon, including definition, motion, brightness, structure, and shape elements.
Studies on Developing Measurement Tool	Baysan & Aydoğan (2016)	It was not a measurement tool in the age range of 5-10 to measure geographic concepts before, but it was developed with this study.
Studies on determining existing knowledge	Türk (2018)	The teachers found themselves partially competent in astronomy subjects. Most of the teachers did not find the astronomy activities in the preschool education program sufficient.
	Saçkes, Smith, & Trundle (2016)	Observational data of preschool students from the two countries showed many similarities. Although science concepts were more common in the US early childhood program, no performance difference has been detected between Turkish and US children.
	Küçüközer & Bostan (2010	Children had a wide variety of ideas about each concept, generally had naive ideas; students had learned these concepts from their families, daily life, and observations.
	Küçük & Laçin Şimşek (2017)	Children were curious about space and described it as emptiness. They stated that there were sun, moon, earth, stars, and planets in space, and the earth is round.

As shown in Table 4, the examined studies had reached some striking results. The studies on preschool teachers had revealed that the teachers considered themselves partially competent in astronomy subjects, regard the undergraduate curriculum inadequate in this respect, and had alternative ideas about astronomy subjects. The studies conducted with preservice teachers also reported similar results. They had determined that preservice teachers could not explain astronomy concepts adequately, had persistent misconceptions about these concepts. Also, they held inappropriate mental models. The results of the studies on preschool children, on the other hand, showed that children often have naive ideas about astronomy concepts. Lastly, the activities prepared as part of the examined studies for teaching astronomy to preschool children have always achieved their purpose and have been effective for children.

Recommendations Offered in the Studies on Astronomy in Preschool

Recommendations offered in studies on preschool astronomy education are shown in Table 5.

Table 5. Recommendations offered in studies examined in the research

Themes	Recommendations
Recommendations for teachers	Developing activities to improve children's scientific process skills
	Creating a rich interactive environment for children
	Giving more importance to creating science learning environments in the preschool period
Recommendations for preservice teachers	Creating a comfortable environment where they can explain what they know about science
	Making activities where they can complete their missing information about the subject
	Practical processing of science education lessons
Recommendations for researchers	Conducting studies with large samples
	Covering different astronomy topics
	Using different data collection tools and diversifying data sources
Recommendations for curriculum developers	The addition of Turkey Geography and Geography classes for undergraduate programs
	Increasing the number of courses related to science education in the undergraduate program

As shown in Table 5, recommendations made in the analyzed studies were grouped under four themes: recommendations for teachers, recommendations for preservice teachers, recommendations for researchers, and recommendations for

curriculum developers. The recommendations for teachers focused on conducting activities and setting an environment for children to learn science in general and astronomy in particular. As to the recommendations for preservice teachers, the examined studies stated that science teaching should be done in a comfortable learning environment and in a practical-oriented way to eliminate their deficiencies. Recommendations for researchers can be listed as increasing the sample size and diversifying the addressed astronomy subjects/concepts and data collection sources. Finally, the examined studies recommend that curriculum developers include courses related to astronomy and/or increase the number of existing courses in the undergraduate curriculum.

CONCLUSION AND DISCUSSION

The present study aimed to make a thematic analysis of the articles and theses about preschool astronomy education published in Turkey. In this context, 20 studies in the national literature were reviewed. The review was on the themes of publication year, publication type, indexing, keywords, the addressed astronomy subject/concept, purpose, province of implementation, research method and design, the number and group of participants, data collection tool, data analysis method, results, and recommendations.

The findings of the present study showed that the studies on preschool astronomy education were mostly in the form of articles, and there were few postgraduate studies with no doctoral thesis. Similarly, Ezberci Çevik & Kurnaz (2016), conducted a thematic analysis of the studies on stars published in Turkey, and determined few master thesis studies and no doctoral thesis on the subject. They found that the first study on the subject was conducted in 2007 as an article, and relatively more studies were carried out after 2015. The first master's study on preschool astronomy education was conducted in 2010. By examining the theses on astronomy education, Doğru, Satar, & Çelik (2019) found that the number of theses published on astronomy education gained momentum as of 2012. This finding is consistent with Ezberci Çevik and Kurnaz (2016) work reporting that studies on stars increased after 2010. In the study conducted by Kurnaz et al. (2016) to make a thematic analysis of national articles on astronomy education, the number of studies on the subject increased between 2011 and 2015. Özpir Mantaş (2018) also made a systematic analysis of the studies on preschool science education in Turkey and detected that the first study on preschool science education was conducted in 2005, followed by an increase in research on this subject in 2006, 2009, and 2010, but, overall, there was no stability. Özen Uyar & Ormancı (2016) reported that studies on preschool science education increased as of 2012. Considering these studies, it can be stated that astronomy education studies have lately gained popularity as a result of the researchers' inclination towards preschool science education studies in recent years.

As to indexing, the present study found that nine of the examined articles have been published in journals indexed by ULAKBIM, and four in journals indexed by prominent international databases (ERIC and SSCI). This finding is also consistent with those of the relevant studies in the literature (Kurnaz, Bozdemir, Altunoğlu & Ezberci Çevik, 2016; Özen Uyar & Ormancı, 2016).

When the distribution of the studies on preschool astronomy education based on keywords was examined, the keywords preschool, mental models, and astronomy concepts were seen to be frequently used. This reflects that the examined studies mainly focus on mental models and astronomy concepts.

The examined studies had frequently addressed the Sun-Earth-Moon, basic astronomy concepts, space, and day and night. Since the focus of the study is astronomy for preschool children, it is quite natural that such astronomy subjects had been addressed in line with the student level. This is because modern astronomy topics such as the Big Bang and the expansion of the universe are not suitable for preschool studies. similar to the findings of the present study, the articles on astronomy education stated that focus was mostly on basic astronomy concepts, the concepts of solar system and space (Kurnaz, Bozdemir, Altunoğlu, & Ezberci Çevik, 2016).

The study also determined that as the findings of the analysis of keywords indicated, the studies on the subject had been carried out to determine the mental models, check conceptual knowledge, detect and eliminate misconceptions, and test the effect of astronomical activities. Considering that the main purpose of determining the mental models related to astronomy concepts is to determine the misconceptions, it can be stated that the studies examined in the present study mainly focused on astronomy concepts. Teaching a concept related to a subject and revealing and eliminating misconceptions while doing this is the basis of teaching (Ayvacı & Sezer, 2018). Based on this, it can be said that astronomy education studies for preschool children are at the beginning level in Turkey. Similarly, Satar and Çelik (2019) concluded that most studied subjects in national (i.e., Turkish) theses on astronomy education are concepts and concept maps. The same study also reports that the foreign (i.e., non-Turkish) theses mostly focus on student motivation. These results are in accordance with the findings of the thematic analysis study carried out by Ayvacı and Sezer (2018) and Kurnaz et al. (2016). The research trend in preschool science education studies is quite different from that in astronomy education studies. The trend of these studies is for teacher training (Özpir Mantaş, 2018). In the present study, the studies on the misconceptions about astronomy were followed by the intervention studies to determine the effects of the astronomy activities on students. These studies point to the need to determine the methods and techniques for how to make astronomy education, which has started to attract attention in Turkey in recent years, stronger.

The examined studies had mostly been carried out in Trabzon and Balıkesir provinces. On a regional scale, the studies had generally been conducted in provinces in the Black Sea Region of Turkey (Samsun and Trabzon). Studies on stars had mostly been conducted in Ankara, Trabzon, Balıkesir, and Istanbul (Ezberci Çevik & Kurnaz, 2016). Based on this, one may think that there are researchers studying astronomy education in Trabzon and Balıkesir provinces.

The study also found that research designs were not clearly stated in the methodology sections of some quantitative studies and many qualitative studies, in which general explanations were made about how the studies were carried out, and research designs were not specified in many studies. Ezberci Çevik & Kurnaz (2016) and Kurnaz et al. (2016) also emphasized this, mentioning the studies in which methodology was not explained. Among the studies specifying their methodology, the studies employing the qualitative method outnumbered, followed by the studies involving descriptive survey and experimental design. Doğru, Satar, and Çelik (2019), on the other hand, determined that 40.6% of the national thesis studies on astronomy education used an experimental design and that experimental design was mostly preferred in foreign theses too. The most preferred designs in national articles on astronomy education are quasi-experimental and case study designs (Kurnaz et al., 2016). While the case study is most preferred in national studies on stars (Ezberci Çevik, & Kurnaz, 2016), the quantitative method is the most preferred in preschool science education studies (Özpir Mantaş, 2018). The scarcity of mixed-method studies involving the combined application of qualitative and quantitative paradigms in the examined studies can be considered as a methodological deficiency in the field.

As more than half of the examined studies were seen to be carried out with preschool children, it can be said that such studies will contribute to the evaluation and improvement of preschool astronomy education. The examined studies aimed to determine conceptual learning and mental models may have led researchers to work with preschool students. Similarly, the analysis of the studies on astronomy education revealed that they were mostly conducted with middle school students (Doğru, Satar & Çelik, 2019; Kurnaz et al., 2016). Unlike these results, Ayvacı & Sezer (2018) found that the theses and articles on astronomy education were mostly conducted on science teachers, followed by seventh-grade students. This difference may be because their analysis involved articles in addition to the national theses. It is reported that national preschool science education studies mostly take preschool teachers as samples (Özpir Mantaş, 2018).

Ten different data collection tools had been used in the examined studies. Among these, the most frequently used ones wereinterview, drawing, and achievement tests. As a result of the thematic analysis of the thesis studies on astronomy education, such studies had mostly used open-ended question forms and multiple-choice tests for data collection (Ayvaci & Sezer, 2018). The distribution of the articles on the subject by data collection tool indicated that the studies on stars had mostly employed multiple-choice achievement tests (Ezberci Çevik & Kurnaz, 2016). Considering the high number of studies involving preschool children among the examined studies, the illiteracy of these children may have led the researchers to use interviews and drawing as data collection tools. As a result of this situation, the most frequently used data analysis methods in the studies had been descriptive analysis and content analysis. Ayvacı & Sezer (2018) also obtained similar findings. Advanced statistical methods such as Structural Equation Modeling (SEM), MANOVA, and regression had not been preferred inquantitative methodology studies.

A holistic view of the main results of the examined studies showed that preservice and in-service preschool teachers hade a lack of knowledge and misconceptions about astronomy subjects, and thus, their mental models were also inappropriate. This may be due to the abstract structure of the subject of astronomy and incorrect associations in daily life and maybe fed by the inadequacy of astronomy education. The thematic study by Ayvacı & Sezer (2018) also found that most teachers had misconceptions about astronomy subjects. In the thematic study carried out specifically for stars, the participants were seen to have misconceptions and imperfect knowledge about stars (Ezberci Çevik, & Kurnaz, 2016). A common result of the studies conducted to determine preschool children's mental models is that the children have naive ideas about the subject. In the intervention studies testing their effect, astronomical activities had been found to have a positive effect. Ayvacı & Sezer (2018) also reached a parallel result.

Recommendations offered in the examined studies parallel with these results are as follows: increasing the number of courses related to science/astronomy in the undergraduate curriculum and conducting practice-oriented teaching aimed at eliminating preservice teachers' imperfect knowledge. Recommendations for future studies include enriching the astronomy subjects addressed, enriching data sources, and working with larger samples. The thematic study carried out by Ayvacı & Sezer (2018) found that the recommendations of the examined studies fell under the themes of better training of teachers on astronomy and providing students with strong learning environments.

RECOMMENDATIONS

1- National studies on preschool astronomy are limited. Based on this, it may be suggested to raise the number of studies on the subject. Increasing studies on the subject will enrich the literature and provide important data for educators. Moreover, increasing the qualitative and quantitative studies in the field may lead to a rise in the importance given to astronomy for preschool children within educational policies.

2- Postgraduate studies on preschool astronomy education are few and only include a master thesis. Therefore, it may be suggested to increase postgraduate studies, especially doctoral dissertations. Doctoral studies will definitely be of great value as they provide the field with unique knowledge.

3- Four of the studies on preschool astronomy education had been published in journals included in prominent indexes (ERIC and SSCI) on an international scale, while nine are indexed by ULAKBIM, holding a significant position in the national field. Hence, future studies should also be of adequate quality to be included in prominent indexes.

4- The studies on preschool astronomy, which are already few, have not spread across Turkey and had been conducted in just some provinces. For this reason, studies can be carried out in other provinces, and their results can be examined comparatively.

5- The studies have mostly preferred preschool children as a sample. This may contribute to the evaluation and improvement of preschool astronomy education. Including other stakeholders in future studies along with preschool children and even diversifying data sources in each study, if possible, will both strengthen the studies and enrich the literature by allowing the subject to be viewed from different angles.

6- Most of the examined studies do not provide a thorough explanation of research design as part of the methodology. A detailed explanation of the methodology should be considered to ensure validity in future studies.

7- Research designs are not clearly stated in the methodology sections of some quantitative studies and many qualitative studies; general explanations are made about how the studies were carried out, and research designs are not specified in many studies.

8- In the context of qualitative data analysis, it is desirable to use content analysis along with descriptive analysis. However, it may be considered as a deficiency that the quantitative studies using survey and experimental designs have not used advanced statistical methods such as regression. Thus, it can be recommended to use strong statistical methods in future studies.

Researchers' Contribution Rate

The study was conducted and reported with equal collaboration of the researchers. Ebru EZBERCİ ÇEVİK and Nagihan TANIK ÖNAL agreed on the research problem together. Ebru EZBERCİ ÇEVİK contributed to the study in the sections of the research model, data collection, data analysis and explanation of the findings. Nagihan TANIK ÖNAL contributed to the conceptual framework, data collection, data analysis and presentation of findings sections in the study. Then the authors discussed the results and contributed to the final manuscript.

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