INVESTIGATING THE RELATIONSHIP BETWEEN CHILDREN'S SCIENTIFIC PROCESS SKILLS AND PARENTS' SCIENTIFIC LITERACY SKILLS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

BENGİ NUR İŞLER

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF ELEMENTARY AND EARLY CHILDHOOD EDUCATION, EARLY CHILDHOOD EDUCATION

SEPTEMBER 2023

Approval of the thesis:

INVESTIGATING THE RELATIONSHIP BETWEEN CHILDREN'S SCIENTIFIC PROCESS SKILLS AND PARENTS' SCIENTIFIC LITERACY SKILLS

submitted by **BENGİ NUR İŞLER** in partial fulfillment of the requirements for the degree of **Master of Science in Elementary and Early Childhood Education, Early Childhood Education, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Sadettin KİRAZCI
Dean
Graduate School of Social Sciences ___________________

Prof. Dr. Feyza TANTEKİN ERDEN
Head of Department
Department of Elementary and Early Childhood Education ___________________

Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN
Supervisor
Department of Elementary and Early Childhood Education ___________________

Examining Committee Members:

Assist. Prof. Dr. Elif BULDU (Head of the Examining Committee)
TED University
Department of Elementary and Early Childhood Education ___________________

Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN (Supervisor)
Middle East Technical University
Department of Elementary and Early Childhood Education ___________________

Assoc. Prof. Dr. Serap SEVİMLİ-ÇELİK
Middle East Technical University
Department of Elementary and Early Childhood Education ___________________

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Bengi Nur İŞLER

Signature:

ABSTRACT

INVESTIGATING THE RELATIONSHIP BETWEEN CHILDREN'S SCIENTIFIC PROCESS SKILLS AND PARENTS' SCIENTIFIC LITERACY SKILLS

İŞLER, Bengi Nur
M.S., The Department of Elementary and Early Childhood Education, Early Childhood Education
Supervisor: Assoc. Prof. Dr. Hasibe Özlen DEMİRCAN

September 2023, 157 pages

This study was designed as a quantitative study to investigate the relationship between children's scientific process skills and parents' scientific literacy skills. The participants of this study were 354 children enrolled in preschool education in İstanbul, along with their parents in the spring term of 2022-2023 academic year. The study was conducted using three data collection instruments. These instruments were Demographic Information Form, Scientific Process Skills Scale for 60-72-month-old Children (Özkan, 2015) and Universal Science Literacy Scale (USLS) (Çelik, 2016). The data were analyzed by using two-way between groups analysis of variance (ANOVA), one-way analysis of variance (ANOVA), and hierarchical multiple regression (HMR). The study findings showed no statistically significant difference in children's scientific process skills regarding gender and number of siblings they have. However, the study's findings indicated a statistically significant difference in children's scientific process skills based on age, favoring the older age group. In addition, parents' scientific literacy skills levels were recorded as high and very high. Furthermore, the study findings indicated that parents' scientific literacy skills predicted children’s scientific process skill scores after controlling for the effects of demographic characteristics, specifically education status and parents’ ages.

Keywords: Scientific Process Skills, Scientific Literacy Skills, Preschool Children, Parents

ÖZ

ÇOCUKLARIN BİLİMSEL SÜREÇ BECERİLERİ İLE EBEVEYNLERİN BİLİMSEL OKURYAZARLIK BECERİLERİ ARASINDAKİ İLİŞKİNİN İNCELENMESİ

İŞLER, Bengi Nur
Yüksek Lisans, Temel Eğitim, Okul Öncesi Eğitimi Bölümü
Tez Yöneticisi: Doç. Dr. Hasibe Özlen DEMİRCAN

Eylül 2023, 157 sayfa

Bu araştırma çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlık becerileri arasındaki ilişkiyi incelemek amacıyla nicel bir çalışma olarak tasarlanmıştır. Bu çalışmanın katılımcılarını 2022-2023 eğitim öğretim yılı bahar döneminde İstanbul'da okul öncesi eğitime devam eden 354 çocuk ile ebeveynleri oluşturmuştur. Araştırma üç veri toplama aracı kullanılarak gerçekleştirilmiştir. Bu veri toplama araçları, Demografik Bilgi Formu, 60-72 Ay Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği (Özkan, 2015) ve Evrensel Fen Okuryazarlık Ölçeği'dir (USLS) (Çelik, 2016). Araştırmanın analizleri, gruplar arası iki yönlü varyans analizi (ANOVA), tek yönlü varyans analizi (ANOVA) ve hiyerarşik çoklu regresyon (HMR) analiz yöntemleri kullanılarak yapılmıştır. Araştırmanın bulguları, çocukların cinsiyetlerine ve sahip oldukları kardeş sayısına göre bilimsel süreç becerilerinde istatistiksel olarak anlamlı bir farklılık göstermemiştir. Bununla birlikte, çalışmanın bulguları, çocukların bilimsel süreç becerilerinde yaşa bağlı olarak daha büyük yaş grubu lehine istatistiksel olarak anlamlı bir fark olduğunu göstermiştir. Ebeveynlerin bilimsel okuryazarlık düzeyleri yüksek ve çok yüksek olarak kaydedilmiştir. Ayrıca, araştırmanın bulguları, ebeveynlerin bilimsel okuryazarlık becerilerinin, eğitim durumu ve ebeveynlerin yaşları gibi demografik özelliklerin etkileri kontrol edildikten sonra, çocukların bilimsel süreç beceri puanlarını yordadığını göstermiştir.

Anahtar Kelimeler: Bilimsel Süreç Becerileri, Bilimsel Okuryazarlık Becerileri, Okul Öncesi Dönemdeki Çocuklar, Ebeveynler

Dedication to my beloved family

ACKNOWLEDGMENTS

I received support from many people I loved during this challenging but enlightening journey. I cannot thank enough the people who have been with me during this process and have not spared their help. First and foremost, I would like to express my gratitude to my dear advisor, Assoc. Prof. Dr. Hasibe Özlen Demircan for her valuable guidance and contributions while writing the thesis. Motivating me throughout the process believing in me when I thought I couldn’t do it, kept me moving forward. Working with her was an invaluable experience for me. I could not have continued without her sincerity, constructive comments, and suggestions.

I would also like to thank esteemed jury committee members Assist. Prof. Dr. Elif Buldu and Assoc. Prof. Dr. Serap Sevimli-Çelik for taking the time to read my thesis and for the valuable feedback they gave me to improve it. Their expertise and insights were beneficial for me to enrich this thesis.

I extend my thanks to the preschool principals, teachers, parents, and children who helped me collect data, making the process easier and helping me to make a small contribution to science. I greatly appreciate the time and effort they provided.

I am grateful to Dr. Ahmet Yıldırım for his continuous support throughout this journey. He always answered my questions and provided his best wishes, which greatly motivated me. Additionally, I would also like to thank Rabia Filik Uyanık for her valuable contributions and for guiding me in line with her experiences.

I am lucky to have received such tremendous support throughout this process. I cannot thank enough especially to Hilal Doğan for motivation and encouragement, which played a pivotal role in my journey. Her friendship has enriched my life in countless ways. Also, my sincere thanks go to Nazlı Berfin Yapar and Güneş Ezgi Demirci for the moral support they gave me. They guided me in every step and never withheld their help. I couldn’t have done it without the support of my graduate friends.

I would like to express my gratitude to my fellow research assistant friends, especially Esra Gamze Uğur Ekşi and Gülşah Subaşı at Yıldız Technical University Faculty of Education. They believed in me and provided motivation in every possible way during this journey, readily answering my questions, sharing their experiences, and selflessly helping me overcome any obstacles that crossed my path. I am grateful to have had the privilege of working alongside such exceptional individuals. Their support has been invaluable, and their friendship a cherished treasure.

I also owe my heartfelt thanks to my dear childhood friends Macide Alpkıray and Zeynep Aydemir for their encouragement and support. They were with me every time I felt that I couldn't continue due to the difficulties I faced. They provided me with moral support in every circumstance and patiently listened to me for hours offering valuable insights and advice. Their friendship has been a source of strength and motivation throughout this journey, reminding me that I was never alone in my pursuit of knowledge. I am grateful to have friends like them who have not only celebrated my successes but have also been there to lift me up during the difficult times.

Finally, I would like to express my endless gratitude to my dear parents, Ayşe and Atila İşler, for being with me in every step of the way sin the beginning of my educational journey, and to my brother, Karabey Mustafa İşler. They have always stood by me and supported me in every possible way, even though we were physically apart. I could not have undertaken this journey without their unwavering support. I would also like to extend my thanks to my grandmother, Halime Avcıoğlu, and my grandparents, Ali and Müzeyyen İşler, who have always supported me and provided me with strength through their prayers. Thanks to my family's support and trust in me, I was able to move forward. I am deeply appreciative of my family for their encouragement, understanding, and a shoulder to lean on during the challenging moments of this endeavor.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

USLS Universal Science Literacy Scale

MoNE Ministry of National Education

OECD Organization for Economic Co-operation and Development

NSTA National Science Teachers Association

NRC National Research Council

STEM Science, Technology, Engineering, and Mathematics

EFA Exploratory Factor Analysis

CFA Confirmatory Factor Analysis

PCA Principal Components Analysis

CHAPTER 1

INTRODUCTION

Children naturally observe, investigate, and create discoveries about their environment during the early stages of development (Gallenstein, 2005; National Research Council, 2012). The inherent curiosity of young children is apparent through their inquisitive nature, as evidenced by the frequency and variety of questions they ask about the world (Piaget, 1955). Children show a deep interest in everything around them, keeping an optimistic view that fuels their desire to learn and develop their abilities, and are generally unafraid of problems or setbacks (Freedman-Doan et al., 2000). Furthermore, these innate abilities form the foundation of scientific education and can be further enhanced by engaging children in science-related activities during their early years (Hamlin &Wisneski, 2012; National Science Teachers Association, 2014). This not only establishes a solid basis for future interest in science but also nurtures their curiosity and passion for scientific exploration (National Research Council, 2012). Maintaining early interests, according to research findings, can have a long-term influence by fostering continued involvement with science and affecting children's future vocational preference (Crowley et al., 2015). Therefore, children's interest in science should be cultivated and encouraged from a young age.

Integrating science into children's education is critical since it serves as a foundation to understand the world. Use of scientific approaches empowers children to develop important problem-solving skills, make connections to understand the universe, and improve their decision-making skills (Demir, 2016). Nonetheless, the National Science Teachers Association (2009) states that young children may need more time to completely grasp scientific concepts. Children can actively engage with their environment in science settings offered by adults, allowing them to gain the required abilities for future scientific literacy skills by establishing connections between new material and their previous knowledge (National Science Teachers Association, 2009). Scientific literacy skills were initially defined as "the possession of knowledge and understanding of scientific concepts and processes essential for making personal decisions participating in civic and cultural activities, and attaining economic productivity" (National Research Council, 1996, p. 22). This highlights the crucial significance of scientific literacy skills in shaping individuals' lives. The standard definition of scientific literacy skills includes the awareness of scientific norms and knowledge of important scientific notions (Miller, 1983). Another definition of scientific literacy skills include understanding science-related subjects in terms of theories and phenomena and using existing knowledge and data to evaluate and make inferences (Dragoş & Mih, 2015). Therefore, scientific literacy skills are the process of understanding problems and how to approach them in the most effective way to solve them (Dragoş & Mih, 2015).

Scientific literacy skills could develop when individuals can problem-solve, explain and make inferences, and understand the scientific investigation steps to reach conclusions and these skills are known as scientific process skills, eventually leading to scientific literacy skills (Organization for Economic Co-operation and Development, 2003). The acquisition of scientific process skills can be regarded as a significant step towards developing scientific literacy skills (Jones et al., 2008). The findings of several studies have indicated that the effective utilization of scientific process skills plays a crucial role in the formation and advancement of scientific literacy skills in children and adults (Aydın-Ceran & Esen, 2022; Husna et al., 2022; Kaya et al., 2012).

A central aim of childhood education remains to cultivate scientifically literate learners, while presuming that on their own, children are unable to become sufficiently adept in scientific methods (Watters et al., 2001). However, it is known that children's intrinsic curiosity encourages them to be actively engaged in their surroundings, naturally leading to the development of scientific process skills, namely, observation, classifying, communicating, estimating, predicting, and inferring. These skills involve learning by doing and serve as a life-long learning process enabling individuals to create knowledge and solve problems (Özkan, 2015). Scientific process skills form the fundamentals of the context of active investigations children make in daily life (Jones et al., 2008). They promote the development of knowledge-gaining abilities used to acquire knowledge by using optimal cognitive and psychomotor skills (Turiman et al., 2012). Therefore, scientific process skills enable children to be active and develop a responsibility for individual learning. Developing scientific process skills allow children to think critically, make decisions, solve problems, find answers, and satisfy their curiosity when faced with a problem.

Moreover, scientific process skills can prepare children for the thinking process and scientific attitude (Turiman et al., 2012). The instruction and acquisition of scientific process skills are designed to allow children to grasp the facts and concepts while also relating them to the theory of using scientific process skills and fostering scientific attitudes (Turiman et al., 2012). Moreover, children’s use of scientific process skills enables them to understand scientific concepts, learn scientific information, discover the nature of science, be free researchers, and develop positive attitudes, interests, and skills toward science (Batı & Kaptan, 2013). In addition, in developing or utilizing scientific process skills, certain factors such as their gender, age, number of siblings, and parental influence could play a significant role.

Research suggests that gender related science encounters outside of the school may occur before notable variations in science achievements occur (Adamson et al., 1998). The studies focused on the family settings in investigating gender in children’s development (Hamel, 2021). In a study, it was found that parent-child interactions during science-related tasks, parents evaluated science activities as more challenging and less fascinating for their daughters than for their sons (Tenenbaum & Leaper, 2003). Another study finding states that parents who have boys in the ages of 4-7 years old reported more science-related activities than their girls in the same ages (Alexander et al., 2012). This is also consistent with Bronfenbrenner’s ecological systems theory stating the importance of children’s environment in shaping their cognitive development (Bronfenbrenner, 1979). Moreover, in a study investigating the role of gender and attitudes towards science in children in fourth and eighth grade, it was stated that children’s attitudes towards science should be taken into account as the findings revealed that gender played a significant role (Geesa et al., 2020). Gender differences could be seen in children’s scientific process skills as studies demonstrate variations in between secondary and high school students in relation to science and science achievement based on gender (Bacharach et al., 2003; Catsambis, 1995; Ogura & Takemura, 1994; Renee’White, 1999; Turhan et al., 2008; Yamtinah, et al., 2017).

Considering that scientific process skills in secondary and high school differ in terms of gender, it could be possible that they also differ in the early childhood. Therefore, understanding scientific process skills and possible gender disparities in early childhood could give insight to parents or teachers about children's individual learning needs and preferences, leading to more effective educational techniques. However, understanding the influence of age, in addition to gender, on scientific process skills could be important in unraveling the developmental trajectory of these cognitive skills.

Young children want to understand the world and are not afraid of new words and ideas. Children can apply and grasp scientific concepts to some extent, and they may connect theory with practice (Eshach, 2006). In addition, children's early play-oriented science experiences could form positive attitudes toward science. It is believed that early awareness of science would change children's lives, including their problem-solving skills, critical thinking, and enthusiasm for science-related discoveries. The early years in children's lives are critical because, in these years, children acquire knowledge quickly and start to be curious about exploring new things and opportunities as they emerge.

As children progress through their developmental stages, encompassing physical, social, and cognitive aspects, cognitive development also undergoes a concurrent growth and development. (Lind, 1998). Children's cognitive development, attention spans, and curiosity vary as they grow through these developmental stages (Piaget, 1964). At every age, children exhibit varying levels of cognitive maturity and different thinking patterns. Children have different developmental traits than adults, therefore, it is crucial to offer them opportunities that suits their specific age group. Tailoring education to meet their developmental needs ensures effective learning experiences (Vaivre-Douret, 2011). Through these experiences, children grow, and experience different stages of development and they gradually transfer from using simple cognitive skills to developing more complex ones. This evolution contributes to their effectiveness as thinkers as they mature with age (Berk, 2015). This cognitive maturation pattern can also be observed in scientific process skill development. Indeed, research shows that children's scientific process skills vary in favor of older age groups (Dahsah et al., 2017; Güden & Timur, 2016; Özgelen, 2012; Song & Black, 1991).

While many scientific process skills exhibit a linear age trend, it is worth noting that certain skills necessitate more scaffolding and targeted instructional support compared to others (Jirout & Zimmerman, 2015). Additionally, siblings play an important role in children's social, emotional, moral, and cognitive development (Carpendale & Lewis, 2004). This aligns with Bronfenbrenner (1979) and his ecological systems theory which highlights how immediate relationships, like those with siblings and parents, shape children's development. The experience of growing up with siblings often involves spending considerable time together, engaging in interactions characterized by predominantly positive qualities and substantial mutual imitation (Azmitia & Hesser, 1993). Moreover, even the differences in abilities between siblings could foster an environment conducive to learning from one another, thereby offering chances to acquire new skills (Hartup, 1989). Therefore, this setting of sibling interaction and skill development could help children in fostering social learning, collaborative endeavors, and active engagement in scientific play and exploration.

A study stated that children were ready and eager to learn about the world around them from infancy (French, 2004). Thus, starting from infancy, children transform their daily experiences to construct their theories (Nelson, 1986). Therefore, providing children with various science-related opportunities to test their ideas and theories is crucial. Research shows that when adults who are supportive of scientific skills facilitate children's first science experiences, they are able to make more careful and focused observations (French, 2004; Gelman & Brenneman, 2004). Given the opportunity to make direct discoveries about scientific experiences, children are able to reflect on their observations and produce new and complex scientific ideas by testing their theories (French, 2004; Gelman & Brenneman, 2004; Klahr et al., 2011). Therefore, educating scientifically literate individuals is possible not through passing knowledge onto individuals but by enabling them to reach scientific knowledge. In this respect, the place of scientific process skills is prominent and important to teaching ways of acquiring knowledge. Children need process skills both when doing scientific investigations and during their learning process (Harlen, 2000; Taconis et al., 2001).

Although children's scientific process skills develop naturally in their interaction with the environment through play experiences, other factors also affect these skills. Environmental influences have a significant impact on children's development of scientific process skills and their overall development in other areas. Bronfenbrenner stresses the child as the center and contends that multiple systems, including the microsystem, macrosystem, exosystem, and chronosystem, impact the child's development directly and indirectly (Bronfenbrenner, 1979). The dynamics within a family are characterized by an ongoing and dynamic interplay of forces as each family member adjusts and adapts in response to the development and changes of other members (Berk, 2012). The parental influence on children refuses the idea of one-way impact and perceives it as a dynamic interaction between the children, parents, and the social environment (Ceka & Murati, 2016). Within this paradigm, the parents are one of the most critical influences on their children's growth. The direct effect of parents on their children has a substantial impact on their developmental outcomes. Parents are recognized as influential agents in facilitating the development of these skills. Furthermore, examining children's competencies in these skills and the underlying requirements is warranted. At this point, parents have essential contributions to children's learning experiences as they are one of the primary sources supporting children's development firsthand (Yılmaz et al., 2018).

Therefore, parents are the primary source in the first years of children's lives to raise scientifically literate children in the future. Children could have science awareness through their experiences in their home environment as parents are the first teachers in children's lives (Gilligan et al., 2020). Starting from birth, children encounter the opportunities their parents provide in the direction of their education and socioeconomic status. According to Dabney et al. (2013), when parents serve as the primary source of initial interest in science, a general interest in science is more likely to emerge at an earlier age. Furthermore, the parents' knowledge and interest in science could affect the children's quality and quantity of experiences in science. Moreover, parents' engagement in science-related experiences at home could be considered as a valuable aspect of family habitus which is comprising dispositions and behaviors towards science (Archer et al., 2012). Accordingly, if parents have confidence in science and possess strong scientific literacy skills, they may be more likely to offer science-related experiences at home, prioritize explaining and engaging in scientific endeavors (Fender & Crowley, 2007; Setioko & Ding, 2022).

Given that parents are the adults in the children's immediate environment, they should possess scientific competencies, basic scientific knowledge, realistic and positive views about science education, and interest and positive attitudes towards science to support children. These abilities enable parents to create learning opportunities for children to develop competency in acquiring science which is scientific process skills (Yılmaz et al., 2018). In order to raise scientifically literate individuals in a broader framework, children should be able to understand the concepts of observation, classification, numbers, measurement, inference, prediction, communication, and relations of space and time (Curriculum Development Centre, 1993). For successful improvement of these processes, adult support and guidance are essential.

As some scientific process skills develop unconsciously in children, it is essential to promote these skills further and support them in appropriate learning processes (Jirout & Zimmerman, 2015). Yıldız & Yıldız (2021) reported that it is crucial for parents to guide their children, establish an appropriate environment, and have scientific conversations with children during home interactions in order to develop scientific process skills. Other studies also have revealed that home environment quality has an effect on scientific thinking and scientific process skills of developing individuals (Crowley & Galco, 2001; Kim & Chung, 2001). Thus, knowledgeable or scientifically literate parents could enhance the home environment quality to support children's development.

Additionally, according to the National Science Education Standards, the vision of science education includes gaining scientific process skills and combining science process and scientific knowledge by using children's scientific and critical thinking skills (NRC, 1996). However, children's development cannot be thought of alone without children's parents. While the attitudes and beliefs of parents regarding early science learning and education are also expected to influence the science engagement of young children (Gilligan et al., 2020), parents' scientific literacy skills could also change how they provide meaningful experiences for children to develop scientific process skills to become scientifically literate individuals in the future. Scientific process skills, whose development is supported early, ensure correct knowledge acquisition in children (Chak, 2002). At this point, parents' knowledge and children's immediate environment, such as home, influence children's development. Moreover, parents with higher levels of education tend to create a home atmosphere that values education, particularly in the field of science (Germann, 1994). Clearly, children need their parents' support to improve and enhance their scientific process skills in a daily context. Such findings suggest that parents' skills and literacy are prerequisite to society having scientifically literate individuals.

Upon reviewing the relevant literature, multiple studies investigating the scientific process skills of children were identified. Several explored the scientific process skills of children within the context of parental influence. Others investigated the effect of scientific process skills-based activities on primary school students' problem-solving skills and their scientific process skills using a cognitive domain framework (Gültekin & Altun, 2022; Özgelen, 2012). Several studies also reported on elementary school students' scientific process skills, scientific inquiry approach, and science attitudes (Ergül et al., 2011; Harefa, 2023; Mutlu, 2020). According to Germann (1994), cognitive development, parents' education, and science attitudes affect students' scientific process skills. Some studies associated the scientific process skills and preschool children's gender, age, and parents' educational background in detail (Böyük et al., 2011; Erol et al., 2022; Kunt et al., 2015; Kuru & Akman, 2017; Tuzcuoğlu & Akarsu, 2019; Yıldız & Yıldız, 2021). Scientific process skills were also found in relation to science technology engineering and math education (STEM education). Studies reported that preschool children's scientific process skills were positively influenced by STEM education (Abanoz, 2020; Ünal & Aksüt, 2021). However, despite the prevalence of studies demonstrating a positive correlation between parental educational status and children's scientific process skills, there is a need for further elaboration on this relationship within the existing literature. In the literature, no prior study addressing the relationship between children's scientific process skills and parents' scientific literacy skills was identified to the author's knowledge. Therefore, the current study aimed to contribute to this research area by specifically investigating the association between children's scientific process skills and parents' scientific literacy skills.

1.1 Purpose of the Study

Studies have indicated the relationship between children's scientific process skills, cognitive development, problem-solving skills, and science attitudes (Germann, 1994; Harefa, 2023; Özgelen, 2012). The existing literature revealed insight concerning children's scientific process skills and gender, age, number of siblings and parents related variables such as education level and age (Kuru & Akman, 2017; Ardila et al., 2005; Böyük et al., 2011; Erol et al., 2022; Germann, 1994; İlhan & Tosun, 2016; Saçkes, 2013; Yıldız & Yıldız, 2021). Moreover, in a study conducted by Kunt et al. (2015), it was found that children's scientific process skills were positively associated with parents' educational status. This study highlights how children's scientific process skills could potentially be affected by their parent's education. Apart from exploring the relationship between children's scientific process skills and other factors, namely gender, age, number of siblings and parents' educational status, age and parents' scientific literacy skills may also play a role in influencing their children's acquisition of scientific process skills as they affect children directly (Bronfenbrenner, 1979). Therefore, investigating children's scientific process skills in the context of parents' scientific literacy skills deserves further attention and exploration in future research. This study aims to examine the relationship between children's scientific process skills and parents' scientific literacy skills. In line with the purpose of the research topic, this study investigates the answers to the following research questions:

R.Q.1. What are the scientific process skills scores of preschool children?

1.1. Is there a difference between children's scientific process skills scores and gender?

1.2. Is there a difference between children's scientific process skills scores and age?

1.3. Is there a difference between children's scientific process skills scores and the number of siblings they have?

R.Q.2. What are the scientific literacy skills levels of parents?

R.Q.3. To what extent do parents' scientific literacy skills predict children's scientific process skills scores after the effects of demographic characteristics (i.e., education status and parents' ages) are controlled?

1.2 Significance of the Study

Science forms the foundation of technological, medical, and educational advancements. It enables individuals to understand events and devise solutions through critical thinking. In recent years, seeking scientific solutions to global challenges has become a top priority (United Nations Environment Programme, 2012). Consequently, there has been an increased global focus on science. With rapid advancements in technology and the subsequent impact on the economy, progress in science is evident in our daily lives, ultimately enhancing our overall living standards (Organization for Economic Co-operation and Development, 2018).

Therefore, it has become essential for countries to use science to produce, make changes, improve what already exists, and compete in the international field. In light of technological advancements, science is a future requirement for individuals as various countries determined an aim to provide science for all people to make way for developments (American Association for the Advancement of Science, 1990; Saracho & Spodek, 2008). The future of society is dependent on decisions that need to be founded on scientific understanding (Saracho & Spodek, 2008). Individuals should have scientific awareness through systematic knowledge surrounded by a scientific environment.

In a study conducted by Laugksch (2000), it was stated that countries could only be prosperous internationally if they give enough attention to raising individuals who know how to use, analyze and interpret science-related content and such individuals are named as scientifically literate (Laugksch, 2000). It was argued that being a scientifically literate individual was not limited to having knowledge about common science topics such as biology, physics, and chemistry, but rather it constituted technology, social sciences, and math (American Association for the Advancement of Science, 1989). One of the first steps to being a scientifically literate individual is to have scientific process skills. Developing scientific process skills is essential to achieve scientific understanding and become scientifically literate individuals.

However, in the literature review on the scientific process skills of children, it was seen that there was a limited number of studies focused on the scientific process skills of preschool children in the context of parents. The parent-children studies examined the attitudes and opinions toward science and the effect of parent involvement in science activities in early childhood (Yılmaz et al., 2018). It was seen that studies focused on primary school and elementary school students rather than children in early childhood. National Science Teachers Association argues that parents also play an essential role in the success of children in schools (NSTA, 1994). Parents who encourage the daily use of science concepts and process skills enhance their child's ability to learn necessary skills (NSTA, 1994). Moreover, children acquire their parents' life of style, culture, and opportunities. At this point, parents' scientific literacy skills might help explain whether or not children's scientific process skills are affected by it.

Therefore, new studies investigating the scientific process skills of preschoolers are needed to understand the influence of parents' role in children's scientific process skills. Discovering the relationship between children's scientific process skills and parents' scientific literacy skills and examining the relationship between them may reveal new perspectives on these skills and their natures to various stakeholders, including teachers, parents, policymakers, and researchers. They could benefit from the findings of this study to improve children's development.

The study's findings could help policymakers develop early childhood science-related initiatives. Understanding the impact of the scientific literacy skills of parents on children's scientific process skills could guide the creation of the main framework for both parent involvement and engagement programs. Policymakers could benefit from the findings of this study to develop educational policies that would create a scientifically literate community in the future. Moreover, this study could give a clue to policymakers to design educational interventions for children in order not to make a gender disparity in the early childhood period. Understanding the impact of gender in the development of children's scientific process skills could help to identify and prevent potential gender inequalities in science. Interventions and educational approaches could be designed to close the potential differences in the acquisition and development of scientific process skills. These interventions could include additional educational support programs aimed to help children and their parents.

In addition, acknowledging the importance of age on scientific process skills, given that early childhood is the cornerstone of children's life, teachers can conduct age-appropriate activities to foster children's scientific process skills from an early age. They can also initiate appropriate interventions to foster a positive attitude toward science in young children.

The study's findings can help teachers understand the value of family dynamics in acquisition of science and scientific inquiry leading to develop children's scientific process skills. Teachers could work collaboratively with parents to contribute to children's development by fostering parent involvement and helping to create inclusive learning environment at home as much as possible to contribute to individual development of children. Teachers could plan activities encouraging parent engagement, support project-based research, and provide parent training programs. These efforts could promote collaboration between schools and families and can help children improve scientific process skills in a holistic way. They could promote the cultivation of scientific process skills, and their relevance to everyday life can enhance scientific literacy skill levels.

Findings of this study could give parents valuable insights about their significant role and influence in their children's lives and overall development. Parents can become more aware of how their participation in science-related activities and communication about scientific concepts might benefit their children's learning. They could develop an understanding of spending quality time engaging in their children's education by integrating science into their everyday lives. Parents could receive training to improve themselves, cooperate with the school, create opportunities to develop scientific process skills, and try to raise individuals with scientific literacy skills in the future by improving their children's scientific process skills.

The study’s findings could contribute to the existing literature on children’s scientific process skills in the context of parents’ scientific literacy skills. This study could help researchers investigate parents’ role in children’s scientific process skills. Based on the findings of this study, researchers could explore the various ways in which parents influence their children’s development. To enhance comprehension of the impact of parental influence on children’s development within a scientific context, researchers could undertake comparative studies using diverse research methodologies and sample groups. This approach would allow for a more comprehensive examination of the findings, contributing to a deeper understanding of this important aspect."

Furthermore, investigating the relationship between children’s scientific process skills and parents’ scientific literacy skills could contribute to the evidence for the value of parental support in enhancing the interest in science. It could emphasize the importance of building family conditions that support scientific discovery, access to educational resources, and favorable attitudes toward science. This study could provide support for the literature by informing parents about how essential their scientific literacy skills are in developing their children’s scientific process skills. Therefore, the relationship between children’s scientific process skills and parents’ scientific literacy skills is worth investigating.

1.3 Definition of Terms

Early Childhood: A period including children in the ages from 2 to 6 years (Berk, 2015).

Parent: Individuals who support the cognitive, language, physical, socioemotional, and other needs of their children (Berger & Riojas-Cortez, 2013).

Scientific Process Skills: A set of widely applicable skills that are relevant to various scientific disciplines and reflective of the practices employed by scientists (Padilla, 1990). These skills include observation, classifying, measuring, communicating, estimating, predicting, and inferring (Saracho & Spodek, 2008).

Scientific Literacy Skills: These skills are generally defined as recognizing, analyzing, and interpreting quantitative data and scientific information, leading to an inquiry into scientific knowledge (Gormally et al., 2012).

Scientifically Literate Individuals: Individuals with scientific literacy skills that would enhance their ability to operate as responsible citizens who can think critically, grasp relationships, and have scientific knowledge (Ölçer, 2017).

CHAPTER 2

LITERATURE REVIEW

This chapter includes theoretical background and a review of the related literature of the study regarding scientific process skills in early childhood and scientific literacy skills of parents. Firstly, Jean Piaget's Constructivist Approach, Lev Semyonovich Vygotsky's Sociocultural Theory, and Urie Bronfenbrenner's Ecological Systems Theory are explained as the theoretical framework of the study. Secondly, scientific process skills, scientific process skills in early childhood and scientific literacy skills are presented. Lastly, a summary was provided to conclude the chapter.

2.1. Theoretical Background

At early ages, children observe their surroundings and sometimes copy the actions of others. In this way, children spontaneously develop their knowledge of the world and conduct their own experiments (Piaget, 1964). They try to construct their knowledge by trying, making mistakes, and interacting with people and various environments they have been in. Piaget's constructivist approach, in this sense, focuses on children's active knowledge development and comprehension through interactions with their environment. According to Piaget, children's cognitive development improves as they actively explore and shape the environment they are in (Piaget, 1964). This approach highlights the importance of hands-on experiences and experiments in developing scientific thinking and problem-solving skills in the framework of gaining scientific process skills. In addition, Vygotsky's sociocultural theory emphasizes the influence of social and cultural surroundings on children's development (Berk, 2015). As children are regarded as social beings in his theory, they also learn to think and understand mostly through social interaction (Mahn & John-Steiner, 2013). This theory may help better understand how siblings and parents could contribute to children's scientific process skills and the relationship between them. Furthermore, Bronfenbrenner's ecological systems theory highlights the relationship between the

the social and environmental circumstances in which children grow and develop. Multiple systems that are connected with each other impact children’s development, ranging from the innermost system like family and school to the outermost system like cultural values and traditions (Bronfenbrenner, 1979). This theory could help explain children’s scientific process skills to see how different systems impact their knowledge and participation in scientific activities.

While Piaget’s approach could help investigating how children’s cognitive development could be explored to shape their ability to engage in hypothetical reasoning and abstract thinking can impact their skills to formulate their own theories and conduct experiments, Vygotsky’s and Bronfenbrenner’s theory could help providing useful insights into aspects that impact children’s development and learning. From this point of view, Jean Piaget’s Constructivist Approach, Vygotsky’s Sociocultural Theory and Urie Bronfenbrenner’s Ecological Systems Theory were specified as the theoretical framework of this study.

2.1.1. Jean Piaget: Constructivist Approach

Children need to comprehend and learn about their environment right from the moment they are born. Their parents or other adults could quickly learn something different and new in a limited time because they have limitless knowledge about the world. However, young children do not have the same levels of experience or knowledge. Adults were once young children, and they developed understanding, learning, and actively participating in the world they live in. This process is called cognitive development, which could be explained as the continuum from infancy to adulthood in which individuals develop various ways to understand the world (Piaget, 1964).

Jean Piaget was one of the most important supporters of the constructivist approach to cognitive development (Saracho, 2021). Piaget was interested in how children thought on different occasions and believed that children were active learners (Huitt & Hummel, 2003; Senemoğlu, 2018). He observed that young children were inquisitive about the world and proposed that knowledge development happened spontaneously (Piaget, 1964; Piaget, 1976). Accordingly, his studies concluded that children’s perceptions and decisions were the opposite of adults' (Ülgen, 1997). Moreover, Piaget believed that children had a certain amount of knowledge when they were born, facilitating their perception of the world (Saracho, 2021).

According to Piaget, children are instinctively interested in the environment around them, and they propose various questions related to their experiences (Piaget, 1955). Piaget thought that this interest and questioning were due to children's nature of searching for knowledge (Piaget, 1955). Children's questions also indicate their thinking about the world covering science content areas. Through their questions, children construct new knowledge from personal experiences, leading them to acquire an innovative understanding of their own (Saracho, 2021). Therefore, Piaget supported that individuals learn or construct new knowledge based on previous experiences and learning (Ültanır, 2012). As Piaget observed children of different ages, during the process of children's cognitive development, he concluded that children go through four stages of evolution. These stages are the sensorimotor stage, preoperational stage, concrete operational stage, and formal operations stage.

The first stage is explained as pre-verbal, which involves the first 18 months of children's lives (Piaget, 1964). According to Piaget, in this stage, infants develop knowledge that forms the basis substructure of future representational knowledge (Piaget, 1964). This substructure could be clarified as "infants constructing an understanding of the world by coordinating their sensory experiences such as seeing and hearing with physical actions" (Santrock, 2014, p. 169). Piaget further explained this stage with an example of how children devise ways to explore, assemble and give meaning to the world (Piaget, 1954). These schemes are the basis of knowledge and are formed by the simple actions of the children (Santrock, 2014). Children use schemes in two ways.

The first way to use schemes is to assimilate newly acquired knowledge into already existing schemes (Santrock, 2014). When children gain new information related to what they previously learned, the schema gets explained, or missing information fits into gaps (Saracho, 2021). The second and final way to use schemes is to accommodate their already existing schemes to fit with new knowledge or experiences (Santrock, 2014). When children's unique experiences or knowledge conflicts with the previously formed schemes, children adapt their latest information to their existing knowledge (Santrock, 2014). Moreover, in this stage, infants do not have object permanence, meaning that when an object disappears from their sight, they think it does not exist and do not attempt to find it (Piaget, 1964). With the development of constructing a permanent object, infants try to find the disappearing object and develop structures for future representation (Piaget, 1964).

The second stage is the stage where language, thought, and representation start (Piaget, 1964). This stage is believed to last from 2 to 7 years of age, and children put thoughts into words, images, or drawings as their representation of the world (Piaget, 1964; Santrock, 2014). However, children's actions in the sensorimotor stage are not instantly transformed into operations (Piaget, 1964). Therefore, the preoperational stage has two sub-stages that explain children's transition from the sensorimotor stage to the preoperational stage: the symbolic function stage and the intuitive thought stage.

In the symbolic function stage, children develop the ability to mentally represent objects that are not present (Santrock, 2014). In this stage, children use their drawings to describe various things, such as their house, parents, toys, or environment; however, they do not think logically (Santrock, 2014; Ciccarelli & White, 2012). In the intuitive thought stage, children want to know the answers to their questions and start to use reasoning (Santrock, 2014). According to Santrock (2014), Piaget named this substage intuitive because children look confident about their knowledge but do not know how they have obtained it.

The third stage is explained as children using concrete operations (Piaget, 1964). Piaget called this stage concrete operational because children do not verbally express their thoughts or hypotheses but operate on them (Piaget, 1964). Children in this stage might be unable to imagine the steps of hypothetical questions (Santrock, 2014). However, fundamental science knowledge such as numbers, classification, ordering, and logic of relations form in this stage (Piaget, 1964). According to Piaget, children in this stage can start solving complicated problems and understand reversibility (Bjorklund, 2012; Santrock, 2014).

The fourth and final stage sees children constructing new operations using logic (Piaget, 1964). Children in this stage develop greatly and solve problems using verbal presentations as they begin to think like scientists (Feldman, 2013; Santrock, 2014). It is thought that children reach this formal operational stage at 11 years old and go through four stages of cognitive development (Bernstein et al., 2008). However, it has also been found that some children are unable to reach to formal operational stage (Bernstein et al., 2008).

In conclusion, Piaget observed children attentively and discovered how they altered their new knowledge in their lives (Santrock, 2014). Children's engagement and interaction seems to determine their perception and understanding of the world (Piaget & Inhelder, 1962). Piaget emphasized that children could create and imagine a world that reflects their growth. Children's knowledge varies as their cognitive processes develop and mature. These changes occur when their experiences are processed through complex methods of thinking and by forming knowledge representations (Martin, 2009). In this sense, the constructivist approach could explain how children make use of their daily experiences and experiments when learning, as learning and understanding develop through time and spontaneous accomplishments (Rakison & Lawson, 2013). The development of children shows improvement with age, but the influence of the environment on this issue cannot be ignored. As Piaget conducted extensive research by observing and interviewing children to understand how individuals perceive their environments and the world, he highlighted the dynamic relationship between individuals and their environment (Özgelen, 2012). Children's experiences are shaped by the influence of their environment, and they learn to test them by establishing their own hypotheses. Piaget's approach could highlight the significance of children's experiences in developing scientific process skills, wherein they actively engage in activities such as formulating hypotheses, conducting experiments, and explaining the results. Considering Piaget's constructivist approach, it can be inferred that children explore scientific concepts, enhance critical thinking skills, and develop problem-solving skills with the help of encouraging opportunities they take part in. Therefore, this study is based on this theoretical background as it explains children's capacity for research, observation, and testing of ideas and ultimately providing a foundation for their future scientific pursuits.

2.1.2. Lev Semyonovich Vygotsky: Sociocultural Theory

Vygotsky emphasized that children go through cognitive processes in constructing their knowledge (Vygotsky, 1978). While Vygotsky saw children as active searchers of information, he also recognized the influence of social and cultural surroundings on their thinking (Berk, 2015; Mahn & John-Steiner, 2013). According to Vygotsky (1978), learning initiates several internal developmental processes that could function when children interact with others in their surroundings and collaborate with peers. Also, he emphasized that social forces, such as instruction, are critical to children's learning (Santrock, 2014). Vygotsky proposed the zone of proximal development concept, which depicts tasks that children cannot complete independently but can do with assistance from more talented peers or adults (Santrock, 2014; Vygotsky, 1978). The lower limit is what children can do on their own, while the higher limit is what they can achieve with the help of relatively more knowledgeable peers or adults (Vygotsky, 1978). As children grow old, they seek out conversations with peers, such as validating a playmate's message, adding new ideas, and participating in current play to maintain it (Berk, 2015).

Moreover, adults maintain the problem within children's zone of proximal development and at a tolerable degree of difficulty by asking, prompting, and offering methods (Berk, 2015). Though Vygotsky (1978) considers learning to be a deeply social process, he also emphasizes discourse and language's many functions in education and mediated cognitive progress. Scaffolding, which involves adapting the assistance provided during a teaching session to the children's present level of performance, is similar to zone of proximal development (Berk, 2015). However, unlike the zone of proximal development, when children do not understand how to move forward, the adult utilizes direct teaching, breaking the process down into smaller steps, offering ways, and providing explanations for implementing them (Berk, 2015).

In this sense, the role of peers and adults in the development of children is undeniably essential. Vygotsky's sociocultural theory could guide the present study by investigating the possible relationship between children and the individuals surrounding them, namely their siblings and parents. Children gain assistance and instructions from relatively more skilled peers from them (Mahn & John-Steiner, 2013). Therefore, while shared experiences with siblings through play could improve children's scientific process skills, parents' scientific literacy skills could help enhance children's scientific process skills by asking questions, providing methods and explanations, and facilitating environments that allow hands-on investigations.

2.1.3. Urie Bronfenbrenner: Ecological Systems Theory

Children's development throughout the years is affected by indirect and direct experiences. In these experiences, adults and the environment greatly influence children's learning. Urie Bronfenbrenner proposed an Ecological Systems Theory that explains how all humanity is responsible for even one child. According to Bronfenbrenner, development occurs when small and extra additions accumulate through time and shape children's perceptions of their experiences (Saracho, 2021). In this sense, children are inseparable from their parents and their environment. His theory discusses the child being the center, living in four complex systems, and developing by having an indirect and direct relationship through systems (Bronfenbrenner, 1979). These four systems are named microsystem, mesosystem, exosystem, macrosystem and chronosystem and are stated to be interrelated (Bronfenbrenner, 1979).

The microsystem is the closest system to the child, including environments such as the home or classroom (Bronfenbrenner, 1979). The immediate situations influencing the child, or the firsthand interactions also serve as direct experiences in the microsystem (Bronfenbrenner, 1979). In this sense, a child's experiences about science at home and environment could easily influence children's perception of science and scientific processing skills. As parents are involved in their children's lives, it could be inferred that opportunities presented by parents through their knowledge and their relationship with their children impact children's development.

The mesosystem is the second layer of the ecological systems theory. This system includes all the relations between two or more settings a child interacts with (Bronfenbrenner, 1979). The home, school, classroom, or neighborhood could be given as examples of settings in the mesosystem, as it could be considered a microsystem in it (Bronfenbrenner, 1979).

The exosystem is the third layer of the ecological systems theory. This system refers to all settings that do not include the child by direct experience (Bronfenbrenner, 1979). This system is explained as indirect experiences through policymakers such as government and politicians (Bronfenbrenner, 1979). Even though the child does not have direct experience with them, the decisions or policies concerning education, health, or children significantly affect them. Any early childhood education program or other educational programs constituted by educators could affect the quality and quantity of the related initiatives. However, the relationship between children’s parents and their work is also included in the exosystem. For example, if a parent changes their work pattern, this could result in conflict at home, affecting the child (Santrock, 2014).

The macrosystem is the utmost layer of ecological systems theory and includes all the beliefs, ideologies, cultures, or subcultures the systems contain or could develop in themselves (Bronfenbrenner, 1979). As children’s environment is exposed to the macrosystem, the child is influenced by direct experience. Parents from different backgrounds could also negatively affect their children’s development (Krishnan, 2010).

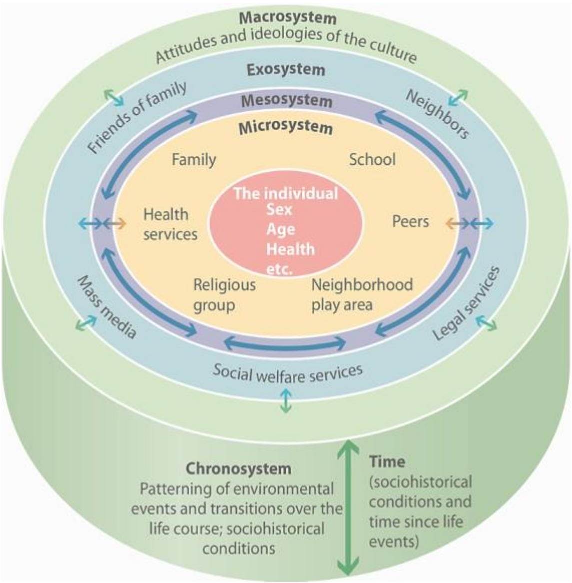

Figure 1 The Ecological Systems Theory (Santrock, 2014)

The chronosystem is explained as the occasions or transitions in one's life span (Schaie, 2012). This system is not a layer but consists of other systems over time (Santrock, 2014). An example of the chronosystem could be given as parents getting divorced and the effects on their children (Hetherington, 2006). As time passes, the interaction between other systems and the microsystem becomes safe and secure, along with the children's psychological state (Santrock, 2014). The representation of these systems can be seen in the Figure 1.

Bronfenbrenner's theory is a holistic approach to explaining how children develop in interrelated systems (Hayes et al., 2017). Accordingly, children develop in a system that directly and indirectly affects them (Bronfenbrenner, 1979). The theory describes four interrelated systems: the microsystem, mesosystem, exosystem, and macrosystem. The ecology of human development argues that children's development and characteristics are shaped by their complex environment through either direct or indirect experiences. The direct experiences refer to the child's immediate interactions with home, school, classroom, or neighborhood, which covers the microsystem and mesosystem. Society's shared beliefs, culture, or ideologies also directly affect children as they develop the same ideologies in their macrosystem. The policymakers, ministry of education, politicians, or local industry also indirectly affect the child by influencing education and healthcare. All systems work together to raise children and shape their personality and education by contributing to different weights.

In this sense, children's learning and development cannot be separated from their parents and current environment. Children's experiences are shaped by the opportunities presented to them by their parents. According to Merz et al. (2015), parental responsiveness impacts the development of children's cognitive skills. It could be inferred that development does not happen in one place and at one time, but it is built in and expressed through environmental conditions (Bronfenbrenner, 1979). Moreover, an effective relationship between parents could enhance and change children's perception of science. Additionally, studies have suggested that children whose parents refuse to engage with them may experience difficulties in developing and maintaining healthy relationships with teachers (Santrock, 2014). In these conditions, parents' knowledge to guide children and the environment are essential because children get motivated and engage in activities through great complexity (Bronfenbrenner, 1979).

Bronfenbrenner's theory forms the basis for the current study, considering children's interactions in these systems. In the microsystem, which is the immediate environment or the interactions influencing the children, such as number of siblings and parents, Bronfenbrenner's theory could explain the relationship between children's scientific process skills, siblings, and parents (Bronfenbrenner, 1979). The macrosystem could shed light on the gender differences in children's scientific process skills, and the exosystem could explain the indirect experiences children have due to their parents' interactions, comprising of ideologies or cultures. As the chronosystem accounts for the changes over time, as children grow old, their scientific process skills could also undergo changes (Schaie, 2012).

2.2. A Conceptual Background: Science

There is a wealth of documented scientific facts and findings, but as means of acquiring knowledge develop, more information is constantly discovered, and this process demonstrates the nature of science (Gallenstein, 2005). Science, due to its engaging nature, serves as an optimal content area for promoting children's learning and development (French, 2004). Science allows children to wonder, make predictions, and use their past knowledge while trying to test out and refine those predictions (Vahey et al., 2019). Examples of what makes an activity 'scientific' could include questioning how ramps make a ball roll toward a target faster or what plants grow. The important thing is to be able to ask investigable questions and provide rich opportunities for children so that they can investigate the answers to their questions (Vahey et al., 2019).

Science provides opportunities for children to learn about scientific concepts, listen to their surroundings, and respond to their questions or ideas (Vahey et al., 2019). It also allows children to ask and answer questions, build persistence, and improve their problem-solving and self-regulation skills, which are essential for academic success (McCormick et al., 2015). While hands-on experiences that cultivate children's curiosity and encourage them to question and examine natural phenomena help to develop these skills, these skills also allow children to engage in more complex activities such as obtaining, organizing, and recording data, making inferences, predicting outcomes, creating hypotheses, and recognizing and regulating factors as they get older (Gallenstein, 2005). Therefore, early childhood is a critical period in the development of children to encourage scientific curiosity, as well as the application of process skills.

2.3. Scientific Process Skills

The qualities that scientists use when conducting scientific research are referred to as scientific process skills. These are relevant to a variety of science areas, representing common scientific behavior and procedures (Padilla, 1990). Scientific process skills encompass the cognitive and metacognitive processes used to conduct scientific investigations and develop mental representations of natural phenomena (Saçkes, 2013). An individual's use of the scientific process skills helps them to understand scientific concepts, understand how to learn scientific information, discover the nature of science, become free researchers, and develop positive attitudes, interests, and skills towards science (Batı & Kaptan, 2013).

Utilizing scientific process skills facilitate the perception and interpretation of everyday events and their correlation with school-acquired knowledge, eventually leading to scientific literacy skills (Tan & Temiz, 2003). Scientific process skills can be categorized into two groups: the basic scientific process skills, which serve as the foundation for scientific investigation, and the integrated scientific process skills, which constitute the method of actual scientific inquiry (Martin, 2009). The basic scientific process skills are essential in scientific inquiry and form the key skills that underlie all scientific investigations. Additionally, the integrated scientific process skills consist of complex activities that build on the basic scientific process skills and are used in problem-based scientific inquiries (Martin, 2009). While basic scientific process skills are considered as observation, classification, measurement, communication, prediction and inference, the integrated scientific process skills include controlling variables, describing how to measure a variable in an experiment, formulating hypotheses and models, arranging data systematically and deriving conclusions from it, and engaging in experimentation (Padilla, 1990). Basic scientific process skills are essential for scientific inquiry, representing the fundamental abilities that underpin all scientific investigations (Martin, 2009). In early childhood, children actively participate in acquiring concepts and developing basic scientific process skills through their engagement in various learning experiences (Lind, 1998). Therefore, the basic scientific process skills which are used in early childhood are explained in detail in the following section.

2.3.1. Scientific Process Skills in Early Childhood

Children, like scientists, ask their parents questions about their environment and nature from an early age, do research to discover solutions to these questions, and begin their school life with these experiences. Children build up their knowledge in a cumulative way by using process skills that involve various activities such as asking questions, making observations (Martin, 2009). Moreover, scientific process skills are among the basic skills that facilitate learning in science education while enabling children to be active, develop responsibility for learning, and to learn research methods (Özkan, 2015).

As science activities aim to develop children's scientific process skills, they also aim to make children understand that the world is worth examining, researching, and learning about, and to contribute to them developing positive attitudes and motivation towards science (Conzeio & French, 2002; Murphy & Smith, 2014; Saçkes et al., 2012;). In early childhood, children learn simple ideas and then more complex ones (Rauf et al., 2013). Children can use the basic scientific processes skills: observation, classification, measurement, communication, estimation and prediction, and inference (Jones et al., 2008). The scientific process skills given in the literature review were determined according to the Scientific Process Skills Scale for 60-72-month-old Children used in the study which was developed by Özkan (2015) (See appendix G).

2.3.1.1. Observation

Observation is one of the most important skills in the scientific thinking process. Human perception and understanding of the world rely heavily on this process, which enables them to gather information from their surroundings. The senses of sight, smell, sound, touch, and taste serve as the channels through which brain receive information, allowing to perceive and describe the characteristics of objects and phenomena (Lind, 2005).

The initial step in acquiring information to address a problem is observation; therefore, children should be encouraged to employ a variety of observation methods and engage in regular practice to gather information effectively (Alisinanoğlu et al., 2017). The research suggests that children have well-developed observation skills (Jones et al., 2008). Children in the early years also observe by feeling objects as they have limited language skills. When they engage in such observations in the company of adults, the adults respond by providing verbal explanations or names for the objects the children are handling (Jones et al., 2008).

2.3.1.2.Classification

Classification is a skill utilized across scientific activity that plays a significant role in helping children connect facts to form concepts and to identify variables when they develop hypotheses and design experimental procedures (Martin, 2009). It involves grouping people, objects, or events into categories based on shared characteristics. Classification aims to create meaningful groupings based on similarities among the items being classified. By categorizing things into distinct groups, children can better understand and make sense of the world around them (Alisinanoğlu et al., 2017).

The classification process begins when children organize real items based on their observations of the objects' properties (Jones et al, 2008). Children must compare things and find subsets, which are groupings that share a unique attribute with that group, to form groups (Lind, 2005). Classification starts with children collecting the objects; however, if an object belongs to more than one category, it could be challenging for children, particularly those still developing concrete thinking skills (Alisinanoğlu et al., 2017).

2.3.1.3. Measurement

Measuring is an essential skill that involves assigning quantitative values to observations. Children often describe or compare objects or events using quantitative terms when engaging in science activities such as observing and classifying.

Additionally, measurements frequently involve comparing the properties of objects to a standard reference (Jones et al., 2008). Measurement in scientific contexts does not solely rely on the use of standard units of measurement (Alisinanoğlu et al., 2017). While standard units provide a common reference point for measurement, there are instances where non-standard or relative measurements are used in early childhood.

Measuring consists of numbers, distances, time, length, area, weight, volume, and temperature. During early childhood, the emphasis is often placed on measuring length, volume, weight, time, and temperature. However, these concepts could be challenging for children in the preoperational stage who have not yet developed the ability to understand conservation (Jones et al., 2008).

2.3.1.4. Communication

Communication is the ability to communicate thoughts and exchange information verbally, allowing people to share ideas and engage in dialogues with others (Jones et al., 2008). Children try to communicate with others even as infants, as they cry to express their needs. As they age, children start to comprehend how knowledge is generated and constructed (Alisinanoğlu et al., 2017). Science activities require precise and accurate information sharing; therefore, language is an important factor in communication (Harlen, 2000; Jones et al., 2008). Children engage in discussions and articulate their thoughts and observations with their peers. Additionally, children gradually make sense of what they have observed and develop a deeper understanding of scientific phenomena (Jones et al., 2008).

2.3.1.5. Estimation and Prediction

A prediction typically relies on previous knowledge, observations, or a combination of both, while estimation can be seen as a specific type of prediction (Jones, 2008). Additionally, estimating and predicting are closely related skills as they both involve a form of thinking that entails anticipating or projecting an event or measurement based on the information at hand (Funk et al., 1985).

In science activities, it is important to ask open-ended questions to children in order to lead children into making reasonable predictions (Alisinanoğlu et al., 2017). To foster the development of estimation skills, it is important to encourage children to articulate the reasons behind their predictions. By asking children to explain their thought processes and provide justifications for their predictions, they are prompted to think critically and reflect on the factors influencing their estimations. This helps children develop a deeper understanding of the concepts involved and enhances their ability to make informed predictions based on evidence and reasoning (Özkan, 2015). Children rely on their past experiences and observations to make predictions. By drawing on what they have learned and observed in the past, children can anticipate or make educated guesses about what may happen in the future (Monhardt & Monhardt, 2006).

2.3.1.6. Inference

Inference is a cognitive process that categorizes observed events or circumstances based on specified features and to make sense of their relationships. It necessitates forming conclusions or developing inferences based on available evidence or observations. Individuals might infer underlying meanings or future outcomes by spotting patterns, parallels, or linkages. In scientific thinking, inference is critical for comprehending cause-and-effect relationships and drawing logical conclusions from observations and data (Alisinanoğlu et al., 2017). It is critical for children to understand the distinctions between observations and inferences in order to improve their capacity to form inferences (Jones et al., 2008). This entails giving young children plenty of opportunities to engage in observation and inference exercises. Children can build the core skills required for making inferences by actively monitoring their surroundings and absorbing information (Jones et al., 2008).

2.3.2. Scientific Process Skills in Relation to Gender, Age and Number of Siblings

Scientific process skills consist of basic skills that help individuals in scientific inquiry and problem solving. These skills are observation, classification, measurement, communication, estimation and prediction, and inference (Jones et al., 2008). Children’s gender, age, and number of siblings they have could have an influence on the development of these skills.

In the literature, some studies stated that there are differences in scientific process skills in terms of gender and age. For instance, in a study conducted by Song and Black (1991), the scientific process skills of interpretation and application in students were investigated in relation to their gender and age. It was revealed that there is a relationship between scientific process skills, gender and age favoring older age groups. In a study examining the scientific process skills and emotional development levels in preschool children, it was found that age of children and their ability to make predictions and inferences based on scientific process skills differed significantly (Tuzcuoğlu & Akarsu, 2019). Furthermore, Dahsah et al. (2017) reported that children's scientific process skills improved as they get older. Additionally, in a study exploring investigate kindergarten children's mathematics and scientific process skills, Saçkes (2013) found that children's gender was a significant predictor of their proficiency in mathematics and scientific process skills favoring girls over boys. However, in third grade, boys tend to achieve higher scores on mathematics and science tests compared to girls. According to Renee'White (1999), the reason for the gender differences observed in science and mathematics could be explained by the variety of treatment and experiences girls and boys receive. Examples of these treatments could be given as the different behaviors of parents towards girls and children and the various opportunities and toys they provide (Renee'White, 1999). In addition to gender and age, the number of siblings children have can also be an important factor in the acquisition and development of scientific process skills.

The number of siblings children have could affect the development of science process skills through social interactions and sharing experiences in both positively and negatively. According to Muñez et al., (2022), children with fewer siblings exhibited better math and reading skills compared to those with more siblings. However, Carpendale and Lewis (2004) stated that siblings are significant in shaping children's social, emotional, moral, and cognitive growth. Additionally, Azmitia and Hesser, (1993) concluded that spending a substantial period of time with siblings and engaging in activities have positive aspects in children's development. However, parents constitute educational resources in children's lives. As a result of this, children with fewer siblings could be more successful because they can use these resources more effectively (Downey, 2001). Consequently, children with siblings could receive less individualized attention and parental support during their early years. Based on these studies, it may be possible to observe differences in the acquisition or development of scientific process skills in the early childhood period in relation to gender, age and number of siblings children have.

2.3.3. Studies in Scientific Process Skills

In this part, studies in scientific process skills in early childhood education were given in detail. When the literature was examined, it was seen that the impact of teachers' practices, on children's scientific process skills or their relationship with each other were examined. Furthermore, a positive correlation was observed between these variables, indicating that teaching practices positively impacted children's development of scientific process skills (Afifah et al., 2019; Dahsah et al., 2017; Dilek et al., 2019; Guarrella et al., 2023; Kim et al., 2022; Vurucu & Şahin).

Studies in the literature examining the relationship between children's scientific process skills and various applications were found. Öngören (2023) conducted a study investigating preschool teachers' earth and space practices in providing children with basic scientific process skills. The study was designed as a phenomenological pattern which is a qualitative research design. The study was conducted with 28 preschool teachers working in public schools. An interview form was used in the data collection process, and data were analyzed by using the inductive content analysis method. At the end of the study, it was concluded that preschool teachers used a variety of approaches to teach the different themes with demonstration, dramatization, art, experimentation, observation, question-and-answer sessions, and instructive. It was discovered that these techniques provided scientific information relevant to earth and space science ideas to children, leading them to develop scientific process skills.

Guarrella, Van Driel and Cohrssen (2023) investigated teacher's assessment practices and the factors that influence these practices during the implementation of playful science experiences in day care and preschool settings in Australia. The study utilized a multiple case study approach and conducted semi-structured interviews with three cases, analyzing the themes that emerged from the interviews. The teachers were introduced to the NT Preschool Science Games and provided with an assessment tool designed for observing and developing scientific process skills. It was revealed that contextual factors, affective responses, and teaching approaches influenced assessment practices. To enhance teacher practice in early childhood science and promote assessing children’s capabilities within playful learning, the researchers proposed a model called “Assessment for Playful Learning.” This model aimed to provide support for teachers in effectively assessing children’s learning experiences in science while incorporating playful and child-centered approaches.

Savaş and Şeker (2022) designed a study to investigate how STEM education training practices developed for preschool children affect their scientific process skills. The quasi-experimental research design was used in the study. The participants of the study were children who attend preschool classrooms in a primary school affiliated with the Ministry of National Education and took place in the fall semester of the 2020-2021 academic year. 12 STEM activities were applied to children in the experimental group for six weeks. During this process, children in the control group were not intervened. The study’s results stated that STEM activities positively affected children’s scientific process skills.

Vurucu and Şahin (2020) conducted a study to investigate the impact of science and engineering practices on children’s scientific process skills in early childhood. The study utilized a mixed method design. Data were collected using the Scientific Process Skills Test and the Student Projects Evaluation Rubric. During the study, children worked in groups to create projects such as bridges, parachutes, cars, and swings. These projects were designed to encompass the stages of the STEM cycle. The collected data from the scientific process skills test were analyzed quantitatively and qualitatively, while the project evaluation rubric was analyzed quantitatively. The results obtained from the study indicated that science and engineering projects positively impact the improvement of children’s scientific process skills.

Saygılı and Yalman (2021) investigated the effects of play-based teaching on improving preschool children’s scientific process skills. This study used the experimental research design, one of the quantitative research methods. The study took place in Mersin, with nine boys and nine girls attending a preschool. The study’s results indicated that play-based teaching effectively helped children to gain and develop the rudiments of scientific process skills.

Based on the findings of these studies, it could be inferred that teachers' practices on specific educational concepts such as earth and space, assessment, STEM education training, science and engineering and play-based teaching have positively affected the development and improvement of children's scientific process skills.

The studies in the literature also investigated how different activities influenced children's scientific literacy skills. Turan and Aydoğdu (2020) researched the impact of robotic coding education on the scientific process skills of preschool children. The design of the study was experimental research. Participants of this study were 30 preschool children and applications were conducted in Erzincan province in the fall semester of the 2017-2018 academic year. A Coding and Robotic Education Program was applied to the experimental group for eight weeks, two days a week, 16 sessions in total. The control group did not receive any intervention during this period. At the end of the study, it was concluded that robotic coding education had positively developed the preschool children's scientific process skills.

Moreover, Dilek, Taşdemir, Konca and Baltacı (2019) designed a study to research children's science motivation and their utilization of scientific process skills in inquiry-based STEM activities. Participants in this study were 14 children in the ages of 5-6 years. Classroom observations, as well as pre-interviews and post-interviews, were used to collect data. According to the study's findings, children actively participated in STEM activities and regularly used at least one of the scientific process skills. Furthermore, it was shown that children displayed engineering thinking skills in addition to scientific process skills. The study also revealed positive changes in children's motivation towards science.

Afifah et al., (2019) investigated how to enhance children's scientific process skills through building beam learning activities. The study focused on implementing building activities centered around optical geometry in the context of beams. The study was designed as descriptive qualitative research. Participants of this study were 18 early childhood children in Bandung, Indonesia. The findings indicated that engaging in building beam activities positively impacted the development of children's science process skills. These activities also contributed positively to the children's cognitive, physical, motor, language, and socio-emotional development.

Yılmaz, İlkörücü and Çepni (2018) conducted a study to investigate the impact of science activities, specifically those involving parent involvement, on the scientific process skills of 5-6-year-old children attending preschool. The study utilized a mixed methods design, collecting quantitative data through a Preschool Science Process Skills Scale for Children Aged 60-72 months and qualitative data through semi-structured interviews with the parents. Participants of this study were 30 children in the 5-6 age range and 15 parents. The study results indicated that the children in the experimental group, who participated in the science activities with parent involvement, demonstrated more developed scientific process skills compared to the control group. The qualitative data revealed that the parents positively perceived the parent involvement activities, leading to increased communication with their children. Furthermore, the qualitative findings indicated that the parents enhanced their children's motivation toward science and provided increased support in this domain.

The findings of above-mentioned studies indicate that activities such as robotic coding, inquiry-based STEM, building beam learning or science contributed positively to the children's development and scientific process skills. Furthermore, some educational programs were found to have impact on children's scientific process skills. While Öcal (2018) researched the Early STEM Education Program's effectiveness on 60–66-month-old children currently attending preschool on their scientific process skills, Tekerci and Kandır (2017) investigated the impact of the Sense-Based Science Education Program on the scientific process skills of children aged 60-66 months. Both programs were found to improve children's abilities related to scientific inquiry, observation, experimentation, and critical thinking. These findings suggested that implementing the programs successfully enhanced the development of scientific process skills in the studied group of children.

Additionally, Batı, Ertürk and Kaptan (2010) designed a study to examine scientific process skill attainments in the cognitive domain of the Preschool Education Program 2009 for Children aged 60-72 months, as well as the awareness levels of preschool teachers regarding scientific process skills. Qualitative research techniques, specifically content analysis and descriptive analysis were employed to analyze the data gathered from the interview forms. The study found that limited emphasis was placed on science activities in preschool education and there was a low level of awareness among preschool teachers regarding scientific process skills. These findings suggested a need for improvement in enhancing the knowledge and awareness of teachers in this area.

Yılmaz and Yüzbaşıoğlu (2022) examined the impact of intelligence games implemented as part of the Ministry of Education Intelligence Games Preschool Course Program on children's scientific process and attention skills. The study was designed as a quasi-experimental design with a pretest and posttest control group. The participants of the study were 59 children in total, 30 of whom were in the experimental group, and 29 were in the control group. Children in the experimental group, who took part in the Intelligence Games Preschool Course Program, demonstrated significantly higher scores than the control group who did not attend the program. Specifically, they demonstrated enhanced abilities in the sub-dimensions of estimation, inference, scientific communication, measurement, and observation, as well as in the overall mean scores of scientific process skills and attention skills.

Moreover, it was seen that education programs that were project-based influenced children's scientific process skills significantly and indicated that they positively affected children's development of scientific process skills. Kim, Yoon and Han (2022) designed a study to investigate the effectiveness of an inquiry-based cooking project in enhancing children's scientific process skills and promoting healthy eating habits. The study employed a quantitative research method. The research was conducted over a period of nine months in South Korea, involving 67 children in the experimental group and 58 children in the control group. The experimental group had cooking projects, whereas the control group received no intervention. The findings of the study showed that cooking projects could enhance academic experiences by fostering scientific processing skills and providing children with the opportunity to explore the joy of food preparation, experiment with different foods and flavors, and develop healthy eating habits.

Can, Yıldız-Demirtaş and Altun (2017) conducted a study to investigate the impact of an active learning and project-based science education program on the scientific process skills and conceptions about the nature of science among 6-year-old children. The study employed a quasi-experimental research design comprising experimental and control groups with pretest and posttest assessments. Participants of the study included 26 children, 17 in the experimental group and 9 in the control group. The experimental group received project-based science education conducted with active learning, while the control group received project-based science education without active learning for 32 weeks. The findings revealed that the experimental group showed higher scores in scientific process skills related to the nature of science and displayed greater familiarity with the corresponding conceptions compared to the control group. These findings provide evidence of the positive impact of project-based science education.

Furthermore, upon reviewing research on scientific process skills during the preschool period, researchers reported that different educational approaches significantly influenced children's scientific process skills. Özkan (2021) conducted a study to examine and compare the scientific process skills of 5-6-year-old preschool children in kindergartens that implemented the Reggio Emilia approach and those that did not. The research aimed to find the impact of the Reggio Emilia program on the development of scientific process skills in young children. The study was designed as a qualitative study. The participants were 80 children in total, 35 of whom went to a preschool providing a Reggio Emilia based program and 45 to a private preschool that did not utilize any such program. Data was collected using the Scientific Process Skills Scale for 60-72-Month Children developed by the researcher. The study provided insights into the potential influence of implementing the Reggio Emilia approach and suggests that the program's implementation may contribute to enhancing children's scientific process skills, highlighting the importance of the school environment and parental factors in shaping children's abilities in this domain.

Buldur (2019) investigated the scientific process skills of preschool children within the context of a Montessori approach. The study employed a longitudinal research design to gather comprehensive data over time. The participants of the study were 60 children between the ages of 4 and 6. Among the participants, 14 children were enrolled in a Montessori class within a public kindergarten, while the remaining 46 children were from four different Montessori classes within a dedicated Montessori kindergarten. This composition allowed for a diverse representation of children engaged in a Montessori educational environment. By examining the progress and acquisition of these skills over time, the study showed the effectiveness of Montessori education in fostering children's scientific thinking and problem-solving abilities.

Kefi (2017) designed a study to examine whether children receiving preschool education could utilize basic scientific process skills by implementing a project approach. The study developed six projects as exemplary models and guided teachers to carry out these projects with children aged 4-5-6 in Foça Municipality Preschool. The study involved analyzing data obtained through document reviews and similar materials collected during the initial phase, development phase, and presentation phase of the projects. Content analysis was employed to analyze the data regarding basic scientific process skills. It was observed that project-based activities supported children in utilizing scientific process skills and the Reggio Emilia, Montessori and project approaches were found effective in developing children's scientific process skills. Implementing these approaches appeared to have a positive impact on improving children's scientific process skills.

In addition, the relationship between children's scientific process skills and different variables was examined in the literature. Sezer and Aksüt-Arslan (2023) researched the relationship between the learning styles of 5–6-year-old children and their scientific process skills. The research design followed a relational survey model, employing a quantitative research approach. The participants of the study were 216 children aged 5-6 years attending independent kindergartens and kindergartens in the city center of Bolu. The findings of the study indicated significant and varying levels of positive relationships between scientific process skills and learning styles among the children.

Erol, İvrendi and Özcan (2022) explored the relationship between children's scientific process skills and self-regulation skills. The study was designed as a correlational survey model. The study was conducted with 223 children between the ages of 4-6 years. The results of the analysis revealed a statistically significant and moderately positive relationship between children's self-regulation skills and scientific process skills. Therefore, it was stated that children's self-regulation skills could be an essential factor in developing scientific process skills.

Yıldız and Yıldız (2021) conducted a study to research the relationship between creative thinking and scientific process skills of preschool children. The research followed a correlational research model, employing quantitative methods. The study was conducted with 70 children aged 60–66 months. The findings of the study revealed a positive relationship between creative thinking and the scientific process skills of preschool children. Moreover, the study highlighted the influence of home environment quality, gender, and parents' educational backgrounds on children's creative thinking abilities.

Tok (2020) examined the resilience level and the mathematics and scientific process skills among 5-year-old children attending preschool education. The study employed a descriptive research method grounded in the quantitative research model. Additionally, a correlational research method was utilized to examine the relationships among the variables under investigation. Participants were 384 5-year-old children who had regularly attended preschool in Malatya. The children exhibited at least one risk factor listed as a criterion and demonstrated adaptation to the environment. Based on the study's findings, it was observed that the resilience levels, as well as the mathematics and scientific process skill levels, among 5-year-old children attending preschool education were generally high. Moreover, the study revealed a moderate positive correlation between resilience and math skills among 5-year-old children and a high positive correlation between resilience and scientific process skills. Additionally, the findings suggest that children's resilience levels significantly predict their math and scientific process skills.

Güven and Yılmaz (2020) designed a study to examine the relationship between children's auditory and visual attention skills and their scientific process skills. The study was designed as survey research which is a quantitative research design. The study was conducted with 156 children between the ages of 60-72 months, and applications were conducted in the 2018-2019 academic year in İstanbul. The Preschool Science Process Skills Scale for 60-72 Months Old Children by Özkan (2015) and the Listening Test and Concentration Test for 5-Year-Old Children by Ergin (2004) were used to assess children. The results showed a positive relationship between children's visual and auditory attention skills and their scientific process skills.

Tuzcuoğlu and Akarsu (2019) explored the relationship between scientific process skills and emotional development levels in preschool children. The study followed a quantitative approach and utilized a correlational survey design to fulfill its research purpose. Participants were 35 children aged 48-66 months and data were collected in İstanbul during the 2018-2019 academic year. These children exhibited a normal developmental course and had received at least one year of preschool education. Upon analysis, no significant relationship was found between scientific process skills and emotional development levels. However, significant differences were identified between sub-dimensions of scientific process skills (communication and classification skills) and emotional development.

Kuru and Akman (2017) conducted a study to investigate the scientific process skills of children attending preschool education institutions while considering various variables. The study utilized a correlational survey research design. The participants were 250 children and 50 preschool teachers. Based on the research findings, it was determined that significant relationships existed between children's age, the type of school they attended, their preschool education status, and their scientific process skills. However, no significant relationship was found between the teachers' professional service time, science activity duration, and the children's scientific process skills.

Kunt, Özel and Kunt (2015) conducted research to determine 6-year-old preschool children's scientific process skills and compare their scientific process skills levels regarding different variables. The study was designed as descriptive research, which is a quantitative research design. The participants were 342 children and data were collected in the spring semester of the 2013-2014 academic year in Kütahya. An assessment tool (The Scientific Process Skills Test) was developed to assess children's scientific process skills. the tool comprised 22 items and six sub-dimensions, including basic process skills. Accordingly, it was found that there was a significant relationship between children's scientific process skills and parents' education, and teachers' education. Moreover, it was stated that children receiving education in private schools had better science process skills than those in state schools.

Saçkes (2013) designed a study to investigate kindergarten children's mathematics and scientific process skills. Additionally, the study explored how children's proficiency in these process skills influences their performance on mathematics and science achievement tests during the 3rd grade. Multilevel structural equation modeling, one of the quantitative research methods, was used in the study. The data from the Early Childhood Longitudinal Study-Kindergarten cohort was used. The findings revealed a strong relationship between science and mathematics process skills at the overall construct level. The study also highlighted that the competence of kindergarten children in mathematics process skills significantly predicted their performance on both science and mathematics achievement tests in the 3rd grade. Conversely, competency in science process skills was only found to be a significant predictor of performance on the science achievement test in the 3rd grade.

In light of these results, children's scientific process skills were found to be significantly related with other developmental domains, such as self-regulation skills, creative thinking, resilience level, auditory and visual attention skills, emotional development, and mathematics skills. Upon reviewing research on scientific process skills during the preschool period, it was also found that Dahsah, Seetee and Lamainil (2017) had developed an instrument for assessing children's basic science process skills through interviews about familiar objects and events. The children were asked to utilize their scientific process skills to complete each task in a step-by-step manner. The study included a sample of 30 children ranging in age from 6 to 10. The results indicated that the instrument could effectively measure children's basic science process skills across all age groups. Furthermore, the study demonstrated that children tend to develop their science process skills as they grow older.

Moreover, Monhardt and Monhardt (2006) offered suggestions to implement scientific process skills into children's literature. By utilizing children's books, the aim was to provide primary school teachers with examples and inspiration for teaching scientific process skills. The examples served as a starting point, encouraging educators to create additional instances. The study highlighted the variety of opportunities within children's literature to foster the development of scientific process skills in an engaging and relevant way.

2.4. Scientific Literacy Skills

Scientific literacy skills are "the ability of an individual to understand scientific laws, theories, phenomena, and things (Friedman, 1974)." This description means the responsibility of each individual to have the necessary scientific knowledge base to make practically any informed decision (Dragoş & Mih, 2015). However, over the years, the definition of scientific literacy skills has changed and gained different meanings. Consequently, the literature also uses many definitions for scientific literacy skills. For instance, Dragoş and Mih (2015) who sought to evaluate the quality of information and arguments presented by scientists and the mass media stated that scientific literacy skills represent the ability to use evidence and data.

Other definitions advance scientific literacy skills as the nature of science, knowledge level, and science and technology's effect on society's way of living (Miller, 1983). According to Durant (1993), scientific literacy skills are the sum of cognitive, affective, and psychomotor skills related to science. From this point of view, scientific literacy skills are the ability to understand, follow, assimilate, and consciously use scientific and technological developments, which includes all cognitive and psychomotor skills that maintain an individual's quality of life (Özdemir, 2010).

Scientific literacy skills also represent what society knows about science (Durant, 1993). According to Jenkins (1994), it means understanding science's nature, aims, limits, and different scientific ideas. Based on these meanings, scientific literacy skills are also regarded as a "public understanding of science" (Durant, 1993). Therefore, the aspects of scientific literacy skills could be defined as science helping to solve current issues, being internalized by society, and being a fundamental activity of humanity (Shen, 1975 as cited in Liu, 2009).

Scientific literacy skills refer to an individual's ability to read, understand and express opinions on scientific issues. In today's scientific and technological society, this skill consists of three dimensions: the nature of science (i.e., understanding the principles and methods of science), content knowledge of science (i.e., understanding basic scientific concepts and terms), and recognizing the impact of science and technology on society (Miller, 1983). Understanding science processes and comprehending scientific knowledge that exists in daily life is one of the scientific literacy skills (Fives et al., 2014).

However, there are different perceptible skills for scientific literacy. These skills include conceptual understanding and an individual's attitude toward science and society (Bauer et al., 2007). A scientifically literate individual is expected to engage in higher-order thinking skills such as "explaining phenomena scientifically," "evaluating and designing scientific inquiry," and "interpreting data and evidence scientifically" (OECD, 2013a)

According to Gormally et al. (2012), scientific literacy skills are related to two major categories: recognizing and analyzing the methods of inquiry that lead to scientific knowledge. Moreover, organizing, analyzing, and interpreting quantitative data and scientific information are stated as scientific literacy skills (Gormally et al., 2012). In this sense, it was proposed that scientific literacy skills could be understanding the methods of inquiry that lead to scientific knowledge, organizing, analyzing, and interpreting scientific information (Gormally et al., 2012). Furthermore, identifying a well-founded scientific argument, evaluating the validity of sources and the use of scientific information, and understanding the research designs and how they influence findings were also given as scientific literacy skills.

According to Laugksch (2000), individuals who possess scientific literacy skills understand the nature of science, have the ability to apply relevant science concepts, principles, laws, and theories, and use science in problem-solving and making decisions. Therefore, scientifically literate individuals know how to use and interpret scientific explanations of the nature of the world and evaluate scientific evidence and explanations (NRC, 2007). Also, scientifically literate individuals understand the nature and development of scientific knowledge while participating productively in scientific practices (NRC, 2007). While scientific literacy skills are widely considered as being of general educational importance, all definitions focus on individuals' ability to use and apply scientific knowledge in real-life situations.

2.4.1. Studies in Scientific Literacy Skills and Science Knowledge

Upon reviewing the literature, it has been noticed that there are few studies on scientific literacy skills of adults. The research focused on primary school, elementary school, and high school students or preservice teachers' scientific literacy skills. Therefore, this section includes both studies on scientific literacy skills of adults and science knowledge.

Studies on parent's scientific literacy skills were limited and mostly studied within the context of children. Some studies in the literature have focused on the scientific literacy skills levels of parents and their children's scientific literacy skills or academic achievement. For instance, Can and Besler (2018) examined the impact of digital and media activities on the scientific literacy skills and media literacy of secondary school students and their parents and explored the relationship between these two factors. In the study, a quasi-experimental research design was used, and the participants were 60 students and 119 parents. The study was conducted in Bursa in the 2013-2014 academic year. Based on the analysis of the data obtained from the research, a significant correlation was found between the pretests and posttests of scientific literacy skills among secondary school students and parents, specifically concerning their engagement in digital and media activities. Based on these findings, several recommendations were proposed to underscore the significance of 21st-century skills literacy, enhance science and media literacy levels, and attain more comprehensive outcomes.

Şahin, Sanalan, Bektaş and Kaygısız (2010) conducted a study to investigate the presence of a significant correlation between the science literacy levels of parents of 7th grade primary school students and the academic success of their children in the science and technology course. The participants were 59 7th-grade students enrolled in private primary schools in Erzincan province during the second term of the 2008-2009 academic year. For the study, the success of the students in science and technology courses was determined using the scores from the Placement Test (SBS) conducted in June of the 2007-2008 academic year. Additionally, the science literacy levels of the parents were assessed using a researcher-developed Science Literacy

Questionnaire consisting of 12 items. The findings revealed that the science literacy levels of parents were significant predictors of student achievement.

In the existing literature, studies investigating the scientific literacy skills of parents also included research conducted with teachers. Gül-Ulukan (2021) investigated the scientific literacy skills levels of parents and preschool teachers who have children in preschool and explored their perspectives on scientific literacy skills and science education. The study utilized mixed methods by using explanatory sequential design. In the quantitative part of the study, data were collected from 275 teachers and 300 parents. The Basic Science and Technology Literacy Test (TFOT) adapted by Duruk (2012) was used to assess their scientific literacy skills levels. In contrast, in the qualitative part, a subset of participants from the quantitative phase was selected. Interviews were conducted with nine teachers and nine parents to gain insights into their views on scientific literacy skills and science education. The study revealed that teachers' and parents' perceptions on scientific literacy skills and science education correspond to their relative degrees of science literacy skills.

In studies focusing on the scientific literacy skills levels of adults, researchers also explored the scientific literacy skills levels of preservice teachers and in-service teachers and attitudes towards scientific literacy skills. Çavaş, Özdem, Çavaş, Çakıroğlu and Ertepınar (2013) designed a study to assess the scientific literacy skills levels of preservice elementary science teachers in Turkish universities and explore the influence of various variables, including attitude toward science, gender, year in university, and parental education level, on their scientific literacy skills. The study sample included 667 first year and 405 fourth year preservice teachers from 10 education faculties in Turkey. The results indicated that preservice teachers exhibited satisfactory levels of scientific literacy regardless of their gender or year in university. The findings suggested that preservice elementary science teachers in Turkey possess adequate scientific literacy skills levels.

Similarly, Dragoş and Mih (2015) conducted a study to assess teachers' attitudes towards scientific literacy skills. The participants in this study were high school teachers selected from the historical region of Maramures. According to the findings, understanding the educational context allowed the adaption of well-defined techniques to improve scientific literacy skills. Teachers could develop their scientific literacy skills by analyzing the educational context and taking relevant activities and techniques. Teachers had an important role in developing scientific knowledge among children, and positive attitudes and continued professional development were essential for making long-term advances in scientific literacy skills.

Though studies on adult scientific literacy skills are scarce, some studies have focused on the science knowledge of adults. Shauli and Baram-Tsabari (2020) investigated the impact of science knowledge on parents' decision-making in hearing-impaired families. The study utilized mixed methods research. The participants were 115 parents who had hearing impaired children. The interviews were made with parents and experts of hearing rehabilitation and a questionnaire was filled out by parents. The findings show that general science knowledge is the most significant predictor of contextual knowledge and therefore has a significant role in the lives of hearing-impaired families.

Crall, Jordan, Holfelder, Newman, Graham and Waller (2013) examined how individuals' knowledge and attitudes toward science change with citizen science program. Additionally, participants' scientific literacy skills and attitudes towards science were investigated. The study was designed as experimental research. The experimental group attended a one-day course, while the control group did not receive any training. The study results indicated improvements in scientific literacy skills and desire to engage in pro-environmental actions.

Furthermore, some studies focused on the impact of training parents on their children's science experiences. Eberbach and Crowley (2017) examined the influence of parental conversations and discipline knowledge on children's observations in informal learning. The study was designed as mixed methods research. The participants of the study were 79 parents and their children aged 6 to 10 years. Half of the parents were trained to use four conversational methods during family observations in a botanical garden. The findings of the study showed that parents who received the training on conversational methods utilized these methods more frequently than those who used their natural conversational style. The parents' disciplinary discussions during the garden observations had an impact on what children learnt from the experience.

Along with studies focusing on scientific literacy skills among parents and teachers, the literature also contains research investigating the scientific literacy skills of children. These were also included in the literature review since one of the most important aspects of scientific literacy skills is scientific process skills (Husna et al., 2022).

Booth, Shavlik and Haden (2022) examined how children's interest in causal information, in other means casual stance, develops over time and its association with their concurrent and subsequent scientific literacy skills. The participants were 153 children from diverse backgrounds assessed at ages 3, 4, 5, and 6. The results revealed that children's causal stance at age three consistently predicted their scientific literacy skills at each subsequent data collection point, extending through preschool, kindergarten, and first grade. The implications of this study highlighted the importance of nurturing children's causal reasoning skills and curiosity from an early age. Enhancing children's causal stance and providing opportunities could contribute to their school readiness and facilitate their development of scientific literacy skills.

Similarly, Choiriyah, Lutfani, Khoirunisa, Faturahman and Nabila (2021) conducted a study to examine the requirements for scientific literacy skills in early childhood that employed qualitative research methods as teachers were interviewed. The participants were 5 early childhood teachers. The findings indicated that implementing scientific literacy skills as a learning program in early childhood classrooms necessitates three aspects, including attitudes, skills, and self-competence in children's cognitive development. The study had implications for education by emphasizing the development of teacher competencies in managing scientific literacy skills during early childhood.

Additionally, when examining the literature, scientific literacy skills of children is also found to be influenced by various variables such as parents or environment. For instance, Booth, Shavlik and Haden (2020) conducted a study on preschoolers' scientific literacy skills development and their interest in science-related topics, exploring the influence of parents' casual talk in this context. The researchers defined casual talk as parents engaging in informal conversations, where they casually explain relevant information and invite their children to participate in explaining as well. This study observed 153 parent-child pairs engaged in play activities in both a museum and a laboratory setting. The frequency with which parents discussed causal information during play was found to predict the strength of their children's understanding of causality, which is an essential component of scientific thinking. The study revealed that parents played a significant role in shaping their children's scientific engagement and literacy from as early as three years of age. By incorporating causal talk and encouraging children to explain causal phenomena, parents can potentially contribute to developing their children's scientific thinking and interest in science-related topics.

Moreover, Kähler, Hahn and Köller (2020) investigated the development of scientific literacy skills in early childhood and how its influenced by children's experiences in learning environments such as their homes and kindergartens. This study utilized longitudinal data from the Starting Cohort 2 of the German National Educational Panel Study, which included 2,937 children from kindergarten to the third grade of primary school. The study's findings indicated that the scientific literacy skills of children in kindergarten increased over time, and there were initial differences in scientific literacy skills among kindergarten children. Furthermore, the study did not identify significant individual differences in the growth of scientific literacy skills over time. This suggests that the initial gap in children's scientific literacy skills was not closed by the time they reached school. It highlighted the importance of early childhood experiences, such as the home and kindergarten environments, in shaping children's scientific literacy skills.

Bauer and Booth (2019) designed a study with the aim of exploring how developing scientific literacy skills in children is influenced by causal reasoning and executive function. The participants were 125 3-year-old children who completed three tasks related to a scientific literacy measure, causal reasoning, and three tasks assessing executive function. It was found that executive function and one specific aspect of causal reasoning called causal inferencing were linked to scientific literacy skills. Furthermore, the study revealed that causal inferencing ability partially mediated the relationship between executive function and scientific literacy skills. This suggests that executive function may play a role in supporting scientific literacy skills by facilitating the development of causal reasoning skills.

Upon examination of the studies, it has been noted that a scientific literacy skills project also played a significant role in enhancing the scientific literacy skills of children. The focus of Mantzicopoulos and Samarapungavan's (2013) study was on the effects of the Scientific Literacy Project, particularly children's participation in its classroom and home components, on science learning and motivation outcomes. The participants were kindergarten children from four neighboring low-income schools. Two schools implemented the SLP science activities, with 79 children participating in the classroom component and 41 children participating in both the classroom and home components. A comparison group of children from two other schools engaged in regular science activities. The findings stated significant benefits for the Scientific Literacy Project groups regarding science learning, achievement, and motivation. Children demonstrated gains in general science knowledge, higher levels of positive self-competence beliefs for science, and independence in learning science. The study highlighted the importance of integrating science activities in both the classroom and home settings to enhance children's science knowledge, self-competence beliefs, family support, and independence in science learning.

The findings of the above-mentioned studies suggested that parents and the environment, such as school and home, play a significant role in children's scientific literacy skills. Additionally, causal reasoning and executive function were found to contribute to the development of scientific literacy skills in children. Furthermore, the Scientific Literacy Project demonstrated advantages for children in terms of science learning, achievement, and motivation.

2.5. Summary of The Literature Review

The existing literature contains numerous research studies that have focused on scientific process skills and scientific literacy skills. with regards scientific process skills, many research studies have been conducted to investigate the relationship between children and other variables, including different teacher practices, areas of development, or impacts of educational programs. The target sample of these studies mostly included preschool children. In light of these studies, it was concluded that children's scientific process skills can be improved with additional applications, educational programs or approaches. Therefore, the objective of this study is to contribute to the understanding of the relationship between parents' scientific literacy skills and children's scientific process skills.

Studies on parents' scientific literacy have been limited and centered around their children. Some researchers have examined both parents' scientific literacy skills levels and their children's scientific literacy or academic achievements. Additionally, investigations into the scientific literacy skills of parents have also encompassed studies involving teachers. In the context of adult scientific literacy skills, researchers have explored the levels of preservice and in-service teachers' scientific literacy skills and their attitudes towards it. While studies on adult scientific literacy skills were scarce, some have concentrated on adults' science knowledge. Furthermore, certain studies have focused on the impact of training parents on their children's science-related experiences. Moreover, in children centered studies, it was seen that they included the development of scientific literacy skills, comparison of the scientific literacy skills levels of students at different educational levels. The other studies concluded that science activities enhance children's science knowledge, self-competence beliefs, and independence in science learning as well as age, parents' educational background, and access to science materials at home may play a role in shaping the scientific literacy skills levels of children. Moreover, students develop crucial scientific skills, attitudes, motivation, and communication abilities when different approaches are utilized. However, research on parents' scientific literacy skills is limited.

CHAPTER 3

METHOD

This chapter includes the research design and the methodological explanation of the current study. It provides detailed information on the procedures in the study to obtain reliable and valid findings.

3.1. Research Design

The main objectives of the current study were threefold. The initial goal was to examine the scientific process skill scores of preschool children and determine whether these scores exhibit variations concerning gender, age, and the number of siblings. The second objective focused on evaluating the scientific literacy skill levels of parents. Finally, the study aimed to assess the potential relationship between children's scientific process skills and their parents' scientific literacy skills. In line with this purpose, the quantitative research method was used as it allows the researcher to collect numerical data from a vast number of participants using instruments with questions and corresponding responses (Creswell, 2012). A correlational research design was also used to explain the relationship between preschool children's scientific process skills and their parents' scientific literacy skills while controlling demographic variables. This would help to identify the relationship among two or more variables and to predict possible outcomes (Fraenkel et al., 2012). In the analysis, variables or groups of variables were introduced step by step, with each independent variable being evaluated based on its contribution to predicting the dependent variable, after accounting for the effects of the preceding variables (Pallant, 2020). This design was employed to assess the predictive power of parent-centered variables on children's scientific process skills. By controlling for parents' education, age, and scientific literacy skills, the study aims to determine the individual and combined impact of each variable on predicting their children's scientific process skills. The dependent variable in this study was determined as preschool children's scientific process skills and the independent variables were determined as parent's scientific literacy skills along with demographic variables, such as parent's education status and age. In accordance with the correlational research design, descriptive research was used to explain characteristics of preschool children's scientific process skills through the application of a demographic information form (i.e. gender, age, and number of siblings) and Scientific Process Skills Scale and parent's scientific literacy skills.

3.2. Research Questions

R.Q.1. What are the scientific process skills scores of preschool children?

1.1. Is there a difference between children's scientific process skills scores and gender?

1.2. Is there a difference between children's scientific process skills scores and age?

1.3. Is there a difference between children's scientific process skills scores and the number of siblings they have?

R.Q.2. What are the scientific literacy skills levels of parents?

R.Q.3. To what extent do parents' scientific literacy skills predict children's scientific process skills scores after the effects of demographic characteristics (i.e., education status and parents' ages) are controlled?

3.3.Population and Sample

In this study, data was collected from İstanbul. The target population were 60-72-months-old children who attend preschool and their parents. A random sampling method is the equal and independent chance of being chosen in a population (Fraenkel et al., 2012). Therefore, in this study, simple random sampling was used to make strong inferences and generalization for the population. Although there is no guarantee that the selected sample would be representative of the population, larger random samples have a higher chance of doing so than other sampling methods (Fraenkel et al., 2012). According to Tabachnick and Fidell (2013), larger samples consisting of more than 300 cases would be sufficient enough to conduct specified analysis, but small sample size would also be sufficient if there are high loading marker variables above .80.

Pallant (2020), on the other hand states that overall sample size should be more than 150 and with at least five cases for each of the variables. In this study, it was aimed to reach more than 300 parents and children to conduct the research.

This study took part in 8 preschools with 354 parents and 354 children. The preschools were located at Küçükçekmece (parents *f* = 51; children *f* =51), Fatih (parents *f* = 31; children *f* = 31), Güngören (parents *f* = 75; children *f* = 75), Zeytinburnu (parents *f* = 42; children *f* = 42) and Esenler (parents *f* = 154; children *f* =154) districts.

In this study, 49.6% of the children were girls (*f* = 175) and 50.4% were boys (*f* = 178). Children's age ranged from 60 months to 75 months (*M* = 68.38, *S.D.* = 3.584). 16.4% of the children were 60-64-month-old (*f* = 58), 43.3% of them were 65-70-month-olds (*f* = 153) and 40.2% of them were 71-75-month-olds (*f* = 142). Children's number of siblings ranged from not having siblings to having 4 siblings. 30.3% of the children had no siblings (*f* = 107), 46.7% of the children had 1 sibling (*f* = 165), 14.7% of the children had 2 siblings (*f* = 52), 5.7% of the children had 3 siblings (*f* = 20) and 2.5% of the children had 4 siblings (*f* = 165).

Among the parents, 18.7% of the mothers (*f* = 66) were aged 30 years or below, 64.9% of the mothers (*f* = 229) were in the age group of 31-40 years, and 16.4% of the mothers (*f* = 58) were 40 years old or older. In addition, 5.7% of the fathers (*f* = 20) were 30 years old or below, 58.6% of the fathers (*f* = 207) were in the age range of 31-40 years, and 35.7% of the fathers (*f* = 126) were 40 years old or older.

Regarding the parents' education levels, .6% of the mothers (*f* = 2) were illiterate, 1.4% (*f* = 5) were literate, 9.6% (f = 34) were primary school graduates, 9.1% (*f* = 32) were secondary school graduates, 28% (f = 99) were high school graduates, 43.1% (*f* = 152) were undergraduates, and 8.2% (*f* = 29) were postgraduates. For fathers, .6% (*f* = 2) were illiterate, .6% (*f* = 2) were literate, 7.4% (*f* = 26) were primary school graduates, 12.7% (f = 45) were secondary school graduates, 30.6% (*f* = 108) were high school graduates, 39.1% (*f* = 138) were undergraduates, and 9.1% (*f* = 32) were postgraduates.

The research showed variations in how the educational status of parents was categorized. While there were studies that show the educational status of parents without categorizing them, there were also studies that distinguish them as low medium high or low and high (Hortaçsu, 1995; Kelesidou et al., 2017; Kunt et al., 2015; Minello & Blossfeld, 2017). In this study, parent's education levels were categorized into two groups as low and high education level (illiterate, literate, primary school graduate, secondary school graduate, and high school graduate combined as having low education level; undergraduate and postgraduate combined as having high education level). Accordingly, 48.7% of the mothers had a low education level (f = 172), and 51.3% a high education level (f = 181). For fathers, 51.8% had low education level (f = 183), and 48.2% had high education level (f = 170). Moreover, 96% of the parents (f = 339) were married, .6% of them (f = 2) were separated, and 3.4% (f = 12) were divorced.

3.4. Data Collection and Instrumentation

The study was conducted using three data collection instruments. These were a Demographic Information Form (See appendix F), the Scientific Process Skills Scale for 60-72-month-old Children (Özkan, 2015) (See appendix G) and the Universal Science Literacy Scale (USLS) (Çelik, 2016) (See appendix H).

The data was collected with the cooperation of preschool administrators and teachers. The Demographic Information Form and Universal Science Literacy Scale (USLS) was distributed to parents or primary caregivers by teachers with the approval of preschool administrators. Parents filled out the Demographic Information Form and Universal Science Literacy Scale (USLS) and turned them to the teachers. The researcher gathered the returned instruments and applied the Scientific Process Skills Scale for 60-72-month-old Children by interviewing children individually.

3.4.1. Demographic Information Form

The demographic information form was provided by the researcher to parents or primary caregivers to obtain information about the participant parents and preschool children. This included questions about parent's age, educational level, marital status, professions and their children's age, gender, and number of siblings (See appendix F).

3.4.2. Scientific Process Skills Scale for 60-72-month-old Children

The Scientific Process Skills Scale for 60-72-month-old Children was developed by Özkan in 2015 in Turkish to assess 60-72-month-old children's scientific process skills (See appendix G). The scientific process skills were classified as basic or integrated (Padilla, 1990). Basic skills help children learn through experience and the scale focuses on simple scientific process skills (Özkan, 2015).

In order to develop the items for the Scientific Process Skills Scale, Ministry of National Education's (MoNE) Early Childhood Education Program, which was developed in 2013, national and international literature were used (Özkan, 2015). Initially 53 items and materials related to items were presented to experts in the field of Early Childhood Education and a pilot study was conducted with 30 children in Kadıköy, Beşiktaş, Ataşehir, Ümraniye in the education year of 2012-2013 (Özkan, 2015). The items in the scale were evaluated with the Lawshe technique in terms of content validity with expert opinions (Özkan, 2015). As a result, the items in the scale were decreased to 31 and 4 factors were determined as the following: Prediction-Inference-Communication, Classification, Measuring and Observation (Özkan, 2015). The examples of the items can be seen in Table 3.1. The Scientific Process Skills Scale for 60-72-month-old Children has 31 items and is a binary type of scale consisting of the following answers "0 = false and 1 = true". The highest score that can be obtained from the scale is 31 and lowest score is 0. The lowest score that can be obtained from the dimensions are 0. The highest score that can be obtained from the dimensions are as the following: 12 for Prediction-Inference-Communication, 8 for Classification, 7 for Measuring, and 4 for Observation.

Table 3.1 *Examples of the Items in the Scientific Process Skills Scale*

Factors	Items
Prediction-Inference-Communication	1.3. I have a candle with me, what happens if I light the candle and cover it with a glass?
Classification	2.4. Group these objects according to their materials. (There are 3 objects made of wood and metal)
Measuring	3. 5. Tell me this book's height by measuring with these sticks.

Table 3.1 (continued)

Observation	4.1. Show me two differences between these two pictures. (Two SpongeBob pictures were shown)

In the process of implementing the scale, the researcher interviews each child one by one in a quiet and empty place. The researcher reads the items in the scale while showing the related material to child and waits for the child to respond for approximately 30-45 seconds. The researcher does not show the scale items and materials beforehand. Each item and material are presented and shown in order on the scale. The items could be repeated if the child asks; however, the researcher does not express whether the answers given by the child are true or not.

The Scientific Process Skills Scale for 60-72-month-old Children was applied to 45 children 3 weeks apart to test scale's validity and reliability (Özkan, 2015). The factor structure of the scale was tested by using Varimax Rotation Technique to decide if items were sufficient to factor analysis. KMO and Bartlett's Tests were used to examine the factors and found as .80 (Özkan, 2015). Kuder Richardson coefficient was used to analyze the reliability of the scale and found as .89 (Özkan, 2015). On the basis of these results of the study, the scale items and factors' invariance levels over time were sufficient to use to assess 60-72-month-old children's scientific process skills.

This scale was chosen for implementation with children primarily due to its data collection and development in İstanbul, ensuring cultural relevance. Moreover, the scale demonstrated statistical validity and reliability, making it suitable for assessing children's understanding and maintaining their engagement with the scale items.

3.4.2.1. Scientific Process Skills Scale for 60-72-month-old Children Validity and Reliability

In this study, the Scientific Process Skills Scale for 60-72-month-old Children was applied to 353 children. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Tests of Sphericity were used to examine the items and found as .679. KMO and Bartlett's Tests of Sphericity value is considered satisfactory when it is 0.6 or above, indicating that the sample size is adequate for the analysis (Pallant, 2020). Kuder Richardson coefficient was found as .705. Item-Total Correlation values ranged from .687 to .716. Since values were not less than .3, items in this scale were related to scientific process skills (Pallant, 2020).

Table 3. 2 *KMO and Bartlett's Test of the Scientific Process Skills Scale for 60-72-month-old Children*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.679
Bartlett's Test of Sphericity	Approx. Chi-Square	1407.973
	df	465
	Sig.	.000

3.4.3. Universal Science Literacy Scale (USLS)

Global Scientific Literacy Questionnaire (GSLQ) was developed by Mun et al. (2015) and adapted to Turkish by Çelik (2016) and named the Universal Science Literacy Scale (USLS) (See appendix H). The Global Scientific Literacy Questionnaire was majorly developed using the research of Laugsch & Spargo (1996) as a basis for its items and dimensions. In addition, the questionnaire incorporated a social perspective and emphasizes the importance of human effort in scientific pursuits. According to Mun et al. (2015), the Global Scientific Literacy Questionnaire has been revised to reflect the importance of basic sciences in daily life and to incorporate 21st-century skills and competencies. The Global Scientific Literacy Questionnaire aims to measure the level of scientific literacy skills of the participants.

The scale is composed of 48 items, which are categorized into 4 dimensions and 8 factors. The four dimensions of the scale are Habits of Mind (items 1-13), Character and Values (items 14-22), Science as Human Endeavor (items 23-35), and Metacognition and Self-Direction (items 36-48) (Çelik & Can, 2017). Habits of Mind involve solving problems in a variety of situations through collaboration with others, utilizing appropriate resources, and presenting arguments based on evidence and logic. (Mun et al., 2015). Character and Values encompass the beliefs of showing compassion and understanding towards people and the environment, motivating individuals to address global problems and contribute to them in a scientific manner. (Mun et al., 2015). Science as Human Endeavour involves understanding that theories, empirical evidence, and multidisciplinary methods were created by humans and recognizing the connection between science and society. (Mun et al., 2015).

Metacognition and Self-direction are essential aspects of lifelong learning, where individuals are aware of their cognitive capacity and actively seek new knowledge to overcome problems (Mun et al., 2015).

It is a 5-likert type scale consisting of the following answers “1 = strongly disagree, 2 = disagree, 3 = undetermined or neutral, 4 = agree, 5 = strongly agree”. The highest score that can be obtained from the scale is 240 and the lowest score is 48. The lowest score that can be obtained from the dimensions are as the following: 13 for Habits of Mind, 9 for Character and Values, 13 for Science as Human Endeavor, and 13 for Metacognition and Self-direction. The highest score that can be obtained from the dimensions are as the following: 65 for Habits of Mind, 45 for Character and Values, 65 for Science as Human Endeavor, and 65 for Metacognition and Self-direction.

The Universal Science Literacy Scale’s validity and reliability study was conducted with 645 pre-service science educators (Çelik, 2016). The Cronbach alpha internal consistency coefficient was calculated for each dimension and somewhat changed as the following: Habits of Mind (α=.80), Character and Values (α=.76), Science as Human Endeavor (α=.79), and Metacognition and Self-Direction (α=.85) (Çelik, 2017). The Cronbach alpha internal consistency coefficient calculated for the scale was (α=.91) (Çelik, 2016). Confirmatory factor analysis in the study specify that the goodness-of-fit index found to be statistically significant ($\chi2$/sd=2.03, NFI= 0.94, NNFI= 0.97, CFI= 0.97, GFI= 0.88, AGFI= 0.86, RMSEA= 0.04) (Çelik, 2016). The result of the study suggests that adaptation of the Global Scientific Literacy Questionnaire to Turkish language and culture in the name of Universal Science Literacy Scale could be used to measure scientific literacy skills of individuals.

In the studies conducted, no specific scale dedicated to measuring the scientific literacy skills of parents was identified. Therefore, alternative scales that were developed or adapted for this purpose were explored. Upon examination of the items within these scales, the ones chosen were found to effectively measure the components of scientific literacy skills. Additionally, the data used for these scales were collected from diverse locations across Turkey, and the statistical analysis confirmed their significant validity and reliability.

3.4.3.1.Universal Science Literacy Scale (USLS) Validity and Reliability

Principal components analysis (PCA) and factor analysis (FA) are statistical methods used to explore a set of variables in order to identify groups of variables that are closely related to each other but relatively independent from other groups (Tabachnick & Fidell, 2013). Factor analysis is divided into explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) (Pallant, 2020). Principal components analysis (PCA) involves converting the original variables into a reduced set of linear combinations, incorporating all of the variability present in the variables (Pallant, 2020). In contrast, in factor analysis (FA), factors are determined through a mathematical model that focuses specifically on the shared variance among the variables (Tabachnick & Fidell, 2013).

Matsunaga (2010) proposed a "hybrid approach" that involves conducting an exploratory factor analysis (EFA) initially, followed by a confirmatory factor analysis (CFA) using separate datasets to validate the results obtained from the EFA. In this approach, an EFA was performed using the SPSS 26.0 Program to examine the factor structure of the Universal Science Literacy Scale. Subsequently, a CFA was conducted using the LISREL 8.8 program developed by Jöreskog and Sörbom (2006) to assess the overall model fit and the quality of the factor structure statistically. Accordingly, the data was randomly divided into two and subjected to EFA ($n = 186$) and CFA ($n = 172$) separately.

When examining the data set, sample size, normality, and Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) were checked for the factorability of the correlation matrix whether it was appropriate to perform EFA (Pallant, 2020). Some cases were found out to be outliers ($n = 12$). Only one case was found to be an extreme outlier; therefore, it was deleted. Bartlett's test of sphericity had a statistically significant value ($p < .05$) and KMO value was higher than .60; therefore, EFA was appropriate to perform (Tabachnick & Fidell, 2013; Pallant, 2020). After the validation of data set, sample size, normality, and Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO); eigenvalues, scatterplot, rotation matrices, and communality coefficients were examined.

Table 3.3 *KMO and Bartlett's Test of Universal Science Literacy Scale*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.926
Bartlett's Test of Sphericity	Approx. Chi-Square	5992.363
	df	1128
	Sig.	.000

The 48 items of the scale were subjected to principal components analysis (PCA) for explanatory factor analysis (EFA). Bartlett's test of sphericity had a statistically significant value (p = .000) and KMO value was .926 which was higher than .60 (See Table 3.3). When the correlation matrix was examined, it was seen that many of the coefficients were .3 and above; therefore, the data set was suitable for performing factor analysis.

To determine the appropriate number of components in principal components analysis (PCA), it is recommended to examine total variance explained table and screeplot (Pallant, 2020). According to Kaiser's criterion, only components with eigenvalues greater than 1 are considered relevant (Pallant, 2020). There were ten components with eigenvalues greater than 1 and explained 68.178% of the variance (See Table 3.4).

Table 3.4 *Principal Component Analysis of Universal Science Literacy Scale*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19,034	39,654	39,654	19,034	39,654	39,654
2	2,720	5,668	45,321	2,720	5,668	45,321
3	2,162	4,505	49,826	2,162	4,505	49,826
4	1,659	3,457	53,284	1,659	3,457	53,284
5	1,452	3,026	56,310			
6	1,234	2,570	58,880			
7	1,212	2,525	61,404			
8	1,151	2,397	63,802			
9	1,092	2,274	66,076			
10	1,009	2,102	68,178			

Although an inspection of scree plot revealed a clear break after the first component, the break after the fourth component indicated a possible four factor solution of the scale (See Figure 2). As the original version of the scale was reported as a scale with four factor structure, the scale was forced to four factor solution.

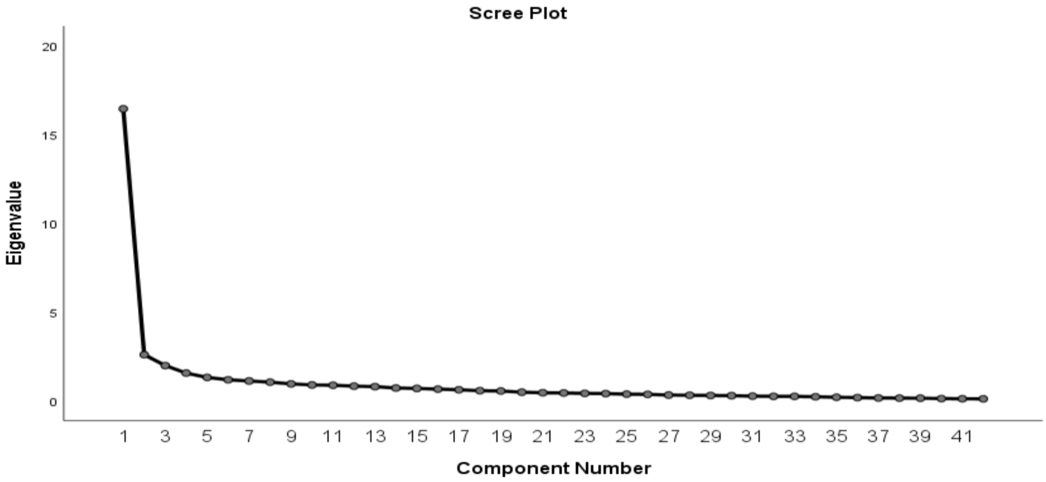

Figure 2 *Scree plot for the Universal Science Literacy Scale*

According to Pallant (2020), once the number of factors is decided, factor analysis can be proceeded by defining the number of factors specifically. Therefore, principal components analysis (PCA) was revised specifying the factors as 4 to be the same as the original scale.

Analyzing a four-component solution, the table depicting the structure matrix showcased unrotated loadings of the items and explored the communality coefficients, as detailed in Table 3.5. Notably, all items demonstrated robust loadings on the component, with coefficients ranging from .429 to .816.

Table 3. 5 *Pattern and Structure Matrix for Exploratory Factor Analysis of Science Literacy Scale*

Item	Component Coefficients				
	Component 1	Component 2	Component 3	Component 4	Communalities
oky40	.816				.7
oky42	.779				
oky43	.737		-.407		
oky36	.732				

Table 3.5 (continued)

oky44	.728		-.360	
oky41	.727			
oky46	.698		-.388	
oky6	.686			
oky3	.683		312	
oky5	.681			
oky39	.670			
oky45	.664		-.336	
oky7	.659	-.340		
oky10	.653	-.399		
oky47	.641		-.351	
oky38	.641			
oky11	.635			
oky15	.635			-.386
oky12	.628	-.377		
oky9	.622			
oky4	.618	-.344		
oky13	.600	-.423		
oky33	.599	.446		
oky35	.599	.330		
oky17	.596			
oky22	.594			
oky32	.594			
oky20	.580		.485	
oky18	.579			-.426
oky24	.564			.307
oky26	.563			
oky8	.556			
oky25	.554			
oky19	.546		.481	-.448
oky34	.539	.328		
oky30	.531			

Table 3.5 (continued)

oky1	.529			
oky2	.483			
oky28	.470	.443		
oky31	.461			
oky29	.429	.484		.308

However, in contradistinction to the original scale, overlapping items were removed one by one starting with the highest values and repeated principal components analysis (PCA) (Tabachnick & Fidell, 2013; Pallant, 2020). For the items in the following: 14, 16, 27, 21, 23, 48 and 37, it was decided to remove them in order. Principal components analysis (PCA) was repeated each time an item was removes from the scale. Item 22 was found to be significantly loaded to the Science as Human Endeavor rather than its original dimension Character and Values. Assuming that this item was perceived to be related to science in the population of this study, this item was not discarded and was evaluated within the Science as Human Endeavor factor. After the changes, the entire process was repeated. In Table 3.6, it can be seen that Bartlett's test of sphericity had a statistically significant value (p = .000) and KMO value was .925 which was higher than .60.

Table 3. 6 *KMO and Bartlett's Test of the Renewed Universal Science Literacy Scale*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.925
Bartlett's Test of Sphericity	Approx. Chi-Square	4745.739
	df	820
	Sig.	.000

Table 3.7 shows the final principal components analysis (PCA). The last PCA with four factor solution explained 53.719% of the variance of Universal Science Literacy Scale (USLS).

Table 3.7 *Principal Component Analysis of the Renewed Universal Science Literacy Scale*

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %

Table 3.7 (continued)

1	15.904	38.791	38.791	15.904	38.791	38.791
2	2.564	6.254	45.045	2.564	6.254	45.045
3	1.990	4.853	49.898	1.990	4.853	49.898
4	1.566	3.820	53.719	1.566	3.820	53.719

After EFA, Confirmatory Factor Analysis (CFA) was conducted to confirm construct validity of Universal Science Literacy Scale consisting of 4 factors. Universal Science Literacy Scale with 4 factors also examined through second-order CFA (See Figure 3). Value of chi-square was statistically (χ^2 = 1545.01, N = 172, df = 775, p = 0.0). Goodness-of-fit indices were explored to examine χ^2/sd and it was an indicator of the good fit with the value of 1.99 (Tabachnick & Fidell, 2013). Universal Science Literacy Scale's goodness-of-fit indexes were calculated as RMSEA = .073, CFI = .95, NFI = .90, NNFI = .94, RMR = .045, and SRMR = .073. These values were regarded as good fit (Çokluk et al., 2012). It was decided that the structural model of the Universal Science Literacy Scale had a good fitness level for parents.

After the validation of the Universal Science Literacy Scale, the scale's reliability was checked by using The Cronbach Alpha. Internal consistency of the scores obtained from a measuring tool refers to reliability of the instrument (Fraenkel et. al., 2012). According to Pallant (2020), scale's with more than 10 items should have a coefficient of .7 or more.

For Universal Science Literacy Scale, the Cronbach Alpha coefficient was found as α = .952 presenting a preferable internal consistency reliability. It was seen that removing any of the items from the scale will not improve the Cronbach Alpha coefficient according to the Item-Total Statistics table. Corrected Item-Total Correlation values ranged from .371 to .714. Since values were not less than .3, items in this scale were related to scientific literacy skills (Pallant, 2020).

The Cronbach Alpha coefficient was also calculated for each factor and reported as the following: Habits of Mind (α=.903), Character and Values (α=.829), Science as Human Endeavor (α=.847), and Metacognition and Self-Direction (α=.919). When the Corrected Item-Total Correlation value for item 22 was examined, it was seen that

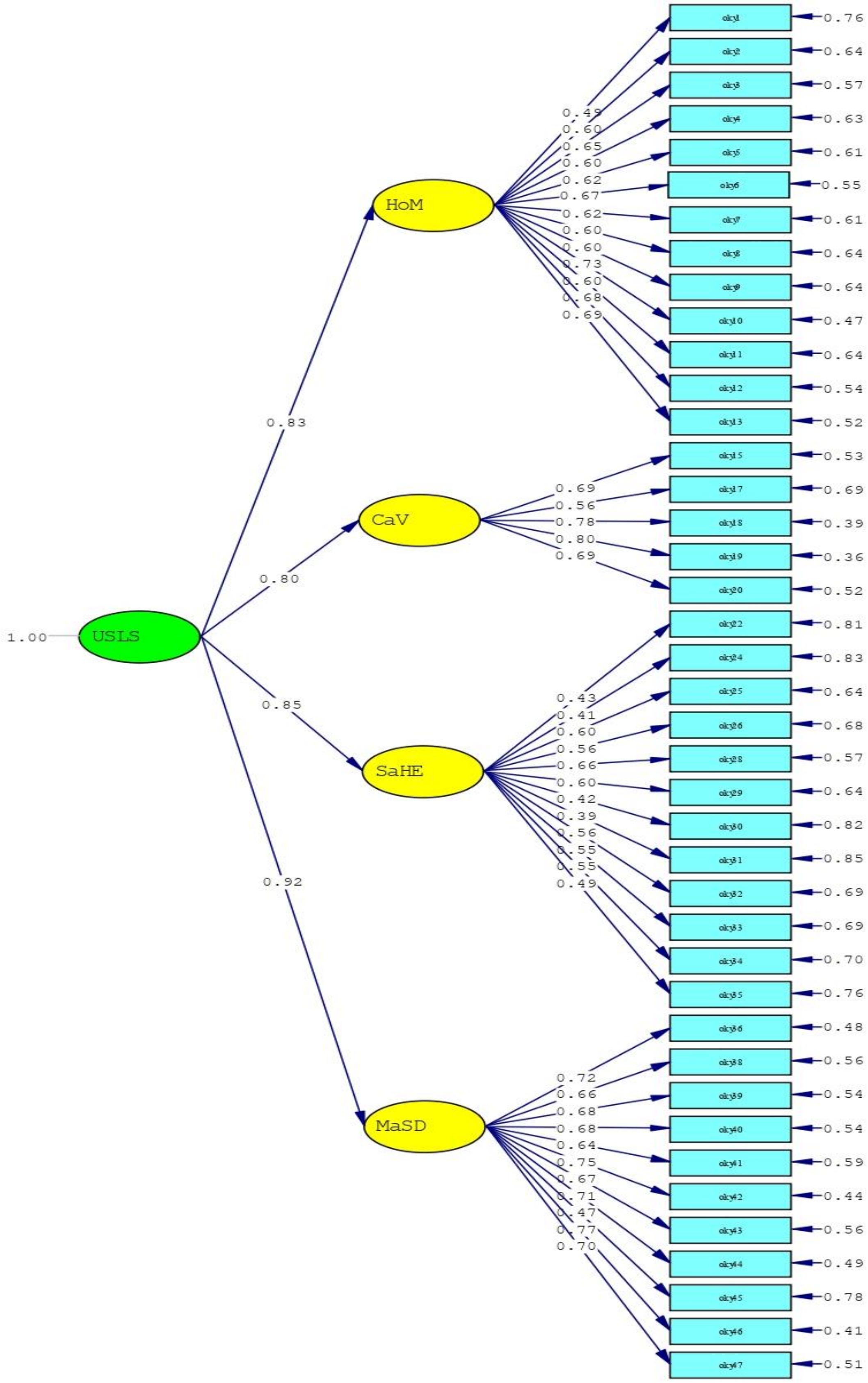

Figure 3 *The Second-order CFA for the Universal Science Literacy Scale*

changing its factor from Character and Values to Science as Human Endeavor was successful as the value was .503. Table 3.8 shows all the Cronbach Alpha coefficients and Corrected Item-Total Correlations.

Table 3.8 *Cronbach's Alpha Coefficient and Corrected Item-total Correlation of Each Factor and the Universal Science Literacy Scale*

	Number of Items	Cronbach Alpha Coefficient (α)	Corrected Item-Total Correlation
Habits of Mind	13	.903	.472 - .678
Character and Values	5	.829	.536 - .746
Science as Human Endeavor	12	.847	.414 - .597
Metacognition and Self-Direction	11	.919	.564 - .754
Universal Science Literacy Scale	41	.952	.371 - .714

With the renewed scale, the highest score that can be obtained from the scale is 210 and the lowest is 41. The lowest score that can be obtained from the dimensions are as the following: 13 for Habits of Mind, 5 for Character and Values, 12 for Science as Human Endeavor, and 11 for Metacognition and Self-direction. The highest score that can be obtained from the dimensions are as the following: 65 for Habits of Mind, 25 for Character and Values, 60 for Science as Human Endeavor, and 55 for Metacognition and Self-direction. The renewed levels were given as the following: very low (41-74.8), low (74.9-108.7), medium (108.8-142.6), high (142.7-176.5) and very high (176.6-210).

3.5. Data Collection Process

The necessary permissions were taken from the developers of the scales; Özkan (2015) and Çelik (2016) (See appendix C), the Human Subjects Ethics Committee (HSEC) (See appendix A) and the Ministry of National Education (MoNE) (See appendix B) to conduct research in İstanbul during the spring semester of the 2022-2023 educational year. Before starting the data collection process, the researcher underwent training for the application of the Scientific Process Skills Scale for 60-72-month-old Children via phone communication. This training was provided due to the scale's incorporation of materials for assessment as the developer of the scale explained each item and which materials to be shown in order. However, no specific training was undertaken for the Universal Science Literacy Scale. The researcher then contacted preschool administrators to ask for a meeting to explain the study and data collection process. The research topic, voluntary participation form (See appendix D), parent consent form (See appendix E), and Universal Science Literacy Scale (USLS) (See appendix H) were explained in detail to school administrators and teachers to answer possible questions from parents. The voluntary participants, parents, filled out voluntary participation form, consent form for their children to attend the study, and the Universal Science Literacy Scale (USLS). The filled-out data was returned to teachers. Thereafter the researcher contacted the teachers to arrange interviews with the children.

In the data collection process, after the voluntary participation form, the consent form for their children to attend the study, and the Universal Science Literacy Scale (USLS) was filled out by the parents, the researcher interviewed the children (See Figure 4). The participant children were taken from their classrooms to a preschool's pre-arranged empty room or classroom with the approval of their teacher. The researcher paid attention not to take children at an activity time and also asked for children's verbal approval. Before administering the scale items, depending on the children's attitude, the researcher tried to make conversations with them to make them more comfortable when answering questions. After that, the researcher explained what they would do together and expectations from the children. Then, the researcher asked one item at a time and showed related materials when necessary. The items were repeated once if the children did not understand them. The researcher waited 30-45 seconds for children's answers. If children did not answer correctly or did not answer at all, "0" point was given to the specific item. It was not shared with the children whether their answers were correct or not during or after the process. The researcher also asked items in a neutral face and tone and tried not to show any sign when children answered correctly or incorrectly. After all items were administered, the researcher verbally expressed gratitude to children for their participation and they were returned back to their classrooms by the researcher.

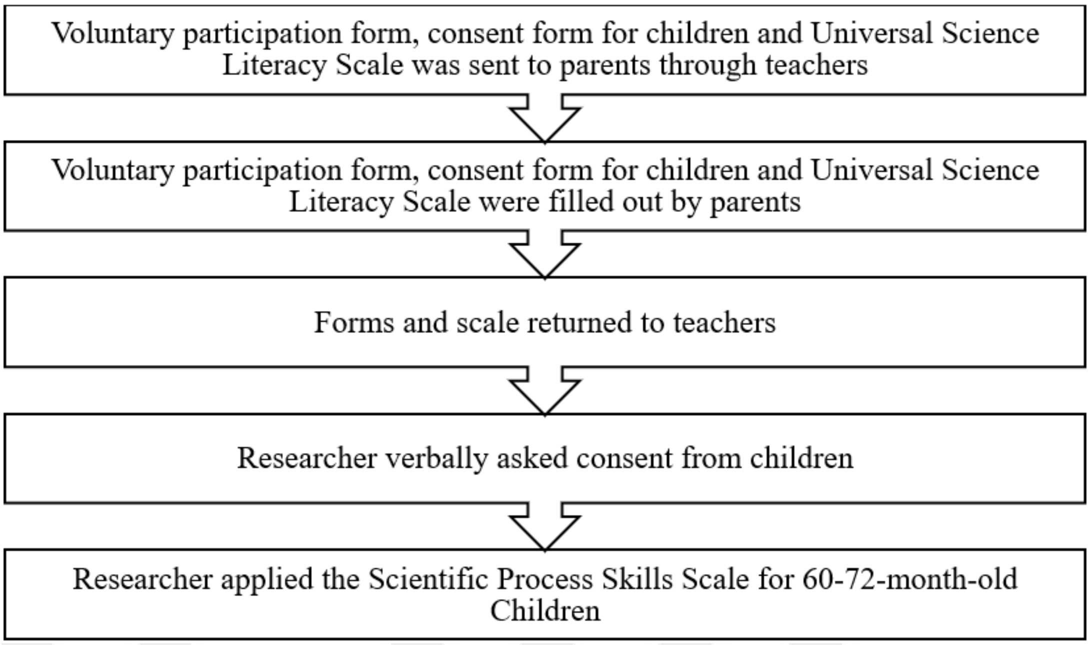

Figure 4 *Data Collection Process*

3.6.Data Analysis

The collected data of the study was analyzed by using the SPSS 26.0 program. According to Tabachnick and Fidell (2013), randomly missing data need to be determined regardless of how many because these values have an impact on the generalizability of the results. Therefore, following data entry, the collected data was examined by applying a data screening process to eliminate false results. The data screening process consisted of examining data entry errors, missing data, outliers, and the assumptions of normality (Pallant, 2020).

In the process of the data screening, missing values were noted and corrected by the researcher by controlling the collected data. It was noticed that in one case, the majority of the items were marked as “5” and stood as an outlier. This specific case was deleted not to affect analysis. The normal probability plots, detrended normal probability plots and box plots were examined and it was seen that some cases exceeded the specified value. Univariate and multivariate outliers were examined to prevent Type I and Type II errors (Tabachnick & Fidell, 2013). Z-scores for variables were calculated to find univariate outliers. According to Büyüköztürk et. al. (2016), Z-scores over 4.00 could be accepted as outliers. Tabachnick & Fidell (2013), states that Z-scores over 3.29 could be accepted as outliers but if the sample size is large, a few outliers could be omitted. In some cases (n = 2), it was seen that Z-scores were slightly over 3.29; however, it was decided to be kept in the study. Multivariate outliers on the other hand, were detected by examining the Mahalanobis Distance value (Pallant, 2020). No outliers were exceeded the critical value of $\chi 2(5) = 20.515$ (Tabachnick & Fidell, 2013).

After examining outliers, normality, linearity, homogeneity of variances, homoscedasticity, independence of residuals of the data to meet assumptions, descriptive statistics was explored to screen general characteristics of the research. In addition, necessary analysis was applied to reach the answers to research questions. One way ANOVA, Two-way ANOVA and Hierarchical Multiple Regression were conducted to investigate further.

3.7. Internal Validity Threats

In a study, internal validity refers to the clarity and unambiguity of any observed association between variables and it ensures that the link may be traced back to the variables under investigation rather than being impacted by other factors (Fraenkel et al., 2012). By establishing strong internal validity, the observed relationship as being directly related to the variables under investigation, free from the influence of external factors could be interpreted confidently (Fraenkel et al., 2012).

Subject characteristics are one of the internal validity threats. The process of selecting individuals to a study could lead to unintentional differences among them, which might be related to the studied variables (Fraenkel et al., 2012). As a result, the presence of different important characteristics in the selected group compared to the overall population can affect the research findings. This highlights the need to carefully consider the representativeness of the chosen subjects to ensure the validity of the study results (Fraenkel et al., 2012). In studies that involve comparing groups, subjects in the different groups may vary in terms of variables like age, gender, and other relevant factors (Fraenkel et al., 2012).

Even if the subjects are selected meticulously, the mortality threat which is losing participants while the study progresses, is always there as participants might be absent during data collection or fail to complete questionnaires (Fraenkel et al., 2012). In this study, while parents are expected to fill one questionnaire at home, the researcher applied the other scale to the children at school. To decrease the withdrawal from the study and to increase the participation rate from parent side, the researcher was in contact with principals and teachers. However, if the children did not come to school on the days the researcher was at preschools or declared that they did not want to participate in the study, the researcher did not force the children to participate.

A location threat occurs when the precise settings or places where data is collected are performed present alternative interpretations for the study outcomes (Fraenkel et al., 2012). In this study, it was crucial to administer the scale to the children in a quiet and isolated setting, ensuring minimal distractions. Since the researcher engaged with the children individually during the scale application, it was important to maintain their undivided attention on the scale items. This precaution was necessary to minimize potential external influences that may impact the children's responses. To minimize or eliminate potential external influences, the researcher conducted face-to-face meetings after initial phone conversations with the preschools. During these meetings, the researcher requested preschools lacking appropriate facilities if they could arrange an available classroom. Preschools unable to provide a suitable environment were subsequently excluded from the list.

Instrument decay, data collector characteristics, and data collector bias pose threats to the reliability and validity of the data collection process (Fraenkel et al., 2012). Instrument decay refers to situations where the instrument used in the study allows for varied interpretations of results or is lengthy and challenging to score (Fraenkel et al., 2012). The characteristics of the researcher responsible for data collection can also influence the nature of the data obtained (Fraenkel et al., 2012). Additionally, there is the potential for unconscious bias or manipulation of data by both data collectors and participants, leading to biased outcomes (Fraenkel et al., 2012).

Unforeseen events may occur during the course of a study that were not anticipated or planned for, which can influence the responses of the participants and is known as a history threat (Fraenkel et al., 2012). In this study, the answers given by the children can be affected by the fact that the children are sleep deprived, hungry, unhappy, or anything they have experienced during the day.

3.8.Ethical Considerations

This study was conducted with the permission of the Human Subjects Ethics Committee (HSEC), the Ministry of National Education (MoNE) through the Provincial Directorate of National Education, and preschool administrations. During the data collection period, the preschools were contacted through phone and asked for a meeting to explain the study and show permissions of the Human Subjects Ethics Committee (HSEC) and the Ministry of National Education (MoNE). The scales were distributed to the teachers after meetings with the preschools. Both of the scales were explained in detail to school administrations and teachers to increase the return rate of the scales.

A voluntary participation form and consent form was used to inform participants about the research topic, application of the survey on both parents and their children, and the expectations from them within the scope of the study. The participants were also informed that their data would be only used by the researcher and will not be shared with third parties.

In this study, participation was completely voluntary and the given items in the scales did not include questions that could cause personal distress. Furthermore, all participants were first informed that they could refuse to participate in the study or leave any time they want if they feel discomfort with the questions without facing any consequences. The researcher also wanted consent from the children verbally and did not apply the scale if they did not give consent.

3.9.Limitations of the Study

The participants were limited to İstanbul during the spring semester of the 2022-2023 educational year. Although meetings were conducted with the preschool administrators and approvals were given, not all parents were available to participate in the study.

The participants of this study were of 60-72-month-old children and their parents. The voluntary participants, parents, used self-assessment tools which were the Demographic Information Form and Universal Science Literacy Scale (USLS). It was assumed by the researcher that the voluntary participants in study read the items in the scale and answered accurately accordingly to their understanding rather than answering what should be.

Parents' educational levels were divided into two groups as low and high. This grouping could have simplified the diversity of the educational levels and limited their influence on children's scientific process skills. Assessment of low and high education levels could have limited the generalizability of the results.

CHAPTER 4

RESULTS

This chapter includes the research findings in detail. The research questions stated in the study were analyzed by using, two-way between groups analysis of variance (ANOVA), one-way analysis of variance (ANOVA), and hierarchical multiple regression (HMR) via SPSS 26.0 Program. The preliminary analysis details were given to explain the assumptions of the specific methods that were used.

4.1. Assumptions

To answer, “Is there a difference between children’s scientific process skills scores and gender?” and “Is there a difference between children’s scientific process skills scores and age?” research questions, two-way between groups ANOVA was used. To conduct two-way between groups ANOVA, there should be one continuous dependent variable and two categorical independent variables consisting of two or more groups (Pallant, 2020). The dependent variable in this research was children’s scientific process skills scores and the independent variables were gender age. Assumptions of two-way ANOVA include independence of observation, random sampling, normal distribution of dependent variable, and homogeneity of variances (Gravetter & Wallnau, 2016; Pallant, 2020).

To answer, “Is there a difference between children’s scientific process skills scores and number of siblings they have?” research question, one-way analysis of variance ANOVA was used. To conduct one-way analysis of variance (ANOVA), there should be one continuous dependent variable and one categorical independent variable consisting of two or more groups (Pallant, 2020). The dependent variable in this research was children’s scientific process skills scores and the independent variable was number of siblings. Assumptions of one-way ANOVA include independence of observation, random sampling, normal distribution of dependent variable, and homogeneity of variances (Gravetter & Wallnau, 2016; Pallant, 2020).

To answer, “To what extent do parents’ scientific literacy skills predict children’s scientific process skills scores after the effects of demographic characteristics (i.e., education status and parents’ ages) are controlled?” research question, hierarchical multiple regression (HMR) was used. To conduct hierarchical multiple regression (HMR), there should be one continuous dependent variable and two or more continuous independent variables (Pallant, 2020). The dependent variable in this research was children’s scientific process skills scores and the independent variables were parents’ scientific literacy skills, education status and ages. Assumptions of HMR include sample size, multicollinearity and singularity, outliers, normal distribution of variables, linearity, homoscedasticity, and independence of residuals (Tabachnick & Fidell, 2013; Pallant, 2020).

4.1.1. Assumptions for Two-way Between Groups ANOVA and One-way ANOVA with Children’s Scientific Process Skills Scores

In this study, first research question was about children’s scientific process skills scores. regarding the difference between the scores and children’s gender, age and number of siblings they have. Two-way between groups ANOVA was conducted to answer the sub questions given below.

1.1. Is there a difference between children’s scientific process skills scores and gender?

1.2. Is there a difference between children’s scientific process skills scores and age?

One-way ANOVA was conducted to answer the sub question given below.

1.3. Is there a difference between children’s scientific process skills scores and the number of siblings they have?

Before conducting these analyses, certain conditions need to be met. These conditions are important for ensuring the accuracy and reliability of the results. The process of meeting these conditions is well-documented and taken into account during the analysis. For example, participants’ observations or measurements should not be affected by others to fulfill the requirement of independence of observation (Pallant, 2020). The data in the current study was collected independently without affected by other observations or measurements.

Pallant (2020), stated that to achieve random sampling in real-life research is difficult. When collecting the data, random sampling method was used in different districts of İstanbul. Preschools distributed voluntary participation form, consent form for children, and Universal Science Literacy Scale (USLS) to parents through teachers. The researcher collected the returned voluntary participation form, consent form for children, and Universal Science Literacy Scale (USLS) from teachers and applied Scientific Process Skills Scale to children; therefore, it could be assumed that the sample used in this study was randomly chosen.

In deciding the normal distribution of the total scores of Scientific Process Skills some measurements were examined. In statistical methodologies, skewness and kurtosis are two main aspects of normality that explain the symmetry and the peakedness of the distribution (Tabachnick & Fidell, 2013). There are different opinions about the value range of the skewness and kurtosis values. It was stated in different sources that the range should be between ±2 (George & Mallery, 2010; Gravetter & Wallnau, 2016) or ±1.5 (Tabachnick & Fidell, 2013) in order the data to be considered normally distributed. In this study, the range value of skewness and kurtosis determined as ±2. The skewness (-.503) and kurtosis (.585) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality and it is common in large samples (Pallant 2020). Mean ($\mu = 171.94$) and 5% trimmed mean ($\mu = 171.67$) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality such as having a reasonably symmetrical distribution in histogram where the highest frequency occurs in the middle of the curve, a relatively straight line in Normal Q-Q Plot, and not clustering of points, with majority gathering around the zero line in Detrended Normal Q-Q Plot (Pallant, 2020). When all statistical and graphical outcomes considered, the data distributed normally.

In deciding the normal distribution of the total scores of Scientific Process Skills regarding children’s gender; for girls, the skewness (-.724) and kurtosis (.540) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality and it is common in large samples (Pallant 2020). Mean (μ = 22.6914) and 5% trimmed mean (μ = 22.8635) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. For boys, the skewness (-.709) and kurtosis (.255) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality. Mean (μ = 22.2360) and 5% trimmed mean (μ = 22.4170) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. When all statistical and graphical outcomes considered, the data distributed normally.

In deciding the normal distribution of the total scores of Scientific Process Skills regarding children's age; for 60-64-month-old children, the skewness (-.938) and kurtosis (.636) values indicated normality. Kolmogorov-Smirnov (.001) value did not indicate normality; however, if the study has more than 30 participants, it could be ignored (Büyüköztürk, 2011). Mean (μ = 21.7759) and 5% trimmed mean (μ = 22.0862) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. For 65-70-month-old children, the skewness (-.365) and kurtosis (-.360) values indicated normality. Kolmogorov-Smirnov (.005) value did not indicate normality. Mean (μ = 22.1373) and 5% trimmed mean (μ = 22.2298) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. For 71-75-month-old children, the skewness (-.937) and kurtosis (1.053) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality. Mean (μ = 22.1373) and 5% trimmed mean (μ = 22.2298) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. When all statistical and graphical outcomes considered, the data distributed normally.

In deciding the normal distribution of the total scores of Scientific Process Skills regarding children's number of siblings, for no siblings, the skewness (-1.007) and kurtosis (1.288) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality, but it is not a major concern. Mean (μ = 23.0280) and 5% trimmed mean (μ = 23.3255) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. For children who have one sibling, the skewness (-.720) and kurtosis (.234) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality. However, if the study has more than 30 participants, it could be ignored (Büyüköztürk, 2011). Mean (μ = 22.5091) and 5% trimmed mean (μ = 22.6684) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. For children who have 2 or more siblings, the skewness (-.459) and kurtosis (.078) values indicated normality. Kolmogorov-Smirnov (.025) value did not indicate normality. Mean (μ = 21.6173) and 5% trimmed mean (μ = 21.7140) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality. When all statistical and graphical outcomes considered, the data distributed normally.

The final assumption is homogeneity of variances which is examining whether equal variances are obtained from samples or not (Pallant, 2020). In homogeneity of variances, Levene's Test for Equality of Variances value should be above .05 or else equal variances cannot be assumed, and assumption would be violated (Pallant, 2020). For the total scores of Scientific Process Skills regarding children's gender and age, the Levene's Test for Equality of Variances was .501; therefore, the assumption is not violated. For the total scores of Scientific Process Skills regarding children's number of siblings, the Levene's Test for Equality of Variances was .997; therefore, the assumption is not violated.

4.1.2. Assumptions for Hierarchical Multiple Regression (HMR)

In this study, the final research question was about children's scientific process skills and parents' scientific literacy skills. Hierarchical multiple regression (HMR) was conducted to answer the research question below.

R.Q.3. To what extent do parents' scientific literacy skills predict children's scientific process skills scores after the effects of demographic characteristics (i.e., education status and parents' ages) are controlled?

Before proceeding with the analysis, it was essential to meet assumptions to ensure accurate and reliable results. These assumptions play a crucial role in determining the validity of the findings, and their fulfillment is carefully documented and considered throughout the analysis process. For instance, the observations or measurements should not be affected by others to fulfill the requirement of independence of observation (Pallant, 2020). The data in the current study was collected independently without being affected by other observations or measurements.

Pallant (2020), stated that to achieve random sampling in real-life research is difficult. When collecting the data, random sampling method was used in different districts of İstanbul. Preschools distributed the voluntary participation form, consent form for children, and Universal Science Literacy Scale (USLS) to parents through teachers, it could be assumed that the sample used in this study was randomly chosen.

In deciding the normal distribution of the total scores of Science Literacy Scale, some measurements were examined. In statistical methodologies, skewness and kurtosis are two main aspects of normality that explain the symmetry and the peakedness of the distribution (Tabachnick & Fidell, 2013). There are different opinions about the value range of the skewness and kurtosis values. It was stated in different sources that the range should be between ±2 (George & Mallery, 2010; Gravetter & Wallnau, 2016) or ±1.5 (Tabachnick & Fidell, 2013) in order the data to be considered normally distributed. In this study, the range value of skewness and kurtosis determined as ±2. The skewness (-.503) and kurtosis (.585) values indicated normality. Kolmogorov-Smirnov (.000) value did not indicate normality and it is common in large samples (Pallant 2020). Mean (μ = 171.94) and 5% trimmed mean (μ = 171.67) values were in close proximity to each other; therefore, they indicated normality. Moreover, histogram, Normal Q-Q Plot, and Detrended Normal Q-Q Plot provided conditions to be regarded as having normality such as having a reasonably symmetrical distribution in histogram where the highest frequency occurs in the middle of the curve, a relatively straight line in Normal Q-Q Plot, and not clustering of points, with majority gathering around the zero line in Detrended Normal Q-Q Plot (Pallant, 2020). When all statistical and graphical outcomes considered, the data distributed normally.

4.1.2.1. Sample Size

Tabachnick & Fidell (2013), states that hierarchical multiple regression (HMR) sample size needs to be $N \geq 50 + 8m$, in which m equals to number of independent variables, to predict dependent variable properly. In the current study, number of independent variables were 5 which were mother's education, father's education, mother's age, father's age, and scientific literacy skills.

4.1.2.2. Multicollinearity and Singularity

The relationship between independent variables should not be $r \geq .7$ to meet the multicollinearity assumption (Pallant, 2020). In the current study, the highest correlation value between independent variables is .577. The singularity is not violated as subscales, or a combination of independent variables were not present in the results (Pallant, 2020). The tolerance value indicates the extent of variability of the stated independent variable is not explained by different independent variables in the regression analysis and should be more than .10 (Pallant, 2020). In the current study, tolerance value ranged from .633 to .913, which was not less than .10. This was also supported by the VIF value ranging from 1.096 to 1.581 which were well below the cut-off of 10 (Pallant, 2020). With the given values, multicollinearity and singularity assumption was not violated.

4.1.2.3. Outliers

Univariate outliers could be seen if one case has extremely high or low score in one of the independent variables in the regression analysis (Pallant, 2020). Z-scores were calculated in order to check univariate outliers and it was seen that z-scores were below the cut point (Tabachnick & Fidell, 2013). Multivariate outliers could be seen if one of the cases has an extreme combination of score on both dependent and independent variables (Pallant, 2020). These outliers could affect the results of the regression analysis. In the current study, Mahalanobis distance values were examined to check multivariate outliers. The Mahalanobis distance calculated as $\chi 2(5) = 20.515$

(Tabachnick & Fidell, 2013). The highest value was 14.488 which was below the critical value 20.515; therefore, assumption was not violated.

4.1.2.4. Linearity and Homoscedasticity

These assumptions could be investigated by examining histogram, normal p-p plot of the regression standardized residual and scatterplot (Pallant, 2020). The shape of the histogram almost bell-shaped leaning right a little. In normal p-p plot of the regression standardized residual, values constituted a reasonable straight line. In scatterplot, the values were roughly formed a rectangular shape and all values were in the range of ±3.3 (Tabachnick & Fidell, 2013). Therefore, the assumption was not violated.

4.1.2.5. Independence of Residuals

In independence of residuals, Durbin-Watson value should be examined to whether the value is in the range of 1 to 3 or not (Field, 2009). In this study, Durbin-Watson value was recorded as 1.904 and did not violate the assumption.

4.2. Descriptive Analysis

In this section, demographic information, and descriptive statistics such as mean, standard deviation, minimum and maximum values of the participants were given in detail.

4.2.1. Demographic Information of Participants

In the current study, the participants were parents and their children. This study took part in 8 preschools with 353 parents and 353 children. The preschools were located at Küçükçekmece (parents f = 51; children f =51), Fatih (parents f = 31; children f = 31), Güngören (parents f = 75; children f = 75), Zeytinburnu (parents f = 42; children f = 42) and Esenler (parents f = 154; children f =154) districts.

In this study, 49.6% of the children were girls (f = 175) and 50.4% were boys (f = 178). Children's age ranged from 60 months to 75 months (M = 68.38, *S.D.* = 3.584). 16.4% of the children were 60-64-month-old (f = 58), 43.3% of them were 65-70-month-olds (f = 153) and 40.2% of them were 71-75-month-olds (f = 142). Children's number of siblings ranged from not having siblings to having 4 siblings. 30.3% of the children had no siblings (*f* = 107), 46.7% of the children had 1 sibling (*f* = 165), 14.7% of the children had 2 siblings (*f* = 52), 5.7% of the children had 3 siblings (*f* = 20) and 2.5% of the children had 4 siblings (*f* = 165). Demographic information of children in the study was given in the Table 4.1.

Table 4.1 *Demographic Information of Children in the Study*

		f	%
Gender	Girls	175	49.6
	Boys	178	50.4
	Total	353	100
Age of the Children	60-64 months	58	16.4
	65-70 months	153	43.3
	71-75 months	142	40.2
	Total	353	100
Number of Siblings	No sibling	107	30.3
	1 sibling	165	46.7
	2 siblings	52	14.7
	3 siblings	20	5.7
	4 siblings	9	2.5
	Total	353	100

Among the parents, 18.7% of the mothers were 30 years old or below (*f* = 66), 64.9% of the mothers were in the ages between 31-40 years (*f* = 229), and 16.4% of the mothers were 40 years old or older (*f* = 58). In addition, 5.7% of the fathers were 30 years old or below (*f* = 20), 58.6% of the mothers were in the ages between 31-40 years (*f* = 207), and 35.7% of the mothers were 40 years old or older (*f* = 126).

When parent's education levels were examined, it was seen that for mothers, .6% of them were illiterate (*f* = 2), 1.4% of them were literate (*f* = 5), 9.6% of them were primary school graduates (*f* = 34), 9.1% of them were secondary school graduates (*f* = 32), 28% of them were high school graduates (*f* = 99), 43.1% of them were undergraduates (*f* = 152), and 8.2% of them were postgraduates (*f* = 29). Moreover, it was seen that for fathers, .6% of them were illiterate (*f* = 2), .6% of them were literate (*f* = 2), 7.4% of them were primary school graduates (*f* = 26), 12.7% of them were secondary school graduates (*f* = 45), 30.6% of them were high school graduates (*f* = 108), 39.1% of them were undergraduates (*f* = 138), and 9.1% of them were postgraduates (*f* = 32).

When parent's education level divided into two groups as low and high education level (illiterate, literate, primary school graduate, secondary school graduate, and high school graduate combined as having low education level; undergraduate and postgraduate combined as having high education level), it was seen that 48.7% of the mothers had low education level (*f* = 172) and 51.3% of the mothers had high education level (*f* = 181). When father's education level was examined, 51.8% of them had low education level (*f* = 183) and 48.2% of them had high education level (*f* = 170). It could be inferred that mothers had slightly high education level than fathers in this study. 96% of the parents were married (*f* = 339), .6% of them were separated (*f* = 2), and 3.4% were divorced (*f* = 12). Demographic information of parents in the study were given in the Table 4.2.

Table 4.2 *Demographic Information of Parents in the Study*

		f	%
Age of Mothers	30 and below	66	18.7
	31-40	229	64.9
	40 and above	58	16.4
	Total	353	100
Age of Fathers	30 and below	20	5.7
	31-40	207	58.6
	40 and above	126	35.7
	Total	353	100
Mother's Education	Illiterate	2	.6
	Literate	5	1.4
	Primary School	34	9.6
	Secondary School	32	9.1
	High School	99	28

Table 4.2 (continued)

	Associate degree	152	43.1
	Postgraduate	29	8.2
	Total	353	100
Father's Education	Illiterate	2	.6
	Literate	2	.6
	Primary School	26	7.4
	Secondary School	45	12.7
	High School	108	30.6
	Associate degree	138	39.1
	Postgraduate	32	9.1
	Total	353	100
Mother's Education Level	Low	172	48.7
	High	181	51.3
	Total	353	100
Father's Education Level	Low	183	51.8
	High	170	48.2
	Total	353	100
Marital Status of Parents	Married	339	.96
	Separated	2	.6
	Divorced	12	3.4
	Total	353	100

4.2.2. Descriptive Statistics of the Scales

Descriptive statistics for both Universal Science Literacy Scale and Scientific Process Skills scales regarding mean, standard deviation, minimum and maximum values were given in detail in this part.

4.2.2.1. Scientific Process Skills Scores of 60-72-month-old Children

In this study, the researcher asked children the items in the Scientific Process Skills scale and recorded their answers. The descriptives of the recorded values were given in detail in Table 4.3. In the Prediction-Inference-Communication dimension, a minimum score was received as 2 and maximum score received as 12 (*M* = 8.4079, *SD* = 2.03887), in the Classification dimension, the minimum score received was 1 and the maximum score 8 (*M* = 5.6147, *SD* = 1.45930), in the Measuring dimension, the minimum score received was 1 and the maximum 7 (*M* = 5.8215, *SD* = 1.16013), and in the Observation dimension, a minimum score of 0 and a maximum of 4 was obtained (*M* = 2.6176, *SD* = 1.04633). For the whole scale, Scientific Process Skills, scored a minimum score of 9 and a maximum of 30 (*M* = 22.4618, *SD* = 4.02751).

Table 4.3 *Descriptive Statistics of Scientific Process Skills Scale*

	M	*SD*	Min. Score Received	Max. Score Received	Possible Min. Score	Possible Max. Score
Prediction-Inference-Communication	8.4079	2.03887	2	12	0	12
Classification	5.6147	1.45930	1	8	0	8
Measuring	5.8215	1.16013	1	7	0	7
Observation	2.6176	1.04633	0	4	0	4
Scientific Process Skills	22.4618	4.02751	9	30	0	31

4.2.2.2. Scientific Literacy Skills of Parents

In this study, parents filled out the Universal Science Literacy Scale and the descriptive statistics were given in detail. The descriptives of the recorded values were given in detail in Table 4.4. In the Habits of Mind dimension, minimum score received as 33 and maximum score received as 65 (*M* = 54.18, *SD* = 6.556), in the Character and Values dimension, minimum score received as 9 and maximum score received as 25 (*M* = 20.9859, *SD* = 3.14739), in the Science as Human Endeavor dimension, minimum score received as 23 and maximum score received as 60 (*M* = 47.19, *SD* = 6.341), and in the Metacognition and Self-direction dimension, minimum score received as 25 and maximum score received as 55 (*M* = 45.39, *SD* = 6.048). For the whole scale, in Universal Science Literacy Scale, the minimum score received was 110 and the maximum 210 (*M* = 171.94, *SD* = 19.580).

Table 4.4 *Descriptive Statistics of Universal Science Literacy Scale*

	M	*SD*	Min. Score Received	Max. Score Received	Possible Min. Score	Possible Max. Score
Habits of Mind	54.18	6.556	33	65	13	65
Character and Values	20.9859	3.14739	9	25	5	25
Science as Human Endeavour	47.19	6.341	23	60	12	60
Metacognition and Self-direction	45.39	6.048	25	55	11	55
Universal Science Literacy Scale	171.94	19.580	110	210	41	210

The levels were given as the following: very low (41-74.8), low (74.9-108.7), medium (108.8-142.6), high (142.7-176.5) and very high (176.6-210). As it can be seen in Table 4.5, none of the participants were recorded as having very low or low scientific literacy skills. 7.9% (*f*=28) of the participants scores regarded as having medium scientific literacy skills. The findings revealed that majority of parents had high or very high scientific literacy skills with the percentage of 52.1 (*f*=184) in high level and 39.9 (*f*=141) in very high level.

Table 4.5 *Scientific Literacy Skills Levels of Parents Regarding Universal Science Literacy Scale*

		f	%
Scientific Literacy Skills Levels	Very Low	0	.0
	Low	0	.0
	Medium	28	7.9
	High	184	52.1
	Very High	141	39.9
	Total	353	100.0

4.3. Analysis of Children's Scientific Process Skills Scores Regarding Their Gender and Age

A two-way between groups analysis of variance was conducted to explore the difference between children's scientific process skill scores, gender, and age. Children's gender was divided into two groups as girls and boys (Group 1: girls, Group 2: boys). Children's age was divided into 3 groups as 60-64-month-olds, 65-70-month-olds and 71-75-month-olds. (Group 1: 60-64-month-olds, Group 2: 65-70-month-olds, Group 3: 71-75-month-olds). The preliminary analysis concerning the assumptions was conducted.

The interaction effect between gender and ages was not statistically significant at the $p < .05$ level: [$F (2, 347) = 2.038$, p=.132]. Besides, the main effect of gender was not significant at the $p < .05$ level: [$F (1, 347) =.220$, p=.640]. However, there was a statistically significant main effect for age at the $p < .05$ level: [$F (2, 347) = 3.012$, p=.05] (See Table 4.6). According to these results, the mean score for the girls (*M* = 22.459, *SD* = .328), and boys (*M* = 22.2400, *SD* = .333) did not differ significantly from each other. Post-hoc comparisons using Tukey HSD test indicated that mean score for children who were 60-64-month-olds (*M* = 21.786, *SD* = .524), 65-70-month-olds (*M* = 22.170, *SD* = .323) and 71-75-month-olds (*M* = 23.093, *SD* =.335) was significantly different from each other. Despite reaching statistical significance in main effect, the actual difference between mean scores is quite small.

Table 4. 6 *Two-way Analysis of Variance of Scientific Process Skills Regarding Gender and Age*

	df	F	Sig.
Gender	1	.220	.640
Age	2	3.012	.050
The Interaction Between Gender and Age	2	2.038	.132

p value: <.05

4.4. Analysis of Children's Scientific Process Skills Regarding Number of Siblings

A one-way between-groups analysis of variance was conducted to explore the differences of children's scientific process skills on number of siblings. Number of siblings divided into 4 groups as the following: Group 1: children who have no siblings, Group 2: children who have one sibling, Group 3: children who have two siblings, and Group 4: children who have three siblings and more. No statistically significant difference was found with the $p < .05$ level in scientific process skills scores for all groups: F (3, 349) = 2.320, p = .075 (See Table 4.7). Tukey's HSD Test for multiple comparisons found that the mean value of scientific process skills scores was not significantly different between any of the groups.

Table 4.7 *One-way Analysis of Variance of Scientific Process Skills Regarding Children's Number of Siblings*

	df	F	Sig.
Between Groups	3	2.320	.075
Within Groups	349		
Total	352		

p value: <.05

4.5. Analysis of Parent's Scientific Literacy Skills on the Prediction of Children's Scientific Process Skills Scores

Hierarchical multiple regression was conducted to assess the ability of control measures (Universal Science Literacy Scale and Scientific Process Skills Scale) to predict children's scientific process skills (Scientific Process Skills Scale) after controlling for the influence of parent's education level and age. Preliminary analyses were conducted to ensure no violation of normality, linearity, multicollinearity, and homoscedasticity. Parents' educational levels were divided into 2 groups (Group 1: Low, Group 2: High). Parents' ages were divided into 3 groups (Group 1: 30 and below, Group 2: 31-40 and Group 3: 40 and above). Mother's and father's education levels entered at Step 1 explain 12.2% of the variance in scientific process skills. The parent's ages entered at Step 2 and the total variance explained by the model as a whole was 12.3%. After entry of the Universal Science Literacy Scale at Step 3, the total variance explained by the model as a whole was 24%, F (4, 348) = $p < .05$. The control measures explained an additional 11.7% of the variance in scientific process skills after controlling for parent's education levels, ages, and scientific literacy skills, *R*squared change = .117, *F*change (1, 348) = 53.724, $p < .05$. In the final model, only three measures were statistically significant, namely mother's education level (*sr* = .174, $p < .05$), father's education level (*sr* = .147, $p < .05$), and their scientific literacy skills (*sr* = .342, $p < .05$). Moreover, it was seen that fathers' education level contributed to children's scientific process skills more than mothers' education level ($\Delta R^2 = .122$, F (2) = 24.227, $p < .05$.). Hierarchical multiple regression analysis predicting scientific process skills with parent's education and age can be seen in Table 4.8.

Table 4.8 *Hierarchical Multiple Regression Analysis Predicting Scientific Process Skills with Parent's Education, Age and Scientific Literacy Skills*

Step and Predictor Variable	*B*	*SE B*	Beta	*sr*	Change in R^2	R^2
Step 1					.122	.122
Constant	17.730	.709				
Mother's Education	1.710	.493	.213	.174		
Father's Education	1.447	.494	.180	.147		
Step 2					.001	.123
Constant	17.796	.715				
Mother's Education	1.683	.495	.209	.170		
Father's Education	1.431	.494	.178	.145		
Parent's Age	.170	.226	.038	.038		
Step 3					.117	.240
Constant	6.492	1.680				
Mother's Education	.930	.473	.116	.092		
Father's Education	1.272	.461	.158	.129		
Parent's Age	.178	.210	.040	.040		
Scientific Literacy Skills	.074	.010	.358	.342		

p value: <.05

The beta values indicated the strength and direction of the relationships between the predictor variables and the outcome variable. In this case, scientific literacy skills emerged as the strongest predictor, suggesting that as the education level and scientific literacy skills value increase, the scientific process skills of the children also improve.

4.6. Summary of the Findings

Data was collected from 354 parents and their children aged 60–72-months from İstanbul. Since the scale applied to parents was not developed for parents, explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) was performed at first. In this study, a series of analyses were conducted to examine the items in question, specifically items 14, 16, 27, 21, 23, 48, and 37. It was decided to remove these items from the scale one by one. After each item was removed, a principal components analysis (PCA) was performed again. Interestingly, item 22 was found to have a significant loading on the Science as Human Endeavor factor rather than its original dimension, Character and Values. Given that this item seemed to be perceived as related to science in the population of this study, it was not discarded and was instead included within the Science as Human Endeavor factor for further evaluation. Moreover, parents' scientific literacy skills levels were recorded as high with an average of 171.94.

In order to reach the results of this study, more than one different analysis method was used**.** Before the analysis, preliminary analysis was conducted to eliminate the errors and examine the assumptions. After the necessary procedures, the study continued with 353 parents and their children.

The first research question of the study was about children's scientific process skills. While the average score for children's scientific process skills was 22.46, necessary analyzes were made regarding gender, age, and number of siblings. A two-way between-groups analysis of variance (ANOVA) was performed to examine the potential differences in children's scientific process skill scores based on their gender and age. The gender variable was divided into two groups: girls (Group 1) and boys (Group 2). The age variable was divided into three groups: 60-64-month-olds (Group 1), 65-70-month-olds (Group 2), and 71-75-month-olds (Group 3). No interaction affect was found between gender and age of the children in terms of scientific process skills. However, a statistically significant relationship was observed for age, indicating that there was a difference in mean scores among the different age groups (60-64-month-olds, 65-70-month-olds, and 71-75-month-olds). Further analysis revealed that the mean scores of these age groups were significantly different from each other. Although the main effect reached statistical significance, the actual difference between the mean scores was found to be quite small.

A one-way between-groups analysis of variance was performed to examine the differences in children's scientific process skills based on the number of siblings. The number of siblings was categorized into four groups: Group 1 included children who have no siblings, Group 2 included children who have one sibling, Group 3 included children who have two siblings, and Group 4 included children who have three siblings or more. There was no statistically significant difference observed in the scientific process skills scores among the different groups. Further analysis using Tukey's HSD Test for multiple comparisons revealed that the mean scores of scientific process skills did not significantly differ between any of the groups.

Hierarchical multiple regression analysis was performed to examine the predictive capacity of control variables (Universal Science Literacy Scale and Scientific Process Skills Scale) in relation to children's scientific process skills (Scientific Process Skills Scale), while accounting for the potential influence of parents' education level and age. The parents' educational levels were categorized into two groups: low and high. The parents' ages were divided into three groups: 30 and below, 31-40, and 40 and above. In the first step of the hierarchical multiple regression analysis, the inclusion of mothers' and fathers' education levels accounted for 12.2% of the variance in children's scientific process skills. In the second step, the inclusion of parents' ages resulted in a total variance explained of 12.3%. After adding the Universal Science Literacy Scale in the third step, the total variance explained increased to 24%. The control measures (parents' education levels, ages, and scientific literacy skills) accounted for an additional 11.7% of the variance in scientific process skills. In the final model, three measures were found to be statistically significant: mothers' education level, fathers' education level, and their scientific literacy skills. The beta values indicated the strength and direction of the relationships, with scientific literacy skills showing the strongest positive relationship. This suggests that as the education level and scientific literacy skills of the parents increase, the children's scientific process skills also improve. Additionally, it was observed that fathers' education level had a stronger impact on children's scientific process skills compared to mothers' education level.

CHAPTER 5

DISCUSSION

The current study investigated the relationship between children's scientific process skills and parents' scientific literacy skills. Additionally, children's scientific process skills scores were examined regarding gender, age, number of siblings, and parents' education, age, and scientific literacy skill levels. This chapter involves the discussion of the research findings in light of existing literature, as well as an examination of their implications. It concludes with suggestions for further studies.

5.1. Discussion on Children's Scientific Process Skills Scores Regarding Gender, Age and Number of Siblings

Based on the study findings pertaining to the first research question, the examination of scientific process skills of 60-72-month-old children was conducted considering various factors, namely gender, age, and number of siblings. Further details regarding the findings are presented and discussed below.

Firstly, the results of scientific process skills scores of children were examined, and it was seen that children's scientific process skills has shown diversity. The average scientific process skills scores of the children were 22.46 out of 31. Although no child answered all the questions correctly, upon analyzing the sub-dimensions, it was observed that some of the children answered all the questions correctly in at least one sub-dimension. Apart from the current study, Karataş (2018) explored the impact of the Primary Years Program on the scientific process skills of children. It was revealed that the mean scores for scientific process skills scores among children in the experimental group were initially recorded as 20.56 prior to the intervention. This result shows that the observed measurements in the two investigations are close and without any intervention, preschool children's scientific process skills scores show similarity. However, after the implementation of the Primary Years Program, Karataş

(2018) stated that the mean scores of scientific process skills among children in the experimental group were increased significantly (M = 27.67). The study underlines a significant increase in children's scientific process skills with the applied education program. Along with the impact of the implemented education program on the enhancement of children's scientific process skills scores and considering the significant role parents play in a children's development, educational initiatives involving both schools and parents could also improve children's scientific process skills.

Secondly, children's scientific process skills were examined regarding their gender in the current study. Although, findings revealed that the mean of scientific process skills scores of girls (M = 22.459) was only slightly higher than the mean of boys (M = 22.240) no statistically significant differences were found between girls and boys. The findings showed that children's scientific process skills did not differ in gender. When the literature was examined, similar findings on children's scientific process skills scores and gender were found. Erol and his colleagues (2022) examined the relationship between scientific process skills and self-regulation skills in a sample of 223 children aged 4 to 6 years old. In their study, it was revealed that children's scientific process skills did not differ in terms of gender. Similarly, Yıldız and Yıldız (2021) explored the association between scientific process skills and creative thinking among preschool children in their study involving 70 participants aged 60-66 months who were enrolled in preschool. The findings of their study stated that there were no significant differences in the scientific process skills scores of children based on gender. The reason for the indifference in scientific process skills scores in terms of gender may be due to the fact that the interests of girls and boys in science do not differ in the preschool period and the equality of education provided in preschools.

Moreover, Güven and Yılmaz (2020) studied 156 preschool children aged 60-72 months to understand how their scientific process skills related to attention skills considering gender. According to the results, there was no significant difference in the subdimensions of the scale and total score averages of the scientific process skills of children depending on the gender. Similarly, Kuru and Akman (2017) explored the scientific process skills of 250 children attending preschool education institutions and 50 preschool teachers while considering various variables. It was reported that children’s scientific process skills did not differ based on gender during the preschool period in their study.

Contrastingly, the existing literature also presents studies that have yielded divergent outcomes. For example, Sezer and Aksüt-Arslan (2023) conducted a study to examine the relationship between the scientific process skills subdimensions and learning styles of 216 children in the ages of 5 to 6-years old. The results indicated that while observation, classification, prediction, and measurement skills did not differ, data recording and inference skills varied significantly based on gender. The skill levels of girls were found to be higher and more advanced compared to boys. Furthermore, Saçkes (2013) designed a study to investigate kindergarten children’s mathematics and scientific process skills. The study also explored how children’s proficiency in these process skills influences their performance on mathematics and science achievement tests during the 3rd grade. A model was constructed to investigate whether the observed differences in process skills and academic achievement scores between boys and girls were different. The results indicated that children’s gender was found to be a statistically significant predictor of children’s proficiency in mathematics and scientific process skills. Girls were more likely to receive higher ratings for their competence in using mathematics and scientific process skills compared to boys. However, in third grade, boys were more likely to achieve higher scores on mathematics and science achievement tests compared to girls. Although there are differences in scientific process skills in terms of gender, the reasons for the differences in the findings in the literature may be due to the individual differences of children, their home and school learning environments, parents’ and teachers’ educational level or attitude toward science (Germann, 1994). Taking into account the variations in findings during the preschool period, it is important to take necessary steps and recognize the essential role of early childhood education. This could help prevent the potential development of such disparities between boys and girls in the years ahead.

Thirdly, children’s scientific process skills were examined regarding their age in the current study. Children’s ages were divided into three groups (Group 1: 60-64-month-olds, Group 2: 65-70-month-olds, Group 3: 71-75-month-olds) and a significant difference was found between scientific process skills scores and age groups of children. Although the difference between the mean scores of 60-64-month-olds (M = 21.786) and 65-70-month-olds (M = 22.170) was small, 71-75-month-old children relatively had higher scores (M = 23.093). It could be said that in this study, as the age of the children increases, their scientific process skills also increase.

When the literature was examined, it was found that similar findings were reported on the relationship between children’s scientific process skills and age. Erol et al. (2022) investigated the relationship between children’s scientific process skills and self-regulation skills. The age of the child was found to be a statistically significant predictor of both the total scientific process skills scores and the science process checklist scores. Furthermore, Tuzcuoğlu and Akarsu (2019) aimed to explore the relationship between scientific process skills and emotional development levels in preschool children. The study revealed a statistically significant difference between the age of children and their ability to make predictions and inferences based on scientific process skills.

Additionally, Kuru and Akman (2017) conducted a study to investigate the scientific process skills of children attending preschools, taking into account various variables. They reported that children’s scientific process skills differed accordingly to their ages. Similar to the findings of the current research, they observed that the average scores of the 5-year-old children were higher compared to the 4-year-olds, and the 5.5-year-olds had higher scores than both the 4-year-olds and 5-year-olds. When Dahsah et al. (2017) developed an instrument for assessing children’s basic science process skills, 30 children in the ages of 6 to 10 were asked to utilize their scientific process skills to complete each task in a step-by-step manner. The findings demonstrated that children’s scientific process skills improved as they get older.

Furthermore, İlhan & Tosun (2016) conducted a study to assess the levels of understanding of science concepts and scientific inquiry processes among kindergarten children, and to compare these levels based on various demographic variables. Within the scope of the study, it was found that children’s age was a significant predictor. Hudson (2011) suggests that Piaget emphasized the importance of age in the cognitive development of children and acknowledged that learning is a process influenced by age. The studies in the literature also support the results of the current research in which children's age is found an important factor to developing scientific process skills.

Lastly, children's scientific process skills were examined regarding the number of siblings they have in the current study. Accordingly, children were divided into four groups (Group 1: children who have no siblings, Group 2: children who have one sibling, Group 3: children who have two siblings, and Group 4: children who have three siblings and more.). There was not a significant difference at $p < .05$ level in between number of siblings of children regarding their scientific process skill scores (F (3, 349) = 2.320, $p = .075$). This suggests that children's scientific process skills scores did not differ according to the number of siblings they have.

Existing literature presents varying outcomes in studies exploring the connection between children's development and the number of siblings. According to Downey (2001), due to the influence of resources on educational opportunities, children with a limited number of siblings experience more significant educational achievement compared to those with a larger number of siblings. In line with this viewpoint, Muñez and his colleagues (2022) revealed a link between the number of siblings and children's cognitive development, showing that upon entering kindergarten, children with fewer siblings exhibited better math and reading skills compared to those with more siblings. Consequently, it is possible that children with an increased number of siblings received comparatively less individualized attention and parental support during their early years (Muñez et al, 2022). Within this framework, in a study conducted by Özkan (2021), it was found that the number of siblings did not significantly impact the scientific process skills scores of preschool children, with the research aiming to compare the scientific process skills of 5-6-year-old preschool children in kindergartens implementing the Reggio Emilia approach versus those that did not. Ölçer (2017) investigated the science content knowledge of children aged 5 to 6 years and found that the scores favored children without siblings in comparison to those with one sibling, as well as compared to those with two or more siblings.

Conversely, the literature contains differing viewpoints that contrast with the ones mentioned earlier about the relationship between children's development and number of siblings. Carpendale & Lewis (2004) highlighted how siblings hold a significant position in shaping children’s social, emotional, moral, and cognitive growth. Moreover, the upbringing with siblings entails spending substantial time together, participating in interactions marked by primarily positive aspects and significant mutual imitation (Azmitia & Hesser, 1993). Supporting this perspective, Tok (2020) stated that scientific process skills among 5-year-old children in preschool were observed to vary significantly based on the number of siblings they had. Tok (2020) reported that children who had 2 siblings had higher scores in scientific process skills than the children who had 3 siblings. Additionally, İlhan and Tosun (2016) reported that the children who had one sibling showed a significant difference in favor compared to those with three or more siblings in levels of understanding of science concepts and scientific inquiry processes. Furthermore, in their study on determining the level of performance on basic science process skills among Turkish primary school second-grade students, Dökme and Aydınlı (2009) found that the performance of the students on these skills was influenced by the number of siblings in their family.

5.2. Discussion on Parents’ Scientific Literacy Skill Levels

Based on the study findings pertaining to the second research question, the examination of scientific literacy skill levels of parents was conducted. Further details regarding the findings are presented and discussed below.

When the scientific literacy skills of the parents were examined, it was seen that minimum score received was 110 and maximum score received as 210. Moreover, parents got an average score of 171.94 points (M = 171.94, SD = 19.580). The Universal Science Literacy Scale evaluates total scores accordingly to 5 levels. The levels were given as the following: very low (41-74.8), low (74.9-108.7), medium (108.8-142.6), high (142.7-176.5) and very high (176.6-210). The Universal Science Literacy Scale’s results revealed that most of the parents had high and very high scientific literacy skills as in line with their educational levels. Therefore, it could be concluded that education is an important factor in developing scientific literacy skills (Laugksch, 2000).

In the literature, there is a scarcity of studies in parents’ scientific literacy skills. The studies mostly included elementary school students, high school students and their parents and teachers teaching at different levels of education (Can & Besler, 2018; Çavaş et al., 2013; Şahin et al., 2014). Salcı and Aydın (2022) investigated the scientific literacy skill levels of both pre-service science teachers and teachers and their findings revealed that pre-service science teachers displayed high levels of scientific literacy skills (M = 194.3) whereas the teachers exhibited very high levels of scientific literacy skills (M = 206.7). Similarly, in their study of examining scientific literacy skill levels of preschool teachers and their attitudes toward science teaching, Başar and Elyıldırım (2022) found that preschool teachers' scientific literacy skill levels as notably high with the average score of 206.48. In research also focusing on parents, in her study, Gül-Ulukan (2021) examined the scientific literacy skill levels of parents and preschool teachers who have children in the preschool period and investigated their perspectives on scientific literacy skills and science education. The study reported that 65% of parent's scientific literacy skills was determined as medium whereas 17% was high and 18% was low. Similarly, teachers' scientific literacy skill levels were mostly categorized as medium (at %74), with 12% scoring high and 14% ranking low. Furthermore, the study stated a positive correlation between education levels and scientific literacy skill scores. As both parents and teachers had higher education levels, their scientific literacy skill scores likewise experienced a corresponding elevation. Consequently, within this framework, it could be inferred that the findings of the current study align with other studies in the literature, underscoring the positive association between educational status and scientific literacy skill.

5.3. Discussion on the Relationship Between Children's Scientific Process Skills Scores and Parents' Scientific Literacy Skills

The study findings regarding the final research question were about examining to what extent parents' scientific literacy skills predict children's scientific process skills, after controlling the effects of parents' education levels and ages. Further details regarding the findings are presented and discussed below.

In order to investigate the influence of parents' scientific literacy skills on children's scientific process skills, the influence of parent's education level and age were controlled. Parents' educational levels were divided into 2 groups as low and high. At

Step 1 of the analysis, the education levels of both mothers and fathers accounted for 12.2% of the variance in scientific process skills. As the educational level of the parents increased, their children's scientific process skills scores also increased. When education levels were investigated in detail, the findings revealed that fathers' educational level predicted children's scientific process skills more than mothers' education level.

Upon reviewing the literature, numerous studies have focused on investigating the impact of parents' educational status on the developmental outcomes of their children. The outcomes of these studies have exhibited notable variations. For instance, Idris et al. (2020) conducted a study to examine the relationship between parents' education and their children's academic achievement, specifically focusing on the educational level of both fathers and mothers. The findings of the study indicated that higher levels of education among both fathers and mothers had a positive impact on their children's academic achievement. In their study of investigating the scientific process skill levels of primary school students', Böyük et al. (2011) found that fathers educational background had an impact on the students' scientific process skills test scores. According to the study, students whose fathers were university graduates exhibited significantly higher scores compared to students whose fathers were primary school graduates. Moreover, when the effect of mothers' educational status on the students' science process skills test scores were examined, a significant difference was observed. The scores were notably higher among students whose mothers were high school or university graduates, as opposed to those whose mothers were primary school graduates. In another study examining the relationship between parents' educational level, the type of school attended by the child and children's performance on executive functioning tests on children in the ages of 5-14, Ardila et al. (2005) found that parents' education level emerged as a stronger predictor of executive function test performance compared to the type of school attended by the children.

Similar with the results of this study, Tok (2020) found that while mothers' educational level did not affect children's scientific process skills, it was determined that scientific process skill levels of children with fathers who have attained a university, high school, and secondary school education were found to be significantly higher compared to children whose fathers have a literacy or primary school education level. Kunt et al.

(2015) conducted a study examining the scientific process skills of 6-year-old preschool students and comparing their science process skill levels in relation to various variables. The findings revealed a positive relationship between the education level of both mothers and fathers and the scientific process skills scores of preschool children. The scores were highest among preschool children whose mothers and fathers had a university degree, while they were lowest among children whose mothers and fathers had a primary school education level. These findings indicated that parental education level has a positive impact on the scientific process skills scores of preschool children.

In contrast to previous findings reported in the literature, Erol et al. (2022) found that mother's educational level was found to be a statistically significant predictor of children's scientific process skills total and science process checklist scores whereas fathers' educational level was not. Moreover, Yıldız and Yıldız (2021) did not find any significant relationship between children's scientific process skills scores and their parents' educational backgrounds. Tuzcuoğlu and Akarsu (2019) also reported that no significant correlation is found between the levels of scientific process skills and emotional development in terms of parents' educational status. However, a relationship was identified between the ability to observe, which is a specific subgroup of scientific process skills, and the educational status of the parents.

Parents' educational status is influential in children's development as parents serve as role models for their children and provide them with a variety of opportunities. Additionally, parents with higher educational levels scored higher scientific literacy skills. Furthermore, parents with higher education levels possess the knowledge and skills to make resources accessible and effectively utilize them for the benefit of their children (Germann, 1994; Hortaçsu, 2010). Consequently, children from such households could develop a more favorable attitude towards science education, actively engage in cognitive development activities within the home, gain experiences and adopt values that contribute to their academic achievements and abilities and foster the acquisition of scientific process skills (Germann, 1994). It was seen that as the educational level of the parents increases, the scientific process skills of their children also increase. Therefore, this study's findings are consistent with the literature.

In Step 2, when the ages of the parents were included, the overall model explained a total variance of 12.3%. Parents' ages were divided into 3 groups (Group 1: 30 and below, Group 2: 31-40 and Group 3: 40 and above). However, the findings showed that age of the parents was not a predictor of children's scientific process skills statistically.

In the literature, to the author's knowledge, no studies were found investigating the relationship between the age of parents and children's scientific process skills. However, there were studies concerning parents' age and children's development in different areas. A pertinent subject that comes under scrutiny is the potential impact of parental age on children's mathematics skills. The connection between mathematics skills and scientific process skills is notable due to the common cognitive and analytical aptitudes they demand as they include critical thinking and problem-solving. Keil et al. (2009) concludes that scientific process skills contribute to the improvement of mathematics skills. In their study of comparing the mathematics skills of children who received Montessori education with those who did not, Tayfun and Aydoğan (2021) found that there was no significant relationship between the ages of the parents and the Early Mathematics Test scores of the children. Additionally, in a study aimed to examine the mathematical reasoning skills of children in the areas of measurement and data analysis-probability, Ergül (2014) found that parents' ages were not a predictor of children's measurement and data analysis-probability skills.

Although there is a recognized positive influence of parents' age on their children's mathematical skills, literature also reveals contrasting findings, with certain studies indicating that parents' age may not significantly contribute to children's development or exhibit a significant correlation. In their study of investigating the relationship between parents' perspectives on science activities and their children's science learning skills among children aged 60-72 months, Günay and Bakanay (2021) observed that parents in the older age group held more positive views on science activities compared to parents in the younger age group. It was discovered that parents in the 30-39 age group had children with greater scientific learning levels than parents in the 29 and below and 40+ age groups. It was stated that having a positive view was not enough; customizing activities by age is also essential for children's interest in science (Günay & Bakanay, 2021).

In Step 3, when the scientific literacy skills of the parents were included, the total variance explained by the model as a whole was 24%. After controlling parents' for educational levels and ages, scientific literacy skills was seen as the most influential predictor of children's scientific process skills.

While there is a lack of studies examining the relationship between children's scientific process skills and parents' scientific literacy skills, it's noteworthy that educational status, a notable parental characteristic, has shown an association. In this direction, there is a need for studies examining this relationship in the field. Moreover, parents play a crucial role in supporting their children's scientific process skills by encouraging them to ask questions, make observations, and conduct experiments, thereby creating opportunities for children to engage in these activities and develop their own deductive reasoning abilities (Kefi, 2018). Children frequently come across science-related topics during their everyday activities, particularly when they spend time with their parents. It is important for parents to foster their children's inclination to inquire, observe, experiment, and thereby develop their own reasoning abilities. This entails providing opportunities for children to apply their scientific process skills effectively (NSTA, 2009). Thus, it is vital for parents to nurture their children's natural curiosity and provide them with opportunities to actively employ their scientific process skills in research activities (Kefi, 2018). In their study of creating framework in museum environments that highlights the importance of parents in promoting 5–12-year-old children's interests, Zimmerman et al. (2010) found that parents utilize verbal communication and physical gestures to direct their attention to their children's interests, encourage engagement with science and math content throughout the museum visit. While even the gestures of the parents can encourage the children, the scientific literacy skills of the parents could potentially contribute to the development of the children, namely their scientific process skills.

During the preschool period, it is crucial to provide children with frequent opportunities to engage in activities such as prediction, classification, and graphing, emphasizing the importance of the outcome. By doing so, children can develop and effectively utilize their fundamental scientific process skills from an early age (Bosse et al., 2009). Children's explorations can be stimulated through thoughtful material selection and thoughtful guidance, leading them to engage in closer examination, generate novel ideas about the world, and lay the groundwork for future experiences and concepts that will contribute to their overall understanding (Chalufour & Worth, 2003). With this direction, the significance of parental influence on children's development gains importance. Marcon (1999) states that when parents are more involved, children's early development and basic skills improve, setting them up for success in school. For instance, in a study exploring how children's science skills influenced the connection between parenting styles and parental involvement, Lin et al. (2023) found that parents' involvement acted as a mediator between children's science problem-solving skills and parenting styles. It can be concluded that active parents' involvement in their children's education positively influences their development and achievements. According to Comer and Haynes (1991), the significance of parents and schools as influential factors in children's psychoeducational development, underscores the benefits of their collaborative efforts. As parents provide social and emotional support, schools create environments that amplify these experiences and facilitate ongoing growth (Comer & Haynes, 1991). Facilitating parent involvement in their children's education can offer parents avenues for social support and personal empowerment. Thus, it could contribute to cultivating a positive school and community environment that holds significance for children's learning (Reynolds & Shlafer, 2010). Moreover, parent involvement could achieve optimal effectiveness when integrated into a comprehensive ecological strategy for enhancing schools, grounded in considerations of children's development, and fostering improved relationships among influential adults in children's lives (Comer & Haynes, 1991).

Research does exist on the influence of parents and parental involvement on children's development and achievements even though there is a lack of studies investigating the impact of parents' scientific literacy skills on their children's scientific process skills (Cohen & Anders, 2020; Lara & Saracostti, 2019; Pelletier & Brent, 2002). Moreover, when the literature was examined, it was seen that previous studies focused on effects of different approaches on children's scientific process skills, relationship between children related variables, teachers' parents' or students' scientific literacy skills along with different demographic variables (Allum et al., 2018; Can & Besler, 2018; Germann, 1994; Guarrella et al., 2023; Harefa, 2023; Kefi, 2017; Kim et al., 2022;

Kunt et al., 2015; Özgelen, 2012; Saçkes, 2013). Parents' and teachers' attitude towards science and science activities and scientific literacy skill levels was also investigated in the literature (Crall et al., 2013; Çavaş et al., 2013; Dragoş & Mih, 2015; Eberbach & Crowley, 2017; Gül-Ulukan, 2021). Consequently, parents' scientific literacy skills could have a significant impact on their children's scientific process skills, contributing to the possible cultivation of scientifically literate individuals in the future. The present study could contribute valuable insights to the existing literature concerning the scientific literacy skills of parents and the scientific process skills exhibited by children aged 60-72 months, as well as their potential associations.

5.4.Conclusion

Based on the study findings pertaining to the first research question, the scientific process skills of 60-72-month-old children were examined considering gender, age, and number of siblings. The findings indicated that children's scientific process skills have shown diversity, with an average score of 22.46 out of 31. Upon analyzing the sub-dimensions, it was seen that some of the children answered all the questions correctly in at least one sub-dimension. Though the results of the present study showed that the mean scores of girls were only slightly higher than the mean of boys, no statistically significant differences were found between them. The findings indicated that children's scientific process skills did not differ in gender in the preschool period, and maybe interventions in education should be carried out to ensure no differences at later age levels. The present study revealed a relationship between the children's scientific process skills scores and ages. As the age of the children increases, their scientific process skills also increase, consistent with the studies in the literature (Dahsah et al., 2017; Erol et al., 2022; Kuru & Akman, 2017; İlhan & Tosun, 2016; Tuzcuoğlu & Akarsu, 2019). In addition, the findings showed that children's scientific process skills scores did not differ in accordance with number of siblings they have. As the literature consists of studies with different findings, the results of this study may emphasize the need for more studies on children's development and the number of siblings they have (Carpandale & Lewis, 2004; Muñez et al., 2022; Ölçer, 2017; Özkan, 2021; Tok, 2020).

Based on the study findings pertaining to the second research question, the examination of scientific literacy skill levels of parents was conducted and found to be high and very high in line with their education levels. Studies in the literature also support the findings of the present study by revealing the relationship between the education levels of parents, in-service and pre-service teachers, and students (Başar & Elyıldırım, 2022; Can & Besler, 2018; Çavaş et al., 2013; Gül-Ulukan, 2021; Salcı & Aydın, 2022; Şahin et al., 2014).

Based on the study findings pertaining to the last research question, examining to what extent parents' scientific literacy skills predict children's scientific process skills after controlling the effects of parents' education levels and ages was conducted. The present study's findings revealed that parents' education levels and scientific literacy skills significantly predicted children's scientific process skills while the parents' ages did not. The findings indicated that parental education level and scientific literacy skills have a positive impact on the scientific process skills scores of preschool children, and they could develop positive attitudes towards science education, actively engage in cognitive development activities contributing to their academic success and foster the acquisition of scientific process skills (Germann, 1994). While the ages of parents showed no impact on children's scientific process skills in the present study, studies in the literature state different findings on parents' age on their children's development (Günay & Bakanay, 2021; Keil et al., 2009). Certain studies indicate that parents' age may not significantly contribute to children's development or exhibit a significant correlation (Ergül, 2014; Tayfun & Aydoğan, 2021).

5.5.Implications

The present study made a valuable contribution to the existing literature by examining children's scientific process skills and their parents' scientific literacy skills. The study particularly focused on investigating the scientific process skills of children based on different variables and whether the educational level and age of parents, as well as their own scientific literacy skill levels, predict the scientific process skills of their children. The findings of the study contribute to the literature by giving a different perspective to children's scientific process skills. The implications of the study provided valuable insights for future research studies to investigate the scientific process skills of children with other parental aspects.

The current study’s findings show that children whose parents have a solid grasp of scientific knowledge are more likely to develop scientific process skills from an early age. Children of parents with high scientific literacy skills could be more likely to develop positive attitudes towards science. Their parents’ enthusiasm for and understanding of science could inspire a similar interest in their children, potentially leading to greater engagement in scientific pursuits.

Findings of the study implies that parents play a significant role in shaping their children’s scientific process skills. It could be inferred that parents with higher scientific literacy skills were more likely to provide an environment that fosters curiosity, critical thinking, and engagement with scientific concepts. Moreover, a holistic approach to education, where parents actively support and engage in their children’s learning at home with the help of teachers, could have a positive impact on various cognitive skills, including scientific process skills.

This study infers that parents serve as role models for their children’s learning behaviors. Parents’ active interest in and knowledge of science can influence children to adopt similar attitudes and behaviors. From this study, it could be concluded that parental influence goes beyond the immediate context and could impact children’s long-term educational success. Children exposed to a scientifically literate environment in which it has science materials and exposed to science related activities at home could be better equipped for science-related studies and careers.

The study findings show that the majority of the parents’ scientific literacy skills were recorded as high in the self-reported surveys. A review of the existing literature revealed that there had been few previous studies on parents’ scientific literacy skills. This study could lead researchers to conduct research about parents’ scientific literacy skills based on various variables.

According to the findings of this study, parents’ scientific literacy skills have a major impact in predicting children’s scientific process skills. This conclusion emphasizes the significance of teachers and schools encouraging scientific literacy skills among parents, as it can have a favorable influence on their children’s development of scientific thinking, problem-solving, and inquiry-based abilities.

These findings may be used by educators and policymakers to create interventions and educational programs that promote parental scientific literacy skills, resulting in better science learning outcomes for children. In an international study conducted by Falk et al. (2016), the findings showed that individuals who attended scientific centers show better levels of comprehension, interest, curiosity, engagement, and affiliation with science and technology than those who did not. In Türkiye, science centers range in mostly big cities, namely İstanbul, Ankara, Eskişehir, Konya, Kocaeli and Gaziantep. Therefore, while there are science centers in big cities, it can be considered to increase science centers in small cities. These science centers could be advertised to encourage parents to go. As science centers associated with general public scientific and technological literacy skills, they could be used to facilitate scientific literacy skills among adults, particularly parents to contribute to children’s development.

Schools could also be a common point so that parents can improve themselves in the field of scientific literacy skills. By providing training in schools, parents can be supported to improve their scientific literacy skills. This way, parents can have the chance to support children’s scientific process skills at home. Moreover, the study emphasizes the importance of parents and schools working together to build a science-rich environment at home and in educational settings including materials used in science activities, supporting science and encouraging children’s scientific discovery and involvement. The teachers and parents could work collaboratively to enhance children’s skills.

5.6.Recommendations for Future Research

In the current study, an examination was conducted on children’s scientific process skills and scientific literacy skills of their parents along with their potential associations. Based on the findings of the study, several recommendations are provided for future research in this field.

This study was carried out on children aged 60-72 months, with a larger sample, studies that include different age groups could be conducted. Moreover, longitudinal studies could provide information about the long-term impact of scientific literacy skills of parents on scientific process skills of children. Following children and parents in a period of time could help discovering and understanding developmental patterns and gaining a better grasp of how impacts of parents change as children grow.

The findings of the study revealed that a majority of the parents self-reported high levels of scientific literacy skills based on the survey assessment. However, the original measuring instrument had to be adapted to parents; therefore, with this study, it was observed that an appropriate measurement tool should be developed to measure the scientific literacy skills of parents. In the future, researchers can develop scales appropriate for parents to assess their scientific literacy skills. Moreover, the researcher assumed that the parents answered the scientific literacy skills items objectively. However, in the future, mixed-methods research could be designed to comprehensively understand and investigate the parents' scientific literacy skills by conducting interviews. These interviews could include questions to better understand the home environment, materials and activities provided by parents and what they do outside of the home and whether they have been in science-related settings to facilitate their children's scientific process skills.

Furthermore, in the current study, the scientific literacy skill levels of mothers and fathers were not examined separately. Future studies may focus on the scientific literacy skill levels of mothers and fathers separately and examine the relationship between their children's scientific process skills with other variables including attitude towards science, time spent on science at home time devoted to science activities, materials at home to gain scientific process skills.

This study investigated the relationship between children's scientific process skills and their parents' scientific literacy skills. As a result of the findings, facilitating training programs to improve scientific literacy skills for parents could be considered. Workshops, education programs, or projects that could encourage parents to participate more strongly in their children's scientific learning could be included. In addition, researchers could conduct studies to determine if there are any variations in children's scientific process skills following these interventions. Additionally, future research could focus on designing studies to investigate whether interventions that increase parents' scientific literacy skills changed their children's scientific process skills.

REFERENCES

Abanoz, T., & Deniz, Ü. (2019). Stem Yaklaşımına Uygun Fen Etkinliklerinin Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerilerine Etkisinin İncelenmesi. *Turkish Studies-Educational Sciences*, *14*(6).

Adamson, L. B., Foster, M. A., Roark, M. L., & Reed, D. B. (1998). Doing a science project: Gender differences during childhood. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *35*(8), 845-857.

Afifah, R. N., Syaodih, E., Suhandi, A., Maftuh, B., Hermita, N., Handayani, H., Qonita, Ningsih, A. R., Gumala, Y., & Samsudin, A. (2019, November). Develop children's science process skills through building activities in center of beam: optical geometry on focus. In Journal of Physics: Conference Series (Vol. 1280, No. 5, p. 052016). IOP Publishing.

Alexander, J. M., Johnson, K. E., & Kelley, K. (2012). Longitudinal analysis of the relations between opportunities to learn about science and the development of interests related to science. *Science Education*, *96*(5), 763-786.

Alisinanoğlu, F., Özbey, S., & Kahveci, G. (2017). Okul öncesinde fen eğitimi. Ankara: Pegem Akademi

Allum, N., Besley, J., Gomez, L., & Brunton-Smith, I. (2018). Disparities in science literacy. *Science*, *360*(6391), 861-862.

American Association for the Advancement of Science [AAAS] (1989). Project 2061—Science for all Americans. Washington, DC: AAAS.

American Association for the Advancement of Science. (1990). *Science for all Americans: Project 2061*. New York: Oxford University Press.

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). Science aspirations, capital, and family habitus: How families shape children's engagement and identification with science. *American educational research journal*, *49*(5), 881-908.

Ardila, A., Rosselli, M., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental neuropsychology*, *28*(1), 539-560.

Ardila, A., Rosselli, M., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental neuropsychology*, *28*(1), 539-560.

Aydın-Ceran, S., & Esen, S. (2022). Improving the Science Process Skills and Science Literacy of Primary School Preservice Teachers with Different Parental Education Levels. *Educational Policy Analysis and Strategic Research*, *17*(4), 209-232.

Azmitia, M., & Hesser, J. (1993). Why siblings are important agents of cognitive development: A comparison of siblings and peers. *Child development*, *64*(2), 430-444.

Bacharach, V. R., Baumeister, A. A., & Furr, R. M. (2003). Racial and gender science achievement gaps in secondary education. *The Journal of genetic psychology*, *164*(1), 115-126.

Başar, T. & Elyıldırım, E. (2022). Okul öncesi öğretmenlerinin fen okuryazarlık düzeyleri ile fen öğretimine yönelik tutumlarının incelenmesi. *Kırşehir Eğitim Fakültesi Dergisi, 23*(1), 1268-1302.

Batı, K. & Kaptan, F. (2013). Bilimsel Süreç Becerilerine Dayalı İlköğretim Fen Eğitiminin, Bilimsel Problem Çözme Becerilerine Etkisi. *İlköğretim Online*, *12* (2), 512-527

Batı, K., Ertürk, G., & Kaptan, F. (2010). The awareness levels of pre-school education teachers regarding science process skills. *Procedia-Social and Behavioral Sciences*, *2*(2), 1993-1999.

Bauer, M. W., Allum, N., & Miller, S. (2007). What can we learn from 25 years of PUS survey research? Liberating and expanding the agenda. *Public understanding of science*, *16*(1), 79-95.

Bauer, J. R., & Booth, A. E. (2019). Exploring potential cognitive foundations of scientific literacy in preschoolers: Causal reasoning and executive function. *Early Childhood Research Quarterly*, *46*, 275-284.

Berger, E. H., & Riojas-Cortez, M. (2013). *Parents as partners in education: Families and schools working together*. Boston, MA: Pearson.

Berk, L. (2015). *Child development*. Pearson Higher Education AU.

Bernstein, D. A., Clarke-Stewart, A., & Roy, E. J. (2008). *Psychology*. USA: Houghton Mifflin.

Bjorklund, D. F. (2012). *Children's Thinking: Cognitive Development and Individual Differences*. Belmont, USA: Wadsworth, Cengage Learning.

Booth, A. E., Shavlik, M., & Haden, C. A. (2020). Parents' causal talk: Links to children's causal stance and emerging scientific literacy. *Developmental Psychology*, *56*(11), 2055.

Booth, A. E., Shavlik, M., & Haden, C. A. (2022). Exploring the foundations of early scientific literacy: Children's causal stance. *Developmental Psychology, 58*(12), 2302–2309.

Bosse, S., Jacobs, G., & Anderson, T. L. (2009). Science in the air. *YC Young Children*, *64*(6), 10.

Böyük, U., Tanık, N., & Saraçoğlu, S. (2011). İlköğretim ikinci kademe öğrencilerinin bilimsel süreç beceri düzeylerinin çeşitli değişkenler açısından incelenmesi. *Tübav Bilim Dergisi*, *4*(1), 20-30.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press. https://doi.org/10.1016/0190-7409(80)90036-5

Buldur, A. (2019). Montessori eğitim programına devam eden okul öncesi dönem çocuklarının bilimsel süreç becerilerindeki değişimin incelenmesi. *Cumhuriyet Uluslararası Eğitim Dergisi*, *8*(4), 1172-1186.

Büyüköztürk, Ş., (2011). *Sosyal Bilimler İçin Veri Analizi El Kitabı.* Ankara: Pegem Akademi

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö.E., Karadeniz, Ş. & Demirel, F. (2016). *Eğitimde Bilimsel Araştırma Yöntemleri.* Ankara: Pegem Akademi

Can, B. & Besler, H. (2018). Dijital ve Medya Etkinliklerinin Ortaokul Öğrencilerinin ve Ebeveynlerinin Medya ve Bilim Okuryazarlıklarına Etkisinin Belirlenmesi. *PAÜ Eğitim Fakültesi Dergisi, 43*,31-49.

Can, B., Yıldız-Demirtaş, V., & Altun, E. (2017). The effect of project-based science education programme on scientific process skills and conceptions of Kindergarten students. *Journal of Baltic Science Education*, *16*(3)

Carpendale, J. I., & Lewis, C. (2004). Constructing an understanding of mind: The development of children's social understanding within social interaction. *Behavioral and brain sciences*, *27*(1), 79-96.

Catsambis, S. (1995). Gender, race, ethnicity, and science education in the middle grades. *Journal of Research in Science Teaching*, *32*(3), 243-257.

Ceka, A., & Murati, R. (2016). The Role of Parents in the Education of Children. *Journal of Education and practice*, *7*(5), 61-64.

Chak, A. (2002). Understanding children's curiosity and exploration through the lenses of Lewin's field theory: on developing an appraisal framework. *Early Child Development and Care*, *172*(1), 77-87.

Chalufour, I., & Worth, K. (2003). *Discovering nature with young children: Part of the young scientist series*. Redleaf Press.

Choiriyah, C., Lutfiani, N., Khoirunisa, A., Faturahman, A., & Nabila, E. A. (2021). Science literacy in early childhood: Development of learning programs in the classroom. *Indonesian Journal of Early Childhood Education Studies, 10*(2), 136-142.

Ciccarelli, S. K., & White, J. N. (2012). *Psychology*. Pearson Education.

Cohen, F., & Anders, Y. (2020). Family involvement in early childhood education and care and its effects on the social-emotional and language skills of 3-year-old children. *School Effectiveness and School Improvement*, *31*(1), 125-142.

Comer, J. P., & Haynes, N. M. (1991). Parent involvement in schools: An ecological approach. *The Elementary School Journal, 91*(3), 271-277.

Conzeio, K. ve French, L. (2002). Science in the preschool classroom: Capitalizing on children's fascination with the everyday World to foster language and literacy development. *Young Children, 57*(5), 12-18.

Crall, A. W., Jordan, R., Holfelder, K., Newman, G. J., Graham, J., & Waller, D. M. (2013). The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy. *Public understanding of Science*, *22*(6), 745-764.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson Education, Inc.

Crowley, K., & Galco, J. (2001). Everyday activity and the development of scientific thinking. In K. Crowley, C. D. Schunn, & T. Okada (Eds.), *Designing for science: Implications from everyday classroom, and professional settings* (pp. 393–413). New Jersey: Lawrence Erlbaum Associates Publishers.

Crowley, K., Barron, B. J., Knutson, K., & Martin, C. K. (2015). Interest and the development of pathways to science. *Interest in mathematics and science learning*, 297-313.

Curriculum Development Centre. (1993). Evaluation of the implementation study report based on primary schools. Kuala Lumpur. Ministry of Education Malaysia.

Çavaş, P. H., Özdem, Y., Çavaş, B., Çakıroğlu, J., & Ertepinar, H. (2013). Turkish pre-service elementary science teachers' scientific literacy level and attitudes toward science. *Science Education International, 24*(4), 383-401.

Çelik, C. (2016). *Evrensel Fen Okuryazarlık Ölçeği'nin Türkçe'ye uyarlama çalışması ve öğretmen adaylarının evrensel fen okuryazarlık düzeyi*. [Master's thesis, Muğla Sıtkı Koçman University]. YÖK Thesis Center.

Çelik, C., & Can, S. (2017). Intercultural Adaptation and Validity Study: Universal Science Literacy Scale (USLS). *Universal Journal of Educational Research*, *5*(12), 2125-2136.

Çokluk, Ö., Şekercioğlu, G., & Büyüköztürk, Ş. (2012). *Sosyal bilimler için çok değişkenli istatistik: SPSS ve LISREL uygulamaları*. Ankara: Pegem Akademi.

Dabney, K. P., Chakraverty, D., & Tai, R. H. (2013). The association of family influence and initial interest in science. *Science Education*, *97*(3), 395-409.

Dahsah, C., Seetee, N., & Lamainil, S. (2017). The use of interview about events to explore children's basic science process skills. In *Conference Proceedings. New Perspectives in Science Education:* (pp. 497-503).

Demir, E. (2016). Characteristics of 15-Year-Old Students Predicting Scientific Literacy Skills in Turkey. *International Education Studies*, *9*(4), 99.

Dilek, H., Taşdemir, A., Konca, A. S., & Baltacı, S. (2020). Preschool children's science motivation and process skills during inquiry-based STEM activities. *Journal of Education in Science Environment and Health*, *6*(2), 92-104.

Dökme, İ., & Aydınlı, E. (2009). Turkish primary school students' performance on basic science process skills. *Procedia-Social and Behavioral Sciences*, *1*(1), 544-548.

Downey, D. B. (2001). Number of siblings and intellectual development: The resource dilution explanation. *American psychologist*, *56*(6-7), 497.

Dragoş, V., & Mih, V. (2015). Scientific Literacy in School. *Procedia-Social and Behavioral Sciences*, *209*, 167–172.

Durant, J. R. (1993). *What Is Scientific Literacy?* In J. R. Durant & J. Gregory (Eds.), Science and Culture in Europe (pp. 129-137). Science Museum

Eberbach, C., & Crowley, K. (2017). From seeing to observing: How parents and children learn to see science in a botanical garden. *Journal of the Learning Sciences*, *26*(4), 608-642.

Ergül, A. (2014). *Erken Matematiksel Akıl Yürütme Becerileri Değerlendirme Aracı Geliştirilmesi* (Doctoral Dissertation, Hacettepe University). YOK Thesis Center.

Ergül, R., Şimşekli, Y., Çalış, S., Özdilek, Z., Göçmençelebi, Ş., & Şanlı, M. (2011). The Effects of Inquiry-Based Science Teaching on Elementary School Students' Science Process Skills and Science Attitudes. *Bulgarian Journal of Science & Education Policy*, *5*(1).

Erol, A., İvrendi, A., & Özcan, Ö. (2022). Erken Çocuklukta Bilimsel Süreç ile Öz-Düzenleme Becerileri Arasındaki İlişki. *Dokuz Eylül Üniversitesi Buca Eğitim Fakültesi Dergisi*, (54), 988-1005.

Eshach, H. (2006). Bridging in-school and out-of-school learning: Formal, non-formal and informal education. *Journal of Science Education and Technology*, *16*(2), 171-190.

Falk, J. H., Dierking, L. D., Swanger, L. P., Staus, N., Back, M., Barriault, C., Catalao, C., Chambers, C., Chew, L. L., Dahl, S. A., Falla, S., Gorecki, B., Lau, T. C., Llyod, A., Martin, J., Santer, J., Singer, S., Solli, A., Trepanier, G., Tyystjärvi, K., & Verheyden, P. (2016). Correlating science center use with adult science literacy: An international, cross-institutional study. *Science Education*, *100*(5), 849-876.

Feldman, R. S. (2013). *Essentials of Understanding Psychology*. USA: McGraw-Hill.

Fender, J. G., & Crowley, K. (2007). How parent explanation changes what children learn from everyday scientific thinking. *Journal of applied developmental psychology*, *28*(3), 189-210.

Field, A. (2009). *Discovering statistics using SPSS* (3th ed.). London: Sage

Fives, H., Huebner, W., Birnbaum, A. S., ve Nicolich, M. (2014). Developing a measure of scientific literacy for middle school students. *Science Education*, *98*(4), 549-580.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in Education* (8th ed.). McGraw Hill LLC.

Freedman-Doan, C., Wigfield, A., Eccles, J. S., Blumenfeld, P., Arbreton, A., & Harold, R. D. (2000). What am I best at? Grade and gender differences in children's beliefs about ability improvement. *Journal of Applied Developmental Psychology*, *21*(4), 379-402.

French, L. (2004). Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly*, *19*(1), 138-149.

Friedman, M. (1974). Explanation and scientific understanding. *the Journal of Philosophy*, *71*(1), 5-19.

Funk, J. H., et al (1985). *Learning science process skills*. Dubuque, IA: Kendal/Hunt.

Gallenstein, N. L. (2005). Engaging young children in science and mathematics. *Journal of Elementary Science Education*, *17*(2), 27-41.

Geesa, R. L., İzci, B., Chen, S., & Song, H. S. (2020). The Role of Gender and Attitudes toward Science in Fourth and Eighth Graders' Science Achievement in South Korea, Turkey, and the United States. *Journal of Research in Education*, *29*(2), 54-87.

Gelman, R., & Brenneman, K. (2004). Science learning pathways for young children. *Early childhood research quarterly*, *19*(1), 150-158.

George, D., & Mallery, P. (2020). *IBM SPSS Statistics 26 Step by Step A Simple Guide and Reference* (16th ed.). Routhlege Taylor and Francis Group.

Germann, P. J. (1994). Testing a model of science process skills acquisition: An interaction with parents' education, preferred language, gender, science attitude, cognitive development, academic ability, and biology knowledge. *Journal of Research in Science Teaching*, *31*(7), 749-783.

Gilligan, T., Lovett, J., McLoughlin, E., Murphy, C., Finlayson, O., Corriveau, K., & McNally, S. (2020). 'We practise every day': parents' attitudes towards early science learning and education among a sample of urban families in Ireland. *European Early Childhood Education Research Journal*, *28*(6), 898-910.

Gormally, C., Brickman, P., & Lutz, M. (2012). Developing a test of scientific literacy skills (TOSLS): Measuring undergraduates' evaluation of scientific information and arguments. *CBE—Life Sciences Education*, *11*(4), 364-377.

Gravetter, F. J., & Wallnau, L. B. (2017*). Statistics for The Behavioral Sciences* (10th ed.). Cengage Learning.

Guarrella, C., van Driel, J., & Cohrssen, C. (2023). Toward assessment for playful learning in early childhood: Influences on teachers' science assessment practices. *Journal of Research in Science Teaching*, *60*(3), 608-642.

Güden, C., & Timur, B. (2016). Ortaokul öğrencilerinin bilimsel süreç becerilerinin incelenmesi (Çanakkale örneği). *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*, *16*(1), 163-182.

Gültekin, S. B., & Altun, T. (2022). Investigating the Impact of Activities Based on Scientific Process Skills on 4th Grade Students' Problem-Solving Skills. *International Electronic Journal of Elementary Education*, *14*(4), 491-500.

Gül-Ulukan, M. R. (2021). *Ebeveyn ve Öğretmenlerin Bilim Okuryazarlık Düzeyleri ile Okul Öncesi Dönemde Bilim Eğitimine İlişkin Görüşleri*. [Master's thesis, Hacettepe University]. YÖK Thesis Center.

Günay, S., & Bakanay, C. D. (2021). Ebeveynlerin Fen Etkinliklerine Yönelik Görüşleri ile Çocuklarının Bilim Öğrenme Becerileri Arasındaki İlişkinin İncelenmesi. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *18*(48), 222-243.

Güven, G., & Yılmaz, E. (2020). science process skills in children regarding external elements. *Ilkogretim Online*, *19*(4), 2227-2236.

Hamel, E. E. (2021). Science starts early: A literature review examining the influence of early childhood teachers' perceptions of gender on teaching practices. *Journal of Childhood, Education & Society*, *2*(3), 267-286.

Hamlin, M., & Wisneski, D. B. (2012). Supporting the scientific thinking and inquiry of toddlers and preschoolers through play. *Implementation Program: Teacher Guide*, 291.

Harefa, E. (2023). Implementation of Scientific Inquiry Approach for Enhancing Scientific Literacy among Elementary Students. *IRAONO: Journal of Elementary and Childhood Education*, *1*(1), 32-38.

Harlen, W. (2000). *Teaching of science in primary schools.* London: Fulton.

Hartup, W. W. (1989). Social relationships and their developmental significance. *American psychologist*, *44*(2), 120.

Hayes, N., O'Toole, L., & Halpenny, A. M. (2017). *Introducing Bronfenbrenner: A guide for practitioners and students in early years education.* Taylor & Francis.

Hetherington, E. M. (2006). The influence of conflict, marital problem solving, and parenting on children's adjustment in nondivorced, divorced, and remarried families. In A. Clarke-Stewart & J. Dunn (eds.), *Families count* . New York: Oxford University Press.

Hortaçsu, N. (1995). Parents' education levels, parents' beliefs, and child outcomes. *The Journal of Genetic Psychology*, *156*(3), 373-383

Hudson, A. (2011). Jean Piaget's Theories and applications for first grade mathematics. *St. Edward's University*.

Huitt, W., & Hummel, J. (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive.* Valdosta, GA: Valdosta State University.

Husna, N., Halim, A., Evendi, E., Syukri, M., Nur, S., Elisa, E., & Khaldun, I. (2022). Impact of Science Process Skills on Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 1827-1833.

Idris, M., Hussain, S., & Ahmad, N. (2020). Relationship between parents' education and their children's academic achievement. *Journal of Arts & Social Sciences*, *7*(2), 82-92.

İlhan, N., & Tosun, C. (2016). Kindergarten students' levels of understanding some science concepts and scientific inquiry processes according to demographic variables (the sampling of Kilis Province in Turkey). *Cogent education*, *3*(1), 1144246.

Jenkins, E. W. (1994). Scientific literacy. In T. Husen & T. N. Postlethwaite, (Eds.), The interna-tional encyclopedia of education 9(2), 5345–5350. Oxford, UK: PergamonPress.

Jirout, J., & Zimmerman, C. (2015). Development of science process skills in the early childhood years. In C. Trundle, & M. Saçkes (Eds.), *Research in early childhood science education* (pp. 143–165). Dordrecht: Springer.

Jones, I., Lake, V. E., & Lin, M. (2008). Early Childhood Science Process Skills. In O. Saracho, & B. Spodek (Eds.), *Contemporary perspectives on science and technology in early childhood education* (pp. 17-39). IAP.

Jöreskog, K. G., & Sörbom, D. (2006). LISREL 8.80 for Windows [Computer software]. Lincolnwood, IL: Scientific Software International.

Kähler, J., Hahn, I., & Köller, O. (2020). The development of early scientific literacy gaps in kindergarten children. *International journal of science education*, *42*(12), 1988-2007.

Karataş, F. N., (2018). *İlk Yıllar Eğitim Programının (Prımary Years Programme) Okul Öncesi Eğitime Devam Eden Çocukların Bilimsel Süreç Becerilerine Etkisi.* [Master's Thesis, Yıldız Technical University]. YOK Thesis Center.

Kaya, V. H., Bahceci, D., & Altuk, Y. G. (2012). The relationship between primary school students' scientific literacy levels and scientific process skills. *Procedia-Social and Behavioral Sciences*, *47*, 495-500.

Kefi, S. (2017). Analyzing the practices of project approaches in preschool education in terms of basic scientific process skills/Okul öncesi eğitimde proje yaklaşımı uygulamalarının temel bilimsel süreç becerilerini kapsama durumunun incelenmesi. *Erken Çocukluk Çalışmaları Dergisi, 1*(1), 3.

Keil, C., Haney, J., & Zoffel, J. (2009). Improvements in student achievement and science process skills using environmental health science problem-based learning curricula. *The Electronic Journal for Research in Science & Mathematics Education*.

Kelesidou, S., Chatzikou, M., Tsiamagka, E., Koutra, E., Abakoumkin, G., & Tseliou, E. (2017). The role of parents' educational level and centre type in parent satisfaction with early childhood care centres: A study in Greece. *European Early Childhood Education Research Journal*, *25*(5), 768-783.

Kim, K. J., Yoon, J., & Han, M. K. (2022). Young chefs in the classroom: promoting scientific process skills and healthy eating habits through an inquiry-based cooking project. *International Journal of Early Years Education*, *30*(4), 881-890.

Kim, Y. S., & Chung, W. H. (2001). An regression analysis for variables effect of development of scientific thinking. *Journal of the Korean Association for Science Education, 21*(4), 710–724.

Klahr, D., Zimmerman, C., & Jirout, J. (2011). Educational interventions to advance children's scientific thinking. *Science*, *333*(6045), 971-975.

Krishnan, V. (2010, May). *Early Child Development: A Conceptual Model* [Paper presentation]. The Early Childhood Council Annual Conference, Christchurch, New Zealand.

Kunt, B., Ozel, E., & Kunt, H. (2015). Determination of science process skills of 60-72 months old preschool students. *Eurasian Education & Literature Journal, 3*(3), 41–55.

Kuru, N., & Akman, B. (2017). Examining the science process skills of preschoolers with regards to teachers' and children' variables. *Education and Science, 42*(190), 269–279.

Lara, L., & Saracostti, M. (2019). Effect of parental involvement on children's academic achievement in Chile. *Frontiers in psychology*, *10*, 1464.

Laugksch, R. C. (2000). Scientific literacy: A conceptual overview. *Science Education*, *84*(1), 71–94.

Laugksch, R. C., & Spargo, P. E. (1996). Construction of a paper-and-pencil test of basic scientific literacy based on selected literacy goals recommended by the American Association for the Advancement of Science. *Public Understanding of Science*, *5*(4), 331.

Lin, X., Yang, W., Xie, W., & Li, H. (2023). The integrative role of parenting styles and parental involvement in young children's science problem-solving skills. *Frontiers in Psychology*, *14*, 1096846.

Lind, K. (1998). Science in early childhood: Developing and acquiring fundamental concepts and skills. Early Childhood Science, *Mathematics and Technology Education, 6*(8).

Lind, K. K. (2005). *Exploring science in early childhood education: A developmental approach* (4th ed.). Clifton Park, NY: Thomson Delmar Learning.

Liu, X. (2009). Beyond science literacy: Science and the public. *International Journal of Environmental and Science Education*, *4*(3), 301–311.

Mahn, H., & John-Steiner, V. (2012). Vygotsky and sociocultural approaches to teaching and learning. *Handbook of Psychology, Second Edition, 7*.

Mantzicopoulos, P., Patrick, H., & Samarapungavan, A. (2013). Science literacy in school and home contexts: Kindergarteners’ science achievement and motivation. *Cognition and instruction*, *31*(1), 62-119.

Marcon, R. A. (1999a, March). Impact of parental involvement on children’s development and academic performance: A three cohort study. Paper presented at the meeting of the Southeastern Psychological Association in Savannah, GA.

Martin, D. J. (2009). *Elementary science methods: A constructivist approach*. Cengage Learning.

Matsunaga, M., (2010). How to Factor-Analyze Your Data Right: Do’s and Don’ts and How To’s. *International Journal of Psychological Research, 3* (1), 97-110.

McCormick, M. P., Cappella, E., O’Connor, E. E., & McClowry, S. G. (2015). Social-Emotional Learning and Academic Achievement: Using Causal Methods to Explore Classroom-Level Mechanisms. *AERA Open*.

Merz, E. C., Zucker, T. A., Landry, S. H., Williams, J. M., Assel, M., Taylor, H. B., Lonigan, C. J., Phillips, B. M., Clancy-Menchetti, J., Barnes, M. A., Eisenberg, N., de Villiers, J., & School Readiness Research Consortium. (2015). Parenting predictors of cognitive skills and emotion knowledge in socioeconomically disadvantaged preschoolers. *Journal of Experimental Child Psychology, 132*, 14-31.

Miller, J. D. (1983). Scientific literacy: A conceptual and empirical review, *Daedalus, 112*(2), 29-48.

Minello, A., & Blossfeld, H. P. (2017). From parents to children: the impact of mothers’ and fathers’ educational attainments on those of their sons and daughters in West Germany. *British Journal of Sociology of Education*, *38*(5), 686-704.

Monhardt, L., Monhardt R., (2006). Creating a context for the learning of science process skills through picture books, *Early Childhood Education Journal, 34*, 67–71

Mun, K., Lee, H., Kim, S. W., Choi, K., Choi, S. Y., & Krajcik, J. S. (2015). Cross-cultural comparison of perceptions on the global scientific literacy with Australian, Chinese, and Korean middle school students. *International Journal of Science and Mathematics Education*, *13*, 437-465.

Muñez, D., Bull, R., & Lee, K. (2022). Maternal education and siblings: Agents of cognitive development in kindergarten. *Developmental Science*, *25*(4), e13218.

Murpy, C. ve Smith, G. (2014). The impact of a curriculum course on pre-service primary teachers' science content knowledge and attitudes towards teaching science. *Irish Educational Studies, 31*(1), 77-95.

Mutlu, A. (2020). Evaluation of students' scientific process skills through reflective worksheets in the inquiry-based learning environments. *Reflective Practice*, *21*(2), 271-286.

Natioanal Science Teachers Association. (1994). *Parent involvement in science learning*. NSTA.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. National Academies Press.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academy of Sciences.

National Research Council. (2007). *Taking science to school: Learning and teaching science in Grades K-8.* Washington, DC: The National Academic Press.

National Science Teachers Association. (2009). NSTA position statement: Parent involvement in science learning.

National Science Teachers Association. (2014). NSTA position statement: Early Childhood Science Education.

Nelson, K. (1986). *Event knowledge: structure and function in development.* Hillsdale, NJ: Erlbaum.

Öcal, S. (2018). *Okul öncesi eğitime devam eden 60-66 ay çocuklarına yönelik geliştirilen STEM programının çocukların bilimsel süreç becerilerine etkisinin incelenmesi.* [Master's Thesis, Yıldız Technical University]. YOK Thesis Center.

OECD. (2003). The PISA 2003 Assessment Framework: Mathematics, Reading, Science and Problem Solving Knowledge and Skills. Paris: OECD.

OECD. (2013a). PISA 2015 Draft Science Framework. OECD Publishing.

OECD. (2018). PISA for development assessment and analytical framework: Reading, mathematics and science. OECD Publishing.

Ogura, Y., & Takemura, S. (1994). Gender difference and the development process of formal reasoning abilities and science process skills in Japan. *Journal of Science Education in Japan*, *18*(3), 115-123.

Ölçer, S. (2017). Science Content Knowledge of 5–6 Year Old Preschool Children. *International Journal of Environmental and Science Education*, *12*(2), 143–175

Öngören, S. (2023). Preschool teachers' science teaching practices: earth and space. *Cultural Studies of Science Education*, 1-20.

Özdemir, O. (2010). Fen ve teknoloji öğretmen adaylarının fen okuryazarlığının durumu. *Türk Fen Eğitimi Dergisi, 7*(3), 42-56.

Özgelen, S. (2012). Students' science process skills within a cognitive domain framework. *Eurasia Journal of Mathematics, Science and Technology Education*, *8*(4), 283-292.

Özkan, B. (2015). *60-72 aylık çocuklar için bilimsel süreç becerileri ölçeğinin geliştirilmesi ve beyin temelli öğrenmeye dayanan fen programının bilimsek süreç becerilerine etkisi* [Doctoral dissertation, Marmara University]. YOK Thesis Center.

Özkan, B. (2021). An Investigation of Scientific Process Skills of Children in the Reggio Emilia Kindergarten and in a Private Kindergarten. *International Journal of Curriculum and Instruction*, *13*(3), 2430-2439.

Padilla, M. J. (1990). The science process skills. *Research Matters-to the science Teacher*, *9004*, 1-4.

Pallant, J. (2020). *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. McGraw-Hill Education.

Pelletier, J., & Brent, J. M. (2002). Parent participation in children'school readiness: The effects of parental self-efficacy, cultural diversity and teacher strategies. *International Journal of Early Childhood*, *34*(1), 45-60.

Piaget, J. & Inhelder, B. (1962). *The Psychology of the Child*. New York: Basic Books

Piaget, J. (1955). *The language and thought of the child.* Cleveland: The World Publishing Company

Piaget, J. (1964). Cognitive Development in Children: Piaget. *Journal of Research in Science Teaching, 2,* 176-186.

Piaget, J. (1976). Piaget's theory. In *Piaget and his school* (pp. 11-23). Springer, Berlin, Heidelberg.

Rakison, D. H., & Lawson, C. A. (2013). Categorization. In P. D. Zelazo (Ed.), *Oxford handbook of developmental psychology.* New York: Oxford University Press.

Rauf, A., Rasul, M., Mansor, N. A., Othman, Z., Lyndon, N. (2013). Inculcation of science process skills in a science classroom. *Asian Social Science; 9*(8).

Renee'White, T. (1999). *An investigation of gender and grade-level differences in middle school students' attitudes about science, in science process skills* *ability, and in parental expectations of their children's science performance*. The University of Southern Mississippi.

Reynolds, A. J., & Shlafer, R. J. (2010). Parent involvement in early education. *Handbook of school-family partnerships*, 158-174.

Saçkes, M. (2013). Children’s competencies in process skills in kindergarten and their impact on academic achievement in third grade. *Early Education and Development, 24*(5), 704–720.

Saçkes, M., Akman, B. ve Trundle, C. K. (2012). A science methods course for early childhood teachers: a model for undergraduate pre-service teacher education. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 6(2),*1-26.

Şahin, R., Sanalan, V., Bektaş, Ö., & Kaygısız, Y. (2014). Ebeveynlerin Fen Okuryazarlık Düzeylerinin İlköğretim 7. Sınıf Öğrencilerinin Fen Ve Teknoloji Dersi Başarılarına Etkisi. *Erzincan University Journal of Science and Technology*, *3*(1), 125-143.

Salcı, E., & Aydın, A. (2022). Öğretmen ve Öğretmen Adaylarının Evrensel Fen Okuryazarlık Düzeylerinin Bazı Değişkenlere Göre Belirlenmesi. *Trakya Eğitim Dergisi*, *12*(1), 92-109.

Santrock, J. W. (2014). *Child Development*. *(14)* McGraw- Hill Education.

Saracho, O., & Spodek, B. (Eds.). (2008). *Contemporary perspectives on science and technology in early childhood education*. IAP.

Saracho, O.N. (2021). Theories of Child Development and Their Impact on Early Childhood Education and Care. *Early Childhood Education Journal, 51*, 15–30.

Savaş, Ö., & Şeker, P. T. (2022). The effect of STEM training practices developed for children on scientific process skills. *Journal of Innovative Research in Teacher Education, 3*(2).

Saygılı, P., & Yalman, F. E. (2021). Okul Öncesi Dönemde Oyun Tabanlı Öğrenme Yönteminin Bilimsel Süreç Becerisine Etkisinin İncelenmesi. *Milli Eğitim Dergisi*, *50*(231), 7-26.

Schaie, K. W. (2012). *Developmental influences on adult intellectual development: The Seattle Longitudinal Study.* New York: Oxford University Press.

Senemoğlu, N. (2018). *Gelişim Öğrenme ve Öğretim Kuramdan Uygulamaya*. Ankara. Gazi Kitabevi.

Setioko, W., & Ding, L. (2022). Influence of parents' views about science on parent–child science talk at home. *International Journal of Science Education, Part B,* 1-21.

Sezer, E. & Aksüt Arslan, P. (2023). Investigation of the relationshıp between learning styles and scientific process skills of 5- to 6-year-old children. *Educational Academic Research*, (49), 63-74.

Shauli, S., & Baram-Tsabari, A. (2019). The usefulness of science knowledge for parents of hearing-impaired children. *Public Understanding of Science, 28*(1), 19-37.

Song, J., & Black, P. J. (1991). The effects of task contexts on pupils' performance in science process skills. *International Journal of Science Education, 13*(1), 49–58.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Taconis, R., Ferguson‐Hessler, M. G., & Broekkamp, H. (2001). Teaching science problem solving: An overview of experimental work. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *38*(4), 442-468.

Tan, M. ve Temiz, B. K., (2003). Fen öğretiminde bilimsel süreç becerilerinin yeri ve önemi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi 1*(13) 89-101

Tayfun, N., & Aydoğan, Y. (2021). Montessori Yönteminin Okul Öncesi Çocuklarının Matematik Becerilerine Etkisi. *International Journal of Field Education*, *7*(2), 207-228.

Tekerci, H., & Kandır, A. (2017). Effects of the sense-based science education program on scientific process skills of children aged 60–66 months. *Eurasian Journal of Educational Research, 17*(68), 239-254.

Tenenbaum, H. R., & Leaper, C. (2003). Parent-child conversations about science: The socialization of gender inequities? *Developmental psychology*, *39*(1), 34.

Tok,Y., (2020). *Okul öncesi eğitime devam eden 5 yaş grubu çocukların yılmazlık düzeyleri ile matematik ve bilimsel süreç becerileri arasındaki ilişkinin incelenmesi*. [Master's thesis, İnönü University]. YOK Thesis Center.

Turan, S., & Aydoğdu, F. (2020). Effect of coding and robotic education on pre-school children's skills of scientific process. *Education and Information Technologies*, *25*(5), 4353-4363.

Turhan, F., Aydoğdu, M., Şensoy, Ö. & Yıldırım, H. İ. (2008). İlköğretim 8. Sınıf Öğrencilerinin Bilişsel Gelişim Düzeyleri, Fen Bilgisi Başarıları, Fen

Bilgisine Karşı Tutumları ve Cinsiyet Değişkenleri Arasındaki İlişkinin İncelenmesi. *Kastamonu Eğitim Dergisi*, *16*(2), 439-450.

Turiman, P., Omar, J., Daud, A. M., & Osman, K. (2012). Fostering the 21st Century Skills through Scientific Literacy and Science Process Skills. *Procedia - Social and Behavioral Sciences, 59*, 110–116.

Tuzcuoğlu, N., & Akarsu, N., (2019) N. Okul Öncesi Dönem Çocuklarının Duygusal Gelişim Düzeyleri ile Bilimsel Süreç Becerilerinin İncelenmesi. *Eğitim Bilimlerinde Akademik Çalışmalar*, 66.

Ülgen, G. (1997). *Eğitim psikolojisi*. İstanbul: Alkım Yayıncılık.

Ültanır, E. (2012). An Epistemological Glance at The Constructivist Approach: Constructivist Learning in Dewey, Piaget, And Montessori. *International Journal of Instruction. (5)*2.

Ünal, M. & Aksüt, P. (2021). 4-6 yaş çocuklarına etkinlik temelli STEM eğitiminin bilimsel süreç becerilerine etkisinin incelenmesi. *Erken Çocukluk Çalışmaları Dergisi, 5*(1), 109-134.

UNEP (2012), 21 Issues for the 21st century: Result of the UNEP Foresight Process on Emerging Environmental Issues, United Nations Environment Programme, Nairobi, http://wedocs.unep.org/handle/20.500.11822/8056.

Vahey, P., Vidiksis, R., & Adair, A. (2019). Science Literacy in Early Childhood: The Connection between Home and School. *American Educator*, *42*(04), 17–21.

Vaivre-Douret, L. (2011). Developmental and cognitive characteristics of "high-level potentialities" (highly gifted) children. *International journal of pediatrics*, *2011*.

Vurucu, C. V., & Şahin, F. (2020). Bilim ve Mühendislik Uygulamalarının Okulöncesi Öğrencilerinin Bilimsel Süreç Becerilerine Etkisinin İncelenmesi. *Türkiye Bilimsel Araştırmalar Dergisi, 5*(2), 285-303.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Watters, J. J., Diezmann, C. M., Grieshaber, S. J., & Davis, J. M. (2001). Enhancing science education for young children: A contemporary initiative. *Australasian Journal of Early Childhood*, *26*(2), 1-7.

Yamtinah, S., Masykuri, M., Ashadi, A., & Shidiq, A. S. (2017). Gender differences in students' attitudes toward science: An analysis of students' science process skill using testlet instrument. In *AIP Conference Proceedings* (Vol. 1868, No. 1). AIP Publishing.

Yıldız, C., & Yıldız, T. G. (2021). Exploring the relationship between creative thinking and scientific process skills of preschool children. *Thinking Skills and Creativity*, *39*, 100795.

Yılmaz, E., Yüzbaşıoğlu, Y., & Hacıtahiroğlu, N. (2022). Zekâ Oyunlarının Okul Öncesi Dönemdeki Çocukların Bilimsel Süreç ve Dikkat Becerilerine Etkisinin İncelenmesi. *Journal of Education for Life/Yaşadıkça Eğitim Dergisi*, *36*(3).

Yılmaz, G., İlkörücü, Ş., & Çepni, S. (2018). The effects of parent-involved science activities on basic science process skills of the children in the age group of 5-6. *Pegem Journal of Education and Instruction*, *8*(4), 879–903.

Zimmerman, H., Perin, S., & Bell, P. (2010). Parents, science, and interest. *Museums & Social Issues*, *5*(1), 67-86

APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

01 ARALIK 2022

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç. Dr. Hasibe Özlen DEMİRCAN

Danışmanlığını yürüttüğünüz Bengi Nur İşler'in ***"Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi"*** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek **0553-ODTUİAEK-2022** protokol numarası ile onaylanmıştır

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Sibel KAZAK BERUMENT
Başkan

Prof. Dr. I.Semih AKÇOMAK
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

Dr. Öğretim Üyesi Şerife SEVİNÇ
Üye

Dr. Öğretim Üyesi Murat Perit ÇAKIR
Üye

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi A. Emre TURGUT
Üye

B. APPROVAL OF MINISTRY OF NATIONAL EDUCATION

T.C.
İSTANBUL VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : E-59090411-20-68423075 16/01/2023
Konu : Anket ve Araştırma İzni (Bengi Nur İŞLER)

VALİLİK MAKAMINA

İlgi : a) Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 21.01.2020 tarihli ve 2020/2 sayılı genelgesi.
b) Orta Doğu Teknik Üniversitesinin 24.12.2022 tarihli ve 54850036-044- E-338 sayılı yazısı.
c) Müdürlüğümüz Araştırma ve Anket Komisyonunun 06.01.2023 tarihli tutanağı.

Araştırma Konusu	: Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi
Araştırma Türü	: Anket
Araştırma Yeri	: Bağcılar, Bahçelievler, Bakırköy, Bayrampaşa, Esenler, Fatih, Güngören, Kağıthane, Küçükçekmece, Zeytinburnu
Araştırma Yapılacak Kişiler	: Öğrenci, Öğrenci Velisi
Araştırmanın Süresi	: 2022 - 2023 Eğitim - Öğretim Yılı

Yukarıda bilgileri verilen araştırmanın; 6698 sayılı Kişisel Verilerin Korunması Kanununa aykırı veri istenmemesi, öğrenci velilerinden açık rıza onayı alınması, Covid-19 tedbirlerinin araştırmacı ve ilgili kurum idarelerince alınması, bilimsel amaç dışında kullanılmaması, bir örneği Müdürlüğümüzde muhafaza edilen mühürlü ve imzalı veri toplama araçlarının kurumlarımıza araştırmacı tarafından ulaştırılarak uygulanması, katılımcıların gönüllülük esasına göre seçilmesi, araştırma sonuç raporunun kamuoyuyla paylaşılmaması ve araştırma bittikten sonra 2 (iki) hafta içerisinde Müdürlüğümüze gönderilmesi, okul idarelerinin denetim, gözetim ve sorumluluğunda, eğitim ve öğretimi aksatmayacak şekilde, ilgi (a) genelge esasları dâhilinde uygulanması kaydıyla Müdürlüğümüzce uygun görülmektedir.

Makamınızca da uygun görüldüğü takdirde olurlarınıza arz ederim.

Levent YAZICI
İl Milli Eğitim Müdürü

OLUR
Dr. Hasan Hüseyin CAN
Vali a.
Vali Yardımcısı

Ek:
1- İlgi (b) Yazı ve Ekleri (6 Sayfa)
2- İlgi (c) Tutanak (1 Sayfa)

C. PERMISSONS TO USE THE SCALES

SCIENTIFIC PROCESS SKILLS SCALE FOR 60-72-MONTH-OLD CHILDREN

Re: 60-72 Aylık Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği Kullanım İzni Hk.

Tarih: Bugün, 15:02:54 +03
Kimden: Banu Özkan
Kime:

Bu iletiye 17-11-2022 15:12:17 de cevap verdiniz.

Metin (2 KB)

Geliştirmiş olduğum 60-72 Aylık Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği'ni kullanabilirsiniz.
İyi çalışmalar.

17 Kas 2022 Per, saat 15:01 tarihinde <> şunu yazdı:

> Sayın Doç. Dr. Banu Özkan Hocam,
>
> ODTÜ Okul Öncesi Eğitimi Anabilim Dalı yüksek lisans öğrencisi ve YTÜ Okul Öncesi Eğitimi Anabilim Dalı'nda araştırma görevlisiyim. Doç. Dr. Hasibe Özlen Demircan danışmanlığında yapmayı planladığım "Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi" konulu tez çalışmam için geliştirmiş olduğunuz '60-72 Aylık Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği'nizi izniniz olursa kullanmak istiyorum. Ölçeğinizin kullanım iznini ve uygulanması hakkında bilgi alabilmek için sizinle görüşebilmeyi saygılarımla rica ediyorum.
>
> İyi çalışmalar dilerim.
>
> Saygılarımla,
> Bengi Nur İşler

--

Doç. Dr. Banu ÖZKAN Dumlupınar Üniversitesi Eğitim Fakültesi Okul Öncesi Eğitimi Anabilim Dalı Assoc. Prof. Banu ÖZKAN Dumlupınar University Faculty of Education Preschool Education Department

UNIVERSAL SCIENCE LITERACY SCALE

Ynt: Evrensel Fen Okuryazarlık Ölçeği Kullanım İzni Hk.

Tarih: 13-10-2022 (13:00:05 +03)
Kimden: Cüneyd ÇELİK
Kime:

Bu iletiye 13-10-2022 14:54:56 de cevap verdiniz.

Metin (3 KB)

Merhaba sayın hocam,
Ölçme aracımızı bilimsel etik çerçeve kapsamında kullanabilirisiniz.

İyi çalışmalar dilerim...

Gönderen:
Gönderildi: 13 Ekim 2022 Perşembe 12:12:59
Kime: Cüneyd ÇELİK
Konu: Evrensel Fen Okuryazarlık Ölçeği Kullanım İzni Hk.

Sayın Hocam,

ODTÜ Okul Öncesi Eğitimi Anabilim Dalı yüksek lisans öğrencisi ve Yıldız Teknik Üniversitesi Okul Öncesi Eğitimi Anabilim Dalı'nda araştırma görevlisiyim. Doç. Dr. Hasibe Özlen Demircan danışmanlığında yapmayı planladığım "Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi" konulu tez çalışmamda uyarlamış olduğunuz 'Evrensel Fen Okuryazarlık Ölçeği'ni izniniz olursa kullanmak istiyorum.

Ölçeğin kullanım iznini ve gerekli bilgileri saygılarımla rica ediyorum.

İyi çalışmalar dilerim.

Saygılarımla,
Bengi Nur İşler

D. VOLUNTARY PARTICIPATION FORM

Ek-4: Gönüllü Katılım Formu

Gönüllü Katılım Formu

Sayın Katılımcımız,

Bu çalışma, "Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi" adıyla, ODTÜ Okul Öncesi Eğitimi Yüksek Lisans öğrencisi ve YTÜ Okul Öncesi Eğitimi'nde Araştırma Görevlisi olan Bengi Nur İşler tarafından ODTÜ Öğretim Üyesi Doç. Dr. Hasibe Özlen Demircan danışmanlığında yapılacak bir araştırma uygulamasıdır.

Araştırmanın Hedefi: Bilimsel süreç becerileri, çocukların aktif olmalarını ve bireysel öğrenme için sorumluluk geliştirmelerini sağlar. Bu beceriler arasında tahmin-çıkarım-iletişim, ölçme, sınıflama ve gözlem bulunmaktadır ve bireyin çevre ile etkileşimlerine bağlı olarak değişkenlik gösterebilir. Bu araştırmanın amacı ebeveynlerin bilimsel okuryazarlık düzeyleri ile okul öncesi dönemdeki çocuklarının bilimsel süreç becerileri arasındaki ilişkiyi incelemektir.

Araştırmanın Nedeni: Tez çalışması

Araştırmanın Yapılacağı Yer(ler): Anaokulları

Araştırma Uygulaması: Anket şeklindedir. Bu çalışma kapsamında sizlerden yaklaşık olarak 10 dakika süren 48 maddelik (Kesinlikle katılıyorum; katılıyorum; katılmıyorum; kesinlikle katılmıyorum seçeneklerini içeren) bilimsel okuryazarlık becerileri ile ilgili bir derecelendirme ölçeği doldurmanız istenecektir. Bu ankete ek olarak, çocuğunuzun çalışmaya katılmasını onaylıyorsanız Veli Onam Formunu doldurarak araştırmacıya ulaştırmanızı rica edilecektir.

Araştırma T.C. Milli Eğitim Müdürlüğünün'nün okul yönetiminin ve öğretmenin izni ile gerçekleşmektedir. Uygulamada katılım tamamıyla gönüllülük esasına dayalı olmaktadır. Çalışmada sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplar tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Sizlerden elde edilen veriler sadece araştırmada kullanılacak ve üçüncü kişilerle paylaşılmayacaktır.

Uygulamalar, kişisel rahatsızlık verecek sorular ve durumlar içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden rahatsız hissederseniz cevaplama işini yarıda bırakabilirsiniz.

Katılımı onaylamadan önce sormak istediğiniz herhangi bir konu varsa sormaktan çekinmeyiniz. Çalışma bittikten sonra bizlere telefon veya e-posta ile ulaşarak soru sorabilir, sonuçlar hakkında bilgi isteyebilirsiniz. Saygılarımızla,

Araştırmacı : Bengi Nur İşler

İletişim Bilgileri :

Yukarıda bilgileri bulunan araştırmaya katılmayı kabul ediyorum.

..../...../..........

İsim-Soyisim İmza:

Katılımcı Adı-Soyadı:

Telefon Numarası:

23

E. PARENT CONSENT FORM

EK-3: Veli Onam Formu

Veli Onam Formu

Sayın Veli;

Çocuğunuzun katılacağı bu çalışma, "Ebeveynlerin Bilimsel Okuryazarlık Düzeyleri ile Okul Öncesi Dönem Çocuklarının Bilimsel Süreç Becerileri Arasındaki İlişkinin İncelenmesi" adıyla, ODTÜ Okul Öncesi Eğitimi Yüksek Lisans öğrencisi ve YTÜ Okul Öncesi Eğitimi'nde Araştırma Görevlisi olan Bengi Nur İşler tarafından ODTÜ Öğretim Üyesi Doç. Dr. Hasibe Özlen Demircan danışmanlığında yapılacak bir araştırma uygulamasıdır.

Araştırmanın Hedefi: Bilimsel süreç becerileri, çocukların aktif olmalarını ve bireysel öğrenme için sorumluluk geliştirmelerini sağlar. Bu beceriler arasında gözlem, sınıflama, tahmin-çıkarım-iletişim ve ölçme bulunmaktadır ve bireyin çevre ile etkileşimlerine bağlı olarak değişkenlik gösterebilir. Bu araştırmanın amacı ebeveynlerin bilimsel okuryazarlık düzeyleri ile okul öncesi dönemdeki çocuklarının bilimsel süreç becerileri arasındaki ilişkiyi incelemektir.

Araştırma Uygulaması: Anket şeklindedir. Bu çalışma kapsamında çocuğunuza bazı resimler ve materyaller göstererek bilimsel süreç becerileri ile ilgili sorulan anket sorularına cevap vermesi istenecektir. Anket yaklaşık olarak 15 dakika sürmektedir. Çalışmaya başlamadan önce sizden çocuğunuzun katılımcı olması için izin istediğimiz gibi çocuğunuzdan da sözlü olarak katılımıyla ilgili rızası istenecektir.

Araştırma T.C. Millî Eğitim Müdürlüğü'nün, okul yönetiminin ve öğretmenin de izni ile gerçekleşmektedir. Anket soruları öğretmenin de denetimi altında çocuğunuza bazı resimler ve materyaller gösterilerek sorulacaktır. Araştırma uygulamasına katılım tamamıyla gönüllülük esasına dayalı olmaktadır. Çocuğunuz çalışmaya katılıp katılmamakta özgürdür. Araştırma çocuğunuz için herhangi bir istenmeyen etki ya da risk taşımamaktadır. Çocuğunuzun katılımı **tamamen sizin isteğinize bağlıdır**, reddedebilir ya da herhangi bir aşamasında ayrılabilirsiniz. Araştırmaya katılmamama veya araştırmadan ayrılma durumunda öğrencilerin akademik başarıları, okul ve öğretmenleriyle olan ilişkileri etkilemeyecektir.

Çalışmada öğrencilerden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplar tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir.

Uygulamalar, genel olarak kişisel rahatsızlık verecek sorular ve durumlar içermemektedir. Ancak, katılım sırasında sorulardan ya da herhangi başka bir nedenden çocuğunuz kendisini rahatsız hissederse cevaplama işini yarıda bırakıp çıkmakta özgürdür. Bu durumda rahatsızlığın giderilmesi için gereken yardım sağlanacaktır. Çocuğunuz çalışmaya katıldıktan sonra istediği an vazgeçebilir. Böyle bir durumda veri toplama aracını uygulayan kişiye, çalışmayı tamamlamayacağını söylemesi yeterli olacaktır. Anket çalışmasına katılmamak ya da katıldıktan sonra vazgeçmek çocuğunuza hiçbir sorumluluk getirmeyecektir.

Onay vermeden önce sormak istediğiniz herhangi bir konu varsa sormaktan çekinmeyiniz. Çalışma bittikten sonra bizlere telefon veya e-posta ile ulaşarak soru sorabilir, sonuçlar hakkında bilgi isteyebilirsiniz. Saygılarımızla,

Araştırmacı : Bengi Nur İşler

İletişim bilgileri :

Velisi bulunduğum .... sınıfı .... numaralı öğrencisi ....'in yukarıda açıklanan araştırmaya katılmasına izin veriyorum. (Lütfen formu imzaladıktan sonra çocuğunuzla okula geri gönderiniz*).

..../...../............

İsim-Soyisim İmza:

Veli Adı-Soyadı:

Telefon Numarası:

22

F. DEMOGRAPHIC INFORMATION FORM

ÇOCUK VE EBEVEYNE İLİŞKİN KİŞİSEL BİLGİ FORMU

1. **Çocuğun cinsiyeti**

☐Kız ☐Erkek

2. **Çocuğun yaşı:** (Lütfen Gün/Ay/Yıl olacak şekilde yazınız)

…../…../…...

3. **Çocuğun kardeş sayısı**

☐Kardeşi yok ☐2 ☐4

☐1 ☐3 ☐5'ten fazla

4. **Ebeveynlerin yaşı:**

☐Anne: ☐Baba:

5. **Ebeveynlerin medeni durumu**

☐Anne-baba birlikte ☐Boşanmış

☐Anne-baba ayrı yaşıyor ☐Diğer:

6. **Ebeveynlerin eğitim durumu**

Anne Eğitim Durumu:	**Baba Eğitim Durumu:**
☐Okur-yazar değil	☐Okur-yazar değil
☐Okur yazar	☐Okur yazar
☐İlkokul mezunu	☐İlkokul mezunu
☐Ortaokul mezunu	☐Ortaokul mezunu
☐Lise mezunu	☐Lise mezunu
☐Üniversite mezunu	☐Üniversite mezunu
☐Yüksek lisans ve üstü	☐Yüksek lisans ve üstü

7. **Annenin mesleği:** **Babanın mesleği:**

G. SCIENTIFIC PROCESS SKILLS SCALE FOR 60-72-MONTH-OLD CHILDREN

EK-B: 60-72 Aylık Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği

Çocuğun yaşı: Tarih:

TAHMİN-ÇIKARIM-BİLİMSEL İLETİŞİM KURMA

Madde		Puan
1		
2		
3	Elimde bir mum var bu mumu yakıp üzerine bir bardak kapatırsam ne olur, söyle	
4		
5		
6		
7		
8		
9		
10		
11		
12		

SINIFLAMA

Madde		Puan
1		
2		
3		
4	Burada farklı malzemeden yapılmış nesneler var. Aynı malzemeden yapılan nesneleri grupla. (Ağaçtan ve metalden yapılmış malzemeler)	
5		
6		
7		
8		

20

ÖLÇME

Madde		Puan
1		
2		
3		
4		
5	Çubuklarla ölçerek kitabın boyunun kaç çubuk ettiğini söyle	
6		
7		

GÖZLEM

Madde		Puan
1	Burada iki tane resim var. Bu resimler arasında iki tane fark var. Resimleri dikkatle incele ve bu iki farkı göster	
2		
3		
4		

Toplam Puan:

H. UNIVERSAL SCIENCE LITERACY SCALE

EK-2: Veri Toplama Araçları

EK-A: Evrensel Fen Okuryazarlık Ölçeği (GSLS)

EVRENSEL FEN OKURYAZARLIĞI ÖLÇEĞİ	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Bilimsel fikirlerim ile ilgili diğerlerinin yapmış olduğu eleştirel yorumları kabul etmeye istekliyim	1	2	3	4	5
2. Başkaları ile çalışırken, grubun hedeflerini dikkate alırım	1	2	3	4	5
3. İnsanlar bilimsel görüşlerini sunarken, önemli fikirleri seçebilirim	1	2	3	4	5
4. Bilimsel fikirleri hakkında başkalarına faydalı geri bildirimlerde bulunurum	1	2	3	4	5
5. Bilimsel fikirlerimi açıklarken, onları tam ve kapsamlı bir biçimde sunmaya çalışırım	1	2	3	4	5
6. Bilimsel bir problemi çözerken, hangilerinin sonucu etkileyebileceğini belirlemek için önemli fikirleri seçerim	1	2	3	4	5
7. Geçerli sonuçlar çıkarmak için bir deneyden elde edilen verileri dikkatli bir biçimde analiz ederim	1	2	3	4	5
8. Bilimsel bir problemi çözerken, deneysel verilerde kalıpları bulmaya çalışırım	1	2	3	4	5
9. Gözlemlerimi açıklamak için bilimsel modeller geliştiririm ya da var olan modelleri kullanırım	1	2	3	4	5
10. Bir problemi çözerken, çeşitli kaynaklardan konuyla ilgili bilgileri bulmaya çalışırım	1	2	3	4	5
11. Veri toplarken ya da araştırırken, benzerlikleri ya da farklılıkları bulabilirim	1	2	3	4	5
12. Bilimsel bir problemi çözerken, en uygun çözümün hangisi olduğunu belirlemek için bilgileri kıyaslar ve değerlendiririm	1	2	3	4	5
13. Veri toplarken ya da araştırırken, bunu organize bir biçimde yaparım	1	2	3	4	5
14. Çevreyi etkileyebilecek bir şey yaparken, suyun, toprağın, havanın ve yaşamın nasıl birbirleri ile bağlantılı olduğunu düşünürüm	1	2	3	4	5
15. Başkaları sağlıklı bir çevrede yaşayabilsin diye çevreyi korumak için sorumluluk alırım	1	2	3	4	5
16. Dünyayı etkileyen bilimsel konular hakkında dikkat etmemizi sağlayacak kişisel özellikler geliştirmemiz gerektiğine inanmaktayım	1	2	3	4	5
17. Dünyayı etkileyen konular hakkında karar almam gerektiğinde, zor durumda olan insanların lehine hareket etmem gerektiğini düşünürüm	1	2	3	4	5
18. Dünyanın başka bölümlerinde yaşayan insanların duygularına saygı duymaya ve onları anlamaya çalışırım	1	2	3	4	5
19. Dünyanın başka bölümlerinde yaşayan insanları etkileyen problemlerin çözümüne katılmaya istekliyim	1	2	3	4	5
20. Dünyayı etkileyen konular hakkında karar alma aktivitelerine katılma konusunda istekliyim	1	2	3	4	5
21. Kişisel davranışlarım tüm dünyada çevreyi etkileyebilir	1	2	3	4	5
22. Global sorunlar ile ilgili kararlarım dünyayı değiştirmeye katkı sağlayabilir	1	2	3	4	5
23. Bilim adamları yeni kanıtlar buldukça bilimsel fikirler değişebilir	1	2	3	4	5
24. Bilimsel bilgiler doğal dünyanın gözlemlerinden elde edilir	1	2	3	4	5

18

	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
25. Farklı kuramlara inanan insanlar aynı olguları farklı biçimlerde gözlemleyeceklerdir	1	2	3	4	5
26. Bilimsel bilgiyi geliştirmede yaratıcılık önemli bir rol oynar	1	2	3	4	5
27. Bilim, teknoloji ve toplum birbiri ile yakından ilgilidir	1	2	3	4	5
28. Bilimde ilerleme için bilimsel araştırmalarda halkın desteğine gereksinimi vardır	1	2	3	4	5
29. Bilimsel araştırma finansal destek gerektirdiği için, şirketler veya hükümetlerden etkilenebilir	1	2	3	4	5
30. Bilimsel kuramlar (örneğin, katman tektoniği, evrim) insan çabalarının bir sonucudur	1	2	3	4	5
31. İnsanların bilim ve teknolojiyi kullanma biçimleri pek çok sosyal, çevresel ve sağlık problemlerine yol açabilir	1	2	3	4	5
32. İnsanların bilim ve teknolojiden yararlanma biçimleri sosyal problemlerin çözümüne katkı sağlayabilir	1	2	3	4	5
33. Bilim adamları araştırmalarını yürütürken ve bulgularını sunarken entelektüel dürüstlüğü önemsemelidir	1	2	3	4	5
34. Bilimsel problemler karmaşık olmalarına ve net çözümleri olmamasına rağmen, bilim adamları sürekli olarak çözümler bulmak için çabalamaktadır	1	2	3	4	5
35. Bilim adamları araştırmalarını yürütürken açık görüşlü ve şüphecidir	1	2	3	4	5
36. Bilimsel bir problemi çözmeden önce, problemi anlayıp anlamadığımı kendime sorarım	1	2	3	4	5
37. Yeni bir bilimsel probleme başlarken, problemi çözmek için hangi bilgilere gereksinim duyduğumu düşünürüm	1	2	3	4	5
38. Bilimsel bir problemi çözmeye çalışmadan önce, problemi kendi cümlelerim ile ifade ederim	1	2	3	4	5
39. Yeni bir bilimsel problemi çözmeye başlarken, daha önce benzer problemler ile uğraşıp uğraşmadığımı hatırlamaya çalışırım	1	2	3	4	5
40. Yeni bir bilimsel problem ile karşılaştığımda, problemi çözerken takip edeceğim adımları düşünürüm	1	2	3	4	5
41. Bilimsel bir problemi çözerken, bir adımı tamamladıktan sonra geriye döner bakarım	1	2	3	4	5
42. Bilimsel bir problemi çözerken, adım adım giderim	1	2	3	4	5
43. Bir problemin çözümünü tamamladığımda, doğru süreçleri takip edip etmediğime geri döner bakarım	1	2	3	4	5
44. Bilimsel bir problemi çözerken, ilerlemeden önce problemin tüm yönlerini anlayıp anlamadığımı kendime sorarım	1	2	3	4	5
45. Bilimsel bir problemi çözdükten sonra, onu çözmenin başka yolları olup olmadığına bakarım	1	2	3	4	5
46. Bir problemi çözdükten sonra, çalışmalarımdan ne öğrendiğimi kendime sorarım	1	2	3	4	5
47. Bir deneyin bir bölümünü bitirdikten sonra, amacıma ulaşıp ulaşmadığımı kendime sorarım	1	2	3	4	5
48. Global sorunlar hakkında karar almak için bilimsel kanıt ve bilgi arama konusunda istekliyimdir	1	2	3	4	5

Anket bitmiştir. Doldurduğunuz için teşekkür ederim.

I. TURKISH SUMMARY / TÜRKÇE ÖZET

GİRİŞ

Çocuklar, gelişimin ilk aşamalarında doğal olarak çevrelerini gözlemler, araştırır ve keşifler yaparlar (National Research Council, 2012). Küçük çocuklar öğrenme arzularını besleyen ve yeteneklerini geliştiren iyimser bir bakış açısına sahip olarak çevrelerindeki her şeye derin bir ilgi gösterirler ve genellikle sorunlardan veya aksiliklerden korkmazlar (Freedman-Doan vd., 2000). Ayrıca, bu doğuştan gelen yetenekler, bilimsel eğitimin temelini oluşturur ve çocukları ilk yıllarında bilimle ilgili etkinliklere dahil ederek daha da geliştirilebilir (National Science Teachers Association, 2014). Bu sadece bilime gelecekteki ilgileri için sağlam bir temel oluşturmakla kalmaz, aynı zamanda onların merakını ve bilimsel keşif tutkusunu da besler (National Research Council, 2012). Araştırma bulgularına göre, erken yaştaki ilgileri sürdürmek, bilime sürekli katılımı teşvik ederek ve çocukların gelecekteki meslek tercihlerini etkileyerek uzun vadeli bir etkiye sahip olabilir (Crowley vd., 2015). Bu nedenle, çocukların bilime olan ilgisi küçük yaşta geliştirilmeli ve teşvik edilmelidir.

Bilimi çocukların eğitimine entegre etmek, dünyayı anlamanın temeli olarak hizmet ettiği için kritik öneme sahiptir. Böylece çocuklar önemli problem çözme becerileri geliştirebilir, evreni anlamak için bağlantılar kurabilir ve karar verme becerilerini geliştirebilirler (Demir, 2016). Bununla birlikte, çocukların bilimsel kavramları tamamen kavramak için daha fazla zamana ihtiyaç duyabileceklerini belirtilmektedir. Çocuklar, yetişkinler tarafından sunulan bilim ortamlarında çevreleriyle aktif bir şekilde etkileşime geçebilir ve yeni materyaller ile önceki bilgileri arasında bağlantılar kurarak gelecekteki bilimsel okuryazarlık için gerekli becerileri kazanmalarına olanak tanır (National Science Teachers Association, 2009).

Bilimsel okuryazarlık başlangıçta “kişisel kararlar almak, kentsel ve kültürel faaliyetlere katılmak ve ekonomik üretkenliğe ulaşmak için gerekli olan bilimsel kavram ve süreçlere ilişkin bilgi ve anlayışa sahip olma” olarak tanımlanmıştır (National Research Council, 1996, s. 22). Bu, bireylerin yaşamlarını şekillendirmede bilimsel okuryazarlığın hayati önemini vurgulamaktadır. Bilimsel okuryazarlığın diğer bir tanımı, bilimle ilgili konuları teoriler ve olgular açısından anlamak ve mevcut bilgi ve verileri değerlendirmek ve çıkarımlarda bulunmak için kullanmaktır (Dragoş & Mih, 2015). Bu nedenle bilimsel okuryazarlık , sorunları anlama ve bunları çözmek için en etkili şekilde nasıl yaklaşılacağını anlama sürecidir (Dragoş & Mih, 2015) .

Bilimsel okuryazarlık, bireyler problem çözebildiğinde, açıklayabildiğinde, çıkarımlarda bulunabildiğinde ve sonuçlara ulaşmak için bilimsel araştırma adımlarını anladığında gelişmektedir (Organisation for Economic Co-operation and Development, 2003). Bu beceriler bilimsel süreç becerileri olarak da bilinir ve sonunda bilimsel okuryazarlığa yol açmaktadır (OECD, 2003). Erken çocukluk eğitimi, bilimsel okuryazar bireyler yetiştirmeyi amaçlasa da çocukların kapsamlı bir bilim okuryazarlığına sahip olduğu varsayılmamaktadır (Watters vd., 2001). Bilimsel süreç becerilerinin kazanılması, bilimsel okuryazarlığın geliştirilmesine yönelik önemli bir adım olarak kabul edilmektedir (Jones vd., 2008). Çeşitli araştırmaların bulguları, bilimsel süreç becerilerinin etkin kullanımının çocuklarda ve yetişkinlerde bilimsel okuryazarlığın oluşmasında ve ilerlemesinde çok önemli bir rol oynadığını göstermiştir (Aydın-Ceran & Esen, 2022; Husna vd., 2022; Kaya vd., 2012).

Bilimsel süreç becerilerinin öğretilmesi ve edinilmesi, çocukların gerçekleri ve kavramları kavramalarına olanak tanırken aynı zamanda bilimsel süreç becerilerini kullanma ve bilimsel tutumları geliştirme teorisiyle ilişkilendirmelerini sağlamak üzere tasarlanmıştır (Turiman vd., 2012). Ayrıca çocukların bilimsel süreç becerilerini kullanmaları, bilimsel kavramları anlamalarını, bilimsel bilgileri öğrenmelerini, bilimin doğasını keşfetmelerini, özgür araştırmacı olmalarını ve bilime karşı olumlu tutum, ilgi ve beceriler geliştirmelerini sağlar (Batı & Kaptan, 2013). Bilimsel süreç becerilerinin geliştirilmesinde veya kullanılmasında cinsiyet, yaş, kardeş sayısı, ebeveyn etkisi gibi faktörler önemli rol oynayabilir.

Araştırmalar, okul dışındaki toplumsal cinsiyetle ilgili bilim karşılaşmalarının, fen başarılarında kayda değer değişiklikler meydana gelmeden önce gerçekleşebileceğini öne sürmektedir (Adamson vd., 1998). Bu aynı zamanda Bronfenbrenner'ın bilişsel gelişimlerini şekillendirmede çocukların çevrelerinin önemini belirten ekolojik sistemler teorisiyle de tutarlıdır (Bronfenbrenner, 1979). Yapılan çalışmalar ortaokul ve lise öğrencilerinin bilimsel süreç becerilerinde cinsiyete dayalı fen ve fen başarısı ile ilgili farklılıklar göstermiştir (Bacharach vd., 2003; Catsambis, 1995; Ogura &

Takemura, 1994; Renee'White, 1999; Turhan vd., 2008; Yamtinah, vd., 2017). Ortaokul ve lisede bilimsel süreç becerilerinin farklılık gösterdiği düşünüldüğünde cinsiyet açısından erken çocukluk döneminde de farklılaşmaları söz konusu olabilir. Bu nedenle, erken çocukluk döneminde bilimsel süreç becerilerini ve olası cinsiyet farklılıklarını anlamak, ebeveynlere veya öğretmenlere çocukların bireysel öğrenme ihtiyaçları ve tercihleri hakkında fikir verebilir ve daha etkili eğitim tekniklerine yol açabilir. Bununla birlikte, cinsiyete ek olarak yaşın bilimsel süreç becerileri üzerindeki etkisini anlamak, bu bilişsel becerilerin gelişimsel yörüngesini anlamada önemli olabilir.

Çocuklar fiziksel, sosyal ve bilişsel yönleri kapsayan gelişim evrelerinde ilerledikçe, bilişsel gelişim de eş zamanlı bir büyüme ve gelişme geçirir. (Lind, 1998). Çocukların bilişsel gelişimi, dikkat süreleri ve merakları, bu gelişim evrelerinde büyüdükçe değişir (Piaget, 1964). Her yaşta, çocuklar farklı düzeylerde bilişsel olgunluk ve farklı düşünme kalıpları sergilerler. Çocuklar yetişkinlerden farklı gelişim özelliklerine sahiptir, bu nedenle onlara kendi yaş gruplarına uygun fırsatlar sunmak çok önemlidir. Eğitimi gelişimsel ihtiyaçlarını karşılayacak şekilde uyarlamak, etkili öğrenme deneyimleri sağlar (Vaivre-Douret, 2011). Bu deneyimler sayesinde çocuklar büyür ve farklı gelişim aşamalarını deneyimler ve yavaş yavaş basit bilişsel becerileri kullanmaktan daha karmaşık beceriler geliştirmeye geçerler. Bu evrim, yaşlandıkça olgunlaştıkça düşünür olarak etkili olmalarına katkıda bulunur (Berk, 2015). Ayrıca araştırmalar, çocukların bilimsel süreç becerilerinin ileri yaş grupları lehine farklılık gösterdiğini göstermektedir (Dahsah vd., 2017; Güden & Timur, 2016; Özgelen, 2012; Song & Black, 1991).

Jirout ve Zimmerman (2015) birçok bilimsel süreç becerisinin doğrusal bir yaş eğilimi sergilerken, bazı becerilerin diğerlerine kıyasla daha fazla akran ve yetişkin desteği gerektirdiğini belirtmiştir. Örneğin kardeşler, çocukların sosyal, duygusal, ahlaki ve bilişsel gelişiminde önemli bir rol oynamaktadır (Carpendale & Lewis, 2004). Bu görüş, Bronfenbrenner'ın (1979) kardeşler ve ebeveynler arasındaki yakın ilişkilerin çocukların gelişimini nasıl şekillendirdiğini vurgulayan ekolojik sistemler teorisi ile örtüşmektedir. Kardeşlerle büyüme deneyimi, genellikle önemli bir süreyi birlikte geçirme ve temel olarak olumlu niteliklere sahip etkileşimlerde bulunma ile kendini gösterir (Azmitia & Hesser, 1993). Ayrıca, kardeşler arasındaki farklılıklar birbirlerinden öğrenmeye elverişli bir ortamı destekleyebilir ve böylece yeni beceriler edinme şansı sunabilir (Hartup, 1989). Bu nedenle, bu kardeş etkileşimi ve beceri geliştirme ortamı, çocukların sosyal öğrenmeyi, işbirlikçi çabaları ve bilimsel oyun ve keşifte aktif katılımı teşvik etmelerine yardımcı olabilir.

Çocukların bebeklikten itibaren çevrelerindeki dünyayı öğrenmeye hazır ve istekli oldukları alanyazında belirtmiştir (French, 2004). Böylece, çocuklar bebeklikten başlayarak, teorilerini oluşturmak için günlük deneyimlerini kullanmaktadırlar (Nelson, 1986). Bu nedenle, çocuklara fikirlerini ve teorilerini test etmeleri için bilimle ilgili çeşitli fırsatlar sağlamak çok önemlidir. Bunu başarmak için çocukların ev ortamı gibi yakın çevrelerine büyük görev düşmektedir. Araştırmalar, bilgili ve yetkin yetişkinlerin çocukların ilk fen deneyimlerini kasıtlı olarak desteklediklerinde daha dikkatli ve odaklanmış gözlemler yapabildiklerini göstermektedir (French, 2004; Gelman & Brenneman, 2004). Bilimsel deneyimler hakkında doğrudan keşifler yapma fırsatı verildiğinde, çocuklar gözlemleri üzerine derinlemesine düşünebilmekte ve teorilerini test ederek yeni ve karmaşık bilimsel fikirler üretebilmektedirler (French, 2004; Gelman & Brenneman, 2004; Klahr vd., 2011). Dolayısıyla bilim okuryazarı bireyler yetiştirmek, bireylere bilgi aktarmakla değil, bilimsel bilgiye ulaşmalarını sağlamakla mümkündür. Bu açıdan bilimsel süreç becerilerinin yeri, bilgi edinme yollarının öğretiminde ön plana çıkmakta ve önemlidir. Çocuklar hem bilimsel araştırma yaparken hem de öğrenme sürecinde bilimsel süreç becerilerine ihtiyaç duymaktadırlar (Harlen, 2000; Taconis vd., 2001).

Çocukların bilimsel süreç becerileri oyun deneyimleri yoluyla çevre ile etkileşimlerinde doğal olarak gelişse de diğer faktörler de bu becerileri etkilemektedir. Çevresel etkilerin, çocukların bilimsel süreç becerilerinin gelişimi ve diğer alanlardaki genel gelişimleri üzerinde önemli bir etkisi vardır. Bronfenbrenner, çocuğu merkez olarak vurgular ve mikro sistem, makro sistem, ekzosistem ve kronosistem dahil olmak üzere çoklu sistemlerin çocuğun gelişimini doğrudan ve dolaylı olarak etkilediğini belirtmiştir (Bronfenbrenner, 1979). Bir aile içindeki dinamikler, her aile üyesinin diğer üyelerin gelişim ve değişimlerine yanıt olarak uyum sağlaması nedeniyle süregelen ve dinamik bir güç etkileşimi ile karakterize edilir (Berk, 2012). Bu yüzden ebeveynler çocuklarının gelişimi üzerindeki en önemli etkenlerden biridir. Bu noktada ebeveynler, çocukların gelişimini birinci elden destekleyen birincil kaynaklardan biri oldukları için çocukların öğrenme yaşantılarına önemli katkılar sağlamaktadır (Yılmaz vd., 2018).

Bu nedenle ebeveynler, çocukların hayatlarının ilk yıllarında gelecekte bilim okuryazarı çocuklar yetiştirmek için birincil kaynaktır. Ebeveynler çocukların hayatlarındaki ilk öğretmenler olduklarından, çocuklar ev ortamlarındaki deneyimleriyle bilim farkındalığına sahip olabilirler (Gilligan vd., 2020). Ayrıca, ebeveynlerin bilime olan bilgisi ve ilgisi, çocukların bilimdeki deneyimlerinin niteliğini ve niceliğini etkileyebilir. Buna göre, ebeveynler bilimsel okuryazarlık becerilerine sahipse, evde bilimle ilgili deneyimler sunma, açıklamaya öncelik verme ve bilimsel çabalara katılma olasılıkları daha yüksek olabilir (Fender & Crowley, 2007; Setioko & Ding, 2022).

Ebeveynlerin çocuğun yakın çevresindeki yetişkinler olduğu düşünüldüğünde, çocukları desteklemek için bilimsel yeterliliklere, temel bilimsel bilgilere, bilime ilişkin gerçekçi ve olumlu görüşlere, bilime karşı ilgi ve olumlu tutumlara sahip olmalıdırlar. Bu yetenekler, ebeveynlerin çocuklarına bilimsel süreç becerileri olan bilim edinme yetkinliğini geliştirmeleri için öğrenme fırsatları yaratmalarını sağlamaktadır (Yılmaz vd., 2018). Daha geniş bir çerçevede bilimsel okuryazar bireyler yetiştirmek için çocukların gözlem, sınıflandırma, sayılar, ölçme, çıkarım, tahmin, iletişim, uzay-zaman ilişkileri kavramlarını anlayabilmeleri gerekmektedir (Curriculum Development Centre, 1993). Bu süreçlerin sağlıklı ve etkin bir şekilde devam etmesi için yetişkin desteği ve rehberliği şarttır.

Çocuklarda bazı bilimsel süreç becerileri bilinçsiz olarak gelişse de bu becerilerin daha da geliştirilmesi ve uygun öğrenme süreçlerinde desteklenmesi önemlidir (Jirout & Zimmerman, 2015). Yıldız ve Yıldız (2021) ebeveynlerin bilimsel süreç becerilerini geliştirmek için ev etkileşimlerinde çocuklarına rehberlik etmelerinin, uygun ortam oluşturmalarının ve çocuklarla bilimsel konuşmalar yapmalarının çok önemli olduğunu bildirmiştir. Diğer araştırmalar da ev ortamı kalitesinin bilimsel düşünme ve bilimsel süreç becerileri üzerinde etkisi olduğunu ortaya koymuştur (Crowley & Galco, 2001; Kim & Chung, 2001). Bilgili veya bilim okuryazar ebeveynler, çocukların gelişimini desteklemek için ev ortamının kalitesini artırabilir.

Ebeveynlerin bilimsel okuryazarlık becerileri, çocukların gelecekte bilimsel okuryazar bireyler olabilmeleri için bilimsel süreç becerilerini geliştirmelerine olanak sağlayabilir (Gilligan vd., 2020). Ayrıca, daha yüksek eğitim düzeyine sahip ebeveynler, özellikle fen alanında eğitime değer veren bir ev ortamı yaratma eğilimindedir (Germann, 1994). Bu bağlamda, çocukların günlük yaşamda bilimsel süreç becerilerini geliştirmek için ebeveynlerinin desteğine ihtiyaçları vardır.

İlgili alanyazın incelendiğinde çocukların bilimsel süreç becerilerini araştıran çok sayıda çalışma tespit edilmiştir. Bu çalışmalar çocukların bilimsel süreç becerilerini ebeveyn etkisi bağlamında araştıran çalışmaların olduğunu ortaya koymaktadır. Alanyazındaki çalışmalar bilimsel süreç becerilerine dayalı etkinliklerin ilkokul öğrencilerinin problem çözme becerilerine ve bilimsel süreç becerilerine etkisini bilişsel alan çerçevesi kullanarak incelemiştir (Gültekin & Altun, 2022; Özgelen, 2012). Ayrıca ilkokul öğrencilerinin bilimsel süreç becerileri, bilimsel sorgulama yaklaşımları ve fen tutumları ile ilgili araştırmalar da bulunmaktadır (Ergül vd., 2011; Harefa, 2023; Mutlu, 2020). Germann'a (1994) göre bilişsel gelişim, anne-baba eğitimi ve fen tutumları öğrencilerin bilimsel süreç becerilerini etkilemektedir. Bilimsel süreç becerileri ile okul öncesi çocukların cinsiyeti, yaşı ve ebeveynlerinin eğitim durumları ayrıntılı olarak ilişkilendirilen bazı çalışmalar bulunmaktadır (Böyük vd., 2011; Erol vd., 2022; Kunt vd., 2015; Kuru & Akman, 2017; Tuzcuoğlu & Akarsu, 2019; Yıldız & Yıldız, 2021). STEM eğitimi ile ilgili olarak da bilimsel süreç becerileri bulunmuştur. Araştırmalar, okul öncesi çocukların bilimsel süreç becerilerinin STEM eğitiminden olumlu yönde etkilendiğini bildirmiştir (Abanoz, 2020; Ünal & Aksüt, 2021). Bununla birlikte, ebeveyn eğitim durumu ile çocukların bilimsel süreç becerileri arasında pozitif bir ilişki olduğunu gösteren çalışmaların yaygınlığına rağmen, alan yazında bu ilişkinin daha fazla detaylandırılmasına ihtiyaç vardır. Bu nedenle bu çalışma çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlık becerileri arasındaki ilişkiyi inceleyerek bu araştırma alanına katkı sağlamayı amaçlamıştır.

Amaç

Araştırmalar, çocukların bilimsel süreç becerileri, bilişsel gelişimleri, problem çözme becerileri ve fen tutumları arasındaki ilişkiyi göstermektedir (Germann, 1994; Harefa, 2023; Özgelen, 2012). Mevcut alanyazın, çocukların bilimsel süreç becerileri ile cinsiyet, yaş, kardeş sayısı ve ebeveynlerin eğitim durumu ve yaşlarıyla ile ilgili bulgular ortaya koymaktadır (Akman, 2017; Ardila vd., 2005; Böyük vd., 2011; Erol vd., 2022; Germann, 1994; İlhan & Tosun, 2016; Saçkes, 2013; Yıldız & Yıldız, 2021). Ayrıca Kunt ve arkadaşları (2015), çocukların bilimsel süreç becerilerinin ebeveynlerin eğitim durumu ile olumlu yönde ilişkili olduğu bulmuştur. Çocukların bilimsel süreç becerileri ile cinsiyet, yaş, kardeş sayısı ve ebeveynlerin eğitim durumu gibi diğer faktörler arasındaki ilişkiyi keşfetmenin yanı sıra, ebeveynlerin bilimsel okuryazarlık becerileri de çocuklarının bilimsel süreç becerilerini edinmelerini etkilemede rol oynayabilir. Bu nedenle bu çalışma, çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlık becerileri arasındaki ilişkiyi incelemeyi amaçlamaktadır.

Araştırmanın Önemi

Bilim, teknolojik, tıbbi ve eğitimsel ilerlemelerin temelini oluşturur. Bireylerin olayları anlamasını ve eleştirel düşünme yoluyla çözüm üretmesini sağlar. Küresel zorluklara bilimsel çözümler aramak en önemli öncelik haline gelmiştir (UNEP, 2012). Teknolojideki hızlı ilerlemeler ve bunun ekonomi üzerindeki etkisi ile, bilimdeki ilerleme günlük hayatımızda görülmektedir ve genel yaşam standartlarımızı yükseltmektedir (OECD, 2018). Teknolojik gelişmeler ışığında bilim, bireyler için geleceğin bir gereksinimidir, çünkü ülkeler gelişmelere yol açmak için tüm insanlara bilim sağlamayı amaç edinmiştir (American Association for the Advancement of Science, 1990; Saracho & Spodek, 2008). Toplumun geleceği, bilimsel anlayış üzerine kurulması gereken kararlara bağlıdır (Saracho & Spodek, 2008). Bireyler, bilimsel bir çevre ile çevrili sistematik bilgi aracılığıyla bilimsel farkındalığa sahip olmalıdır.

Laugksch (2000) tarafından yapılan bir çalışmada, ülkelerin ancak bilimle ilgili içeriği nasıl kullanacağını, analiz edeceğini ve yorumlayacağını bilen bireyler yetiştirmeye yeterince önem verirlerse uluslararası düzeyde refah içinde olabilecekleri belirtilmiş ve bu tür bireyler bilimsel okuryazar olarak adlandırılmıştır (Laugksch, 2000). Bilimsel okuryazar birey olmanın biyoloji, fizik, kimya gibi yaygın bilim konuları hakkında bilgi sahibi olmakla sınırlı olmadığı, teknoloji, sosyal bilimler ve matematiği oluşturduğu ileri sürülmüştür (American Association for the Advancement of Science, 1989). Bilimsel okuryazar bir birey olmanın ilk adımlarından biri bilimsel süreç becerilerine sahip olmaktır. Bilimsel anlayışa ulaşmak ve bilimsel okuryazar bireyler olmak için bilimsel süreç becerilerinin geliştirilmesi esastır.

Ancak çocukların bilimsel süreç becerilerine yönelik yapılan çalışmalarda, okul öncesi dönem çocuklarının bilimsel süreç becerilerine ebeveynler bağlamında odaklanan sınırlı sayıda çalışmanın olduğu görülmüştür. Ebeveyn-çocuk çalışmaları, erken çocukluk döneminde bilime yönelik tutum ve görüşleri ve ebeveyn katılımının fen etkinliklerine etkisini incelemiştir (Yılmaz vd., 2018). Çalışmaların erken çocukluk dönemindeki çocuklardan çok ilkokul ve ilkokul öğrencilerine odaklandığı görülmüştür. Ebeveynlerin çocukların okul başarısında önemli bir rol oynadığı savunulmaktadır (NSTA, 1994). Bilim kavramlarının günlük kullanımı ve bilimsel süreç becerilerini teşvik eden ebeveynler, çocuklarının gerekli becerileri öğrenme yeteneğini geliştirmektedirler (NSTA, 1994). Dahası, çocuklar ebeveynlerinin yaşam tarzlarını, kültürlerini ve fırsatlarını edinirler. Bu noktada ebeveynlerin bilimsel okuryazarlık becerileri, çocukların bilimsel süreç becerilerinin bundan etkilenip etkilenmediğini açıklamaya yardımcı olabilir.

Bu nedenle, çocukların bilimsel süreç becerilerinde ebeveynlerin rolünün etkisini anlamak için okul öncesi dönem çocuklarının bilimsel süreç becerilerini araştıran yeni araştırmalara ihtiyaç vardır. Çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlık becerileri arasındaki ilişkinin keşfedilmesi ve aralarındaki ilişkinin incelenmesi, öğretmenler, ebeveynler ve araştırmacılar da dahil olmak üzere çeşitli paydaşlara bu beceriler ve doğaları hakkında yeni bakış açıları sunabilir. Çocukların gelişimini iyileştirmek için bu çalışmanın bulgularından yararlanabilirler.

Çalışmanın bulguları, öğretmenlerin, çocuklarının bilimsel süreç becerilerini geliştirmede ebeveynlerin bilimsel okuryazarlık becerilerinin değerini anlamalarına yardımcı olabilir. Öğretmenler, aile katılımını mümkün olduğunca teşvik ederek çocukların gelişimine katkıda bulunmak için ebeveynlerle iş birliği içinde çalışabilirler. Ayrıca, öğretmenler, aile katılımını teşvik eden etkinlikler planlayabilir, proje tabanlı araştırma yapabilir ve aile eğitim programları oluşturabilir. Okul ve aileler arasındaki iş birliğini teşvik edilmesi, çocukların bilimsel süreç becerilerini geliştirmelerine yardımcı olabilir. Bilimsel süreç becerilerinin geliştirilmesini teşvik edilmesi de gelecekteki bilimsel okuryazarlık düzeylerini artırabilir.

Erken çocukluk döneminin çocukların yaşamının çok önemli bir zaman dilimi olduğu göz önünde bulundurulduğunda, öğretmenler çocukların bilimsel süreç becerilerini erken yaşlardan itibaren geliştirmek için yaşa uygun etkinlikler yürütebilir. Küçük çocuklarda bilime karşı olumlu bir tutum geliştirmek için uygun girişimlerde bulunabilirler. Ayrıca, bu çalışmanın bulguları, gelecekte bilimsel farkındalık ve bilimsel öğrenmeyi arttırmak için erken çocukluk eğitiminde müfredat oluşturma ve öğretim uygulamalarına rehberlik edebilir.

Çalışmanın bulguları, ebeveynlere çocuklarının yaşamları ve genel gelişimi üzerindeki önemli rolleri ve etkileri hakkında değerli bilgiler verebilir. Ebeveynler, bilimle ilgili etkinliklere katılmalarının ve bilimsel kavramlarla ilgili iletişimin çocuklarının öğrenimine nasıl fayda sağlayabileceğinin daha fazla farkına varabilirler. Bilimi günlük yaşamlarına entegre ederek çocuklarının eğitimine kaliteli zaman ayırma anlayışı geliştirebilirler. Ebeveynler kendilerini geliştirmek için eğitimler alabilir, okulla iş birliği yapabilir, bilimsel süreç becerilerini geliştirmek için fırsatlar yaratabilir ve çocuklarının bilimsel süreç becerilerini geliştirerek gelecekte bilimsel okuryazar bireyler yetiştirmeye çalışabilirler.

Ayrıca bu çalışmanın bulguları, erken çocuklukta bilimle ilgili yeni girişimlerin geliştirmesine yardımcı olabilir. Ebeveynlerin bilimsel okuryazarlığının çocukların bilimsel süreç becerileri üzerindeki etkisinin anlaşılması, aile katılımı için ana çerçevenin oluşturulmasına rehberlik edebilir. Bu çalışma, çocuklar için eğitim girişimleri tasarlama konusunda bir ipucu verebilir. Bu girişimler, çocuklara ve ebeveynlerine yardımcı olmayı hedefleyen ek eğitim destek programlarını içerebilir.

Çalışmanın bulguları, ebeveynlerin bilimsel okuryazarlık becerileri bağlamında çocukların bilimsel süreç becerilerine ilişkin mevcut alan yazına katkı sağlayabilir. Bu çalışma, araştırmacıların ebeveynlerin çocukların bilimsel süreç becerilerindeki rolünü araştırmasına yardımcı olabilir. Bu çalışmanın bulgularına dayanarak, araştırmacılar ebeveynlerin çocuklarının gelişimini etkilediği çeşitli yolları keşfedebilirler. Farklı araştırma yöntemleri ve örneklem grupları kullanarak karşılaştırmalı çalışmalar yapabilirler, böylece bulguları daha fazla inceleyebilir ve ebeveynlerin çocukların gelişimi üzerindeki etkisine ilişkin anlayışımızı bilimsel bir bağlamda genişletebilirler.

Ayrıca, çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlık becerileri arasındaki ilişkinin araştırılması, bilime ve fene olan ilgiyi arttırmada ebeveyn desteğinin değerine dair kanıtlara katkıda bulunabilir. Bilimsel keşfi, eğitim kaynaklarına erişimi ve bilime karşı olumlu tutumları destekleyen aile koşulları oluşturmanın önemini vurgulayabilir. Bu çalışma, ebeveynleri çocuklarının bilimsel süreç becerilerini geliştirmede bilimsel okuryazarlık becerilerinin ne kadar önemli olduğu konusunda bilgilendirerek alan yazına destek sağlayabilir.

YÖNTEM

Bu çalışmanın amacı, çocukların bilimsel süreç becerileri ile ebeveynlerinin bilimsel okuryazarlık becerileri arasındaki ilişkiyi değerlendirmektir. Bu amaç doğrultusunda çalışma yapılırken nicel araştırma yöntemi kullanılmıştır. Nicel araştırma, araştırmacının soruları ve karşılık gelen yanıtları içeren araçları kullanarak çok sayıda katılımcıdan sayısal veri toplamasına olanak tanır (Creswell, 2012). İki veya daha fazla değişken arasındaki ilişkiyi açıklamak ve olası sonuçları tahmin etmek için ilişkisel araştırma deseni kullanılmıştır (Fraenkel vd., 2012).

Araştırmanın Modeli

Bu çalışmada, okul öncesi dönemdeki çocuklarının bilimsel süreç becerileri ile ebeveynlerinin bilimsel okuryazarlık becerileri arasındaki ilişkiyi demografik değişkenleri kontrol ederek açıklamak için ilişkisel araştırma deseni kullanılmıştır. Analizde, değişkenler veya değişken grupları adım adım tanıtılmıştır ve her bir bağımsız değişken, önceki değişkenlerin etkileri hesaba katıldıktan sonra bağımlı değişkeni tahmin etme katkısına göre değerlendirilmiştir (Pallant, 2020). Bu desen, ebeveyn merkezli değişkenlerin çocukların bilimsel süreç becerilerini yordama gücünü değerlendirmek için kullanılmıştır. Çalışma, ebeveynlerin eğitimini, yaşını ve bilimsel okuryazarlığını kontrol ederek, her bir değişkenin çocuklarının bilimsel süreç becerilerini yordama üzerindeki bireysel ve birleşik etkisini belirlemeyi amaçlamaktadır. Bu araştırmada bağımlı değişken okul öncesi dönem çocuklarının bilimsel süreç becerileri, bağımsız değişkenler ise anne babanın eğitim durumu ve yaşı gibi demografik değişkenler ile anne babanın bilimsel okuryazarlık becerileri olarak belirlenmiştir. İlişkisel araştırma desenine uygun olarak, ebeveynlerin bilimsel okuryazarlık becerilerinin ve okul öncesi dönem çocuklarının bilimsel süreç becerilerinin özelliklerini demografik bilgi formu (cinsiyet, yaş, kardeş sayısı) ve Bilimsel Süreç Becerileri Ölçeği aracılığıyla açıklamak için betimsel araştırma kullanılmıştır.

Araştırma soruları

1) Okul öncesi dönem çocuklarının bilimsel süreç becerileri puanları nedir?

Çocukların bilimsel süreç becerileri puanları ile cinsiyetleri arasında fark var mıdır?

Çocukların bilimsel süreç becerileri puanları ile yaşları arasında fark var mıdır?

Çocukların bilimsel süreç becerileri puanları ile sahip oldukları kardeş sayıları arasında fark var mıdır?

2) Ebeveynlerin bilimsel okuryazarlık beceri düzeyleri nedir?

3) Demografik özelliklerin (eğitim durumu ve ebeveynlerin yaşları) etkileri kontrol edildikten sonra, ebeveynlerin bilimsel okuryazarlık becerileri, çocukların bilimsel süreç becerileri puanlarını ne ölçüde yordamaktadır?

Evren ve Örneklem

Türkiye'deki bütün okul öncesi dönemdeki çocuklar ve onların ebeveynleri bu çalışmanın hedef popülasyonunu oluşturmaktadır. İstanbul ilindeki Millî Eğitim Bakanlığı'na bağlı resmi bağımsız anaokulları, resmi anasınıfları, özel anasınıfları ve özel bağımsız anaokullarına kayıtlı olan okul öncesi dönemdeki çocuklar ve bu çocukların ebeveynleri erişilebilir popülasyonu oluşturmaktadır. Çalışmanın örneklemini de İstanbul ilindeki resmi bağımsız anaokulları, resmi anasınıfları, özel anasınıfları ve özel bağımsız anaokullarına kayıtlı olan okul öncesi eğitim almaya devam eden çocuklar ve onların ebeveynleri oluşturmaktadır.

Bu çalışmada İstanbul ilinden veriler toplanmıştır. Hedef kitle, anaokuluna devam eden 60-72 aylık çocuklar ve onların ebeveynleridir. Pallant (2020) genel örneklem büyüklüğünün 150'den fazla olması gerektiğini belirtmektedir. Tabachnick & Fidell'e (2013) göre, 300'den fazla katılımcıdan oluşan daha büyük örneklemler belirli bir analizi yapmak için yeterli olmaktadır. Bu çalışmada 354 ebeveyn ve 354 çocuk ile 8 anaokulunda gerçekleştirilmiştir.

Veri Toplama Araçları

Araştırma Demografik Bilgi Formu, Özkan (2015) tarafından geliştirilen 60-72 Ay Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği ve Çelik (2016) tarafından geliştirilen Evrensel Fen Okuryazarlık Ölçeği olmak üzere üç veri toplama aracı kullanılmıştır.

Veri Toplama Süreci

ODTÜ İnsan Araştırmaları Etik Kurulu ve Millî Eğitim Bakanlığı'ndan (MEB) gerekli izinler alındıktan sonra İstanbul ilindeki Milli Eğitim Bakanlığı'na bağlı resmi bağımsız anaokulları, resmi anasınıfları, özel anasınıfları ve özel bağımsız anaokullarına ulaşarak çalışma hakkında bilgi verilmiştir. Çalışmaya katılmayı kabul eden okullarla 2022-2023 eğitim-öğretim yılı bahar yarıyılında veriler toplanmıştır. Velilerden gelebilecek olası soruları yanıtlamak için okul yöneticilerine ve öğretmenlere araştırmanın konusu ve veri toplama araçları ayrıntılı olarak anlatılmıştır.

Veri toplama sürecinde ebeveynler gönüllü katılım formu, çocuklarının araştırmaya katılmaları için onam formu ve Evrensel Fen Okuryazarlık Ölçeği doldurup okula gönderdikten sonra çocuklarla birebir görüşme yapılarak 60-72 Ay Çocuklar İçin Bilimsel Süreç Becerileri Ölçeği uygulanmıştır.

Verilerin Analizi

Mevcut araştırmada nicel veri analizleri kullanılmıştır. Toplanan verileri SPSS 26.0 programı kullanılarak analiz edilmiştir. Veri girişi yapıldıktan sonra yanlış sonuçların ortadan kaldırılması için veri tarama işlemi uygulanarak toplanan veriler incelenmiştir. Veri tarama süreci, veri girişi hatalarını, eksik verileri, aykırı değerleri ve normallik varsayımlarını incelemekten oluşmaktadır (Pallant, 2020). Tip I ve Tip II hataları önlemek için tek değişkenli ve çok değişkenli aykırı değerler incelenmiştir (Tabachnick & Fidell, 2013). Normallik, doğrusallık, varyansların homojenliği, homoskedastisite varsayımları karşılamak için veriler incelendikten sonra, araştırmanın genel özelliklerini taramak için tanımlayıcı istatistikler incelenmiştir. Daha detaylı analiz yapmak için iki yönlü varyans analizi (ANOVA), gruplar arası tek yönlü varyans analizi (ANOVA), ve Hiyerarşik Çoklu Regresyon (HMR) yapılmıştır.

BULGULAR

Birinci Araştırma Sorusunun Bulguları

Okul öncesi dönem çocuklarının bilimsel süreç becerileri puanları nedir sorusunu cevaplamak için araştırmacı çocuklara Bilimsel Süreç Becerileri ölçeğinde yer alan maddeleri sormuş ve cevaplarını not almıştır. Tahmin-Çıkarım-İletişim boyutunda alınan minimum puan 2 ve alınan maksimum puan 12 (*M* = 8.4079, *SD* = 2.03887), Sınıflandırma boyutunda alınan minimum puan 1 ve alınan maksimum puan 8 (*M* = 5.6147), *SD* = 1,45930), Ölçme boyutunda alınan minimum puan 1 ve alınan maksimum puan 7 (*M* = 5,8215, *SD* = 1,16013), Gözlem boyutunda alınan minimum puan 0 ve alınan maksimum puan 4 (*M* = 2,6176, *SD* = 1,04633) olarak kaydedilmiştir. Bilimsel Süreç Becerileri ölçeğinin tamamı için alınan en düşük puan 9 ve en yüksek puan 30'dur (*M* = 22.4618, *SS* = 4.02751).

Okul öncesi dönem çocuklarının bilimsel süreç becerileri puanları ile cinsiyetleri ve yaşları arasında fark var mıdır sorusunu cevaplamak için iki yönlü varyans analizi yapılmıştır. Çocukların cinsiyeti kız ve erkek olarak iki gruba ayrılmıştır (Grup 1: kızlar, Grup 2: erkekler). Çocukların yaşları 60-64 ay, 65-70 ay ve 71-75 ay olarak 3 gruba ayrılmıştır. (Grup 1: 60-64 ay, Grup 2: 65-70 ay, Grup 3: 71-75 ay). Varsayımlara ilişkin ön analiz yapılmıştır.

Cinsiyet ve yaş arasındaki etkileşim etkisi, $p < .05$ düzeyinde istatistiksel olarak anlamlı bulunmamıştır: [F (2, 347) = 2.038, *p* =.132]. Ayrıca cinsiyetin ana etkisi $p < .05$ düzeyinde anlamlı değildir: [F (1, 347) =.220, *p* =.640]. Ancak, $p < .05$ düzeyinde yaş için istatistiksel olarak anlamlı bir ana etki bulunmuştur: [F (2, 347) = 3.012, *p* =.05]. Bu sonuçlara göre kızların ortalama puanları (*M* = 22.459, *SD* = .328) ve erkeklerin ortalama puanları (*M* = 22.2400, *SD* = .333) birbirinden anlamlı farklılık göstermemiştir. Tukey HSD testi kullanılarak yapılan post-hoc karşılaştırmalarında, 60-64 aylık (*M* = 21.786, *SD* = .524), 65-70 aylık (*M* = 22.170, *SD* = .323) ve 71-75 aylık çocukların puanları (*M* = 23.093, *SD* =.335) birbirinden anlamlı olarak farklılık göstermiştir. Ana etkide istatistiksel anlamlılığa ulaşılmasına rağmen, ortalama puanlar arasındaki gerçek farkın az olduğu gözlemlenmiştir.

Okul öncesi dönem çocuklarının bilimsel süreç becerileri puanları ile kardeş sayıları arasında fark var mıdır sorusunu cevaplamak için gruplar arası tek yönlü varyans analizi yapılmıştır. Kardeş sayıları şu şekilde 4 gruba ayrılmıştır: Grup 1: kardeşi olmayan çocuklar, Grup 2: bir kardeşi olan çocuklar, Grup 3: iki kardeşi olan çocuklar, Grup 4: üç ve daha fazla kardeşi olan çocuklar. Tüm gruplar için bilimsel süreç becerileri puanlarında $p < .05$ düzeyinde istatistiksel olarak anlamlı bir fark bulunmamıştır: F (3, 349) = 2.320, p = .075.

İkinci Araştırma Sorusunun Bulguları

Ebeveynlerin bilimsel okuryazarlık beceri düzeyleri nedir sorusunu cevaplamak için bu çalışmada ebeveynler Evrensel Fen Okuryazarlık Becerileri ölçeğini doldurmuştur. Zihin Alışkanlıkları boyutunda en düşük puan 33 ve en yüksek puan 65 (M = 54,18, SD = 6,556), Karakter ve Değerler boyutunda en düşük puan 9 ve en yüksek puan 25 (M = 20,9859, SD = 3,14739), İnsan Çabası Olarak Bilim boyutunda alınan minimum puan 23 ve alınan maksimum puan 60 (M = 47,19, SD = 6,341), Üstbiliş ve Öz-yönelim boyutunda ise minimum puan 25 ve alınan maksimum puan 55 (M = 45,39, SD = 6,048) olarak kaydedilmiştir. Ölçeğin tamamı için Bilimsel Okuryazarlık Becerilerinde alınan en düşük puan 110 ve en yüksek puan 210'dur (M = 171.94, SD = 19.580).

Seviyeler çok düşük (41-74,8), düşük (74,9-108,7), orta (108,8-142,6), yüksek (142,7-176,5) ve çok yüksek (176,6-210) şeklinde verilmiştir. Bulgular, ebeveynlerin çoğunluğunun, %52,1 (f =184) ile yüksek düzeyde ve %39.9 (f =141) ile çok yüksek düzeyde bilimsel okuryazarlık becerilerine sahip olduklarını ortaya koymuştur.

Üçüncü Araştırma Sorusunun Bulguları

Demografik özelliklerin (eğitim durumu ve ebeveynlerin yaşları) etkileri kontrol edildikten sonra, ebeveynlerin bilimsel okuryazarlık becerileri, çocukların bilimsel süreç becerileri puanlarını ne ölçüde yordamaktadır sorusunu cevaplamak için hiyerarşik çoklu regresyon (HMR) analizi yapılmıştır.

Varsayımlar için ön analizler yapılmıştır. Anne ve baba eğitim durumları 2 gruba ayrılmıştır (Grup 1: Düşük, Grup 2: Yüksek). Ebeveyn yaşları 3 gruba ayrılmıştır (Grup 1: 30 ve altı, Grup 2: 31-40 ve Grup 3: 40 ve üstü). 1. adımda girilen anne ve baba eğitim düzeyleri, çocukların bilimsel süreç becerilerindeki varyansın %12,2'sini açıklamaktadır. 2. adımda girilen ebeveyn yaşları ve modelin bir bütün olarak açıkladığı toplam varyans %12,3'tür. 3. adımda bilimsel okuryazarlık sonuçlarının girilmesinden sonra, modelin bir bütün olarak açıkladığı toplam varyans %24, F (4, 348) = $p < .05$ olarak bulunmuştur. Kontrol önlemleri, ebeveynlerin eğitim düzeyleri, yaşları ve bilimsel okuryazarlık becerilerini kontrol ettikten sonra bilimsel süreç becerilerindeki varyansın %11,7'sini açıklamıştır, R kare değişimi = .117, F değişimi (1, 348) = 53.724, $p < .05$. Son modelde, annenin eğitim düzeyi (sr = .174, $p < .05$),) baba eğitim düzeyi (sr = .147, $p < .05$) ve bilimsel okuryazarlık becerileri (sr = .342, $p < .05$) istatistiksel olarak anlamlı çıkmıştır. Ayrıca baba eğitim düzeyinin çocukların bilimsel süreç becerilerine anne eğitim düzeyine göre daha fazla katkı sağladığı görülmüştür ($\Delta R^2 = .122$, $F(2) = 24.227$, $p < .05$.). Bu durumda bilimsel okuryazarlık becerilerinin en güçlü yordayıcı olduğu ortaya çıkmış, bu da eğitim düzeyi ve bilimsel okuryazarlık becerileri değeri arttıkça çocukların bilimsel süreç becerilerinin de arttığı sonucuna varılmıştır.

TARTIŞMA

Birinci araştırma sorusuna ilişkin araştırma bulgularına dayalı olarak 60-72 aylık çocukların bilimsel süreç becerilerinin incelenmesi cinsiyet, yaş, kardeş sayısı gibi çeşitli faktörler dikkate alınarak yapılmıştır. İlk olarak çocukların bilimsel süreç becerileri puanlarının sonuçları incelenmiş ve çocukların bilimsel süreç becerilerinin çeşitlilik gösterdiği görülmüştür. Çocukların bilimsel süreç becerileri puan ortalamaları 31 üzerinden 22,46'dır. Hiçbir çocuk tüm soruları doğru yanıtlamasa da alt boyutlar incelendiğinde bazı çocukların en az bir alt boyutta tüm soruları doğru yanıtladığı görülmüştür. Mevcut çalışmanın dışında Karataş (2018), İlk Yıllar Programının çocukların bilimsel süreç becerileri üzerindeki etkisini araştırmış ve deney grubunda yer alan çocukların bilimsel süreç becerileri puan ortalamalarının uygulama öncesinde başlangıçta 20,56 olarak kaydetmiştir. Bu sonuç, iki araştırmada gözlenen ölçümlerin benzer olduğunu göstermektedir.

İkinci olarak, bu çalışmada çocukların bilimsel süreç becerileri cinsiyetlerine göre incelenmiştir. Bulgular, kızların bilimsel süreç becerileri puanlarının ortalamasının (M = 22.459) erkeklerinkinden (M = 22.240) biraz daha yüksek olduğunu ortaya koymasına rağmen, kızlar ve erkekler arasında istatistiksel olarak anlamlı bir fark bulunamamıştır. Bulgular, çocukların bilimsel süreç becerilerinin cinsiyete göre farklılaşmadığını göstermiştir. Literatür incelendiğinde çocukların bilimsel süreç becerileri puanları ve cinsiyetleri ile ilgili benzer bulgulara rastlanmıştır. Erol ve arkadaşları (2022), bilimsel süreç becerileri ile öz düzenleme becerileri arasındaki ilişkiyi inceledikleri çalışmada çocukların bilimsel süreç becerilerinin cinsiyet üzerinde farklılaşmadığını belirtmişlerdir. Benzer şekilde Yıldız ve Yıldız (2021), okul öncesi çocuklarda bilimsel süreç becerileri ile yaratıcı düşünme arasındaki ilişkiyi araştırdığı çalışmasında cinsiyete göre çocukların bilimsel süreç becerileri puanlarında anlamlı bir farklılık olmadığını belirtmiştir. Ayrıca Güven ve Yılmaz'ın (2020), bilimsel süreç becerilerinin cinsiyet dikkate alınarak dikkat becerileriyle nasıl ilişkili olduğunu anlamak için yaptığı çalışmada bir farklılık görülmemiştir. Benzer şekilde Kuru ve Akman (2017), okul öncesi eğitim kurumlarına devam eden 250 çocuk ve 50 okul öncesi öğretmeninin bilimsel süreç becerilerini çeşitli değişkenleri dikkate alarak araştırdığında çocukların bilimsel süreç becerilerinin cinsiyete göre farklılaşmadığı bildirmiştir. Bu bağlamda mevcut araştırmanın bulgularının literatür ile paralel olduğu söylenebilir.

Üçüncü olarak, mevcut çalışmada çocukların bilimsel süreç becerileri yaşlarına göre incelenmiştir. Çocukların bilimsel süreç becerileri puanlarının yaş gruplarına göre farklılaştığı gözlemlenmiştir. 60-64 aylık (M = 21.786) ve 65-70 aylık (M = 22.170) arasındaki ortalama puanlar arasındaki fark küçük olmasına rağmen, 71-75 aylık çocukların puanları nispeten daha yüksektir (M = 23.093). Bu noktada çocukların yaşı arttıkça bilimsel süreç becerilerinin de arttığı söylenebilir.

Literatür incelendiğinde çocukların bilimsel süreç becerileri ile yaşları arasındaki ilişki konusunda benzer bulguların rapor edildiği görülmüştür. Erol ve ark. (2022), çocukların bilimsel süreç becerileri ile öz düzenleme becerileri arasındaki ilişkiyi araştırdığı çalışmasında çocuğun yaşının toplam bilimsel süreç becerileri puanları için istatistiksel olarak anlamlı bir yordayıcı olduğu bulmuştur. Ayrıca Tuzcuoğlu ve Akarsu (2019), okul öncesi çocuklarda bilimsel süreç becerileri ile duygusal gelişim düzeyleri arasındaki ilişkiyi inceledikleri çalışmalarında çocukların yaşları ile bilimsel süreç becerilerine dayalı tahmin ve çıkarım yapma becerileri arasında istatistiksel olarak anlamlı bir fark olduğunu ortaya koymuşlardır. Kuru ve Akman (2017), anaokuluna devam eden çocukların bilimsel süreç becerilerini çeşitli değişkenleri dikkate alarak yaptıkları çalışmada çocukların bilimsel süreç becerilerinin yaşlarına göre farklılık gösterdiğini bildirmişlerdir. Mevcut araştırmanın bulgularına benzer şekilde, çalışmada 5,5 yaşındaki çocukların ise hem 4 ve 5 yaşındaki çocuklara göre daha yüksek puanlara sahip olduğu gözlemişlerdir. Dahsah ve arkadaşları (2017), çocukların temel bilimsel süreç becerilerini değerlendirmek için bir araç geliştirdikleri çalışmalarında, 6 ila 10 yaşlarındaki 30 çocuğun bilimsel süreç becerilerinin yaşlandıkça geliştiğini belirtmişlerdir.

Son olarak mevcut çalışmada çocukların sahip oldukları kardeş sayısına göre bilimsel süreç becerileri incelenmiştir. Çocukların kardeş sayıları arasında bilimsel süreç beceri puanları arasında anlamlı bir fark bulunmamıştır. Bu durum çocukların bilimsel süreç becerileri puanlarının sahip oldukları kardeş sayısına göre farklılık göstermediğini göstermektedir.

Mevcut literatür, çocukların gelişimi ile kardeş sayısı arasındaki bağlantıyı araştıran çalışmalarda farklı sonuçlar sunmaktadır. Downey'e (2001) göre, kaynakların eğitim fırsatları üzerindeki etkisi nedeniyle, sınırlı sayıda kardeşe sahip çocuklar, daha fazla sayıda kardeşe sahip olanlara göre daha önemli bir eğitimsel başarı elde etmektedir. Bu bakış açısını onaylayan Muñez ve meslektaşları (2022), kardeş sayısı ile çocukların bilişsel gelişimi arasındaki bağlantıyı ortaya koyarak, anaokuluna girdikten sonra daha az kardeşi olan çocukların daha fazla kardeşi olanlara kıyasla daha iyi matematik ve okuma becerileri sergilediğini belirtmiştir. Sonuç olarak, kardeş sayısı artan çocukların, ilk yıllarına nispeten daha az bireyselleştirilmiş ilgi ve ebeveyn desteği alması mümkündür (Muñez vd., 2022). Ölçer (2017) 5-6 yaş arası çocukların fen alan bilgilerini incelemiş ve puanların kardeşi olmayan çocukların tek kardeşi olanlara, iki ve daha fazla kardeşi olanlara göre daha avantajlı olduğunu bulmuştur. Mevcut çalışmanın bulguları literatürdeki çalışmalarla benzerlik göstermektedir.

İkinci araştırma sorusuna ilişkin araştırma bulgularından hareketle ebeveynlerin bilimsel okuryazarlık beceri düzeylerinin incelenmesi yapılmıştır. Ebeveynlerin bilimsel okuryazarlığı incelendiğinde ise en düşük puanın 110, en yüksek puanın ise 210 olduğu görülmüştür. Ayrıca velilerin ortalama puanları 171,94'tür (M = 171,94, *SS = 19,580*). Sonuçlar, ebeveynlerin çoğunun eğitim seviyelerine uygun olarak yüksek ve çok yüksek bilimsel okuryazarlığa sahip olduğunu ortaya koymuştur. Bu nedenle, eğitimin bilimsel okuryazarlık becerilerini geliştirmede önemli bir faktör olduğu sonucuna varılabilir (Laugksch , 2000).

Alan yazında ebeveynlerin bilimsel okuryazarlık becerilerine ilişkin araştırma sayısı oldukça azdır. Çalışmalar çoğunlukla ilkokul öğrencileri, lise öğrencileri ve onların ebeveynleri ile farklı eğitim kademelerinde görev yapan öğretmenleri kapsamaktadır (Can & Besler, 2018; Çavaş vd., 2013; Şahin vd., 2010). Salcı ve Aydın (2022), hem fen bilgisi öğretmen adaylarının hem de öğretmenlerin bilimsel okuryazarlık düzeylerini araştırmıştır. Çalışmanın sonuçları fen bilgisi öğretmen adaylarının yüksek düzeyde bilimsel okuryazarlık (M = 194.3), öğretmenlerin ise çok yüksek düzeyde bilimsel okuryazarlık (M = 206.7) sergilediğini ortaya koymuştur Benzer şekilde Başar ve Elyıldırım (2022), okul öncesi öğretmenlerinin bilimsel okuryazarlık düzeylerini ve fen öğretimine yönelik tutumlarını inceledikleri çalışmalarında, okul öncesi öğretmenlerinin bilimsel okuryazarlık düzeylerinin 206.48 puan ortalaması ile oldukça yüksek olduğunu bulmuşlardır. Ebeveynleri de odağına alan araştırmalarda Gül-Ulukan (2021) araştırmasında, okul öncesi dönemde çocuğu olan ebeveynlerin ve okul öncesi öğretmenlerinin bilimsel okuryazarlık düzeylerini incelediği çalışmasında ebeveynlerin bilimsel okuryazarlıklarının %65'inin orta, %17'sinin yüksek ve %18'inin düşük olduğunu bildirmiştir.

Üçüncü araştırma soruna ilişkin araştırma bulgularından hareketle ebeveynlerin eğitim düzeyleri ve yaşlarının etkisi kontrol edildikten sonra, ebeveynlerin bilimsel okuryazarlık becerilerinin çocukların bilimsel süreç becerilerini ne ölçüde yordadığının incelemesi yapılmıştır. Analizin 1. Adımında hem annelerin hem de babaların eğitim düzeyleri, bilimsel süreç becerilerindeki varyansın %12,2'sini açıklamıştır. Anne babaların eğitim düzeyi arttıkça çocuklarının bilimsel süreç becerileri puanları da yükselmektedir. Eğitim düzeyleri ayrıntılı olarak incelendiğinde, bulgular babaların eğitim düzeylerinin çocukların bilimsel süreç becerilerini annelerin eğitim düzeylerine göre daha fazla yordadığını ortaya koymuştur.

Alan yazın incelendiğinde, çok sayıda çalışma, ebeveynlerin eğitim durumunun çocuklarının gelişimsel sonuçları üzerindeki etkisini araştırmaya odaklanmıştır. Bu çalışmaların sonuçları farklılıklar göstermiştir. Örneğin, İdris ve meslektaşları (2020), özellikle hem babaların hem de annelerin eğitim düzeyine odaklanarak, ebeveynlerin eğitimi ile çocuklarının akademik başarısı arasındaki ilişkiyi incelemek için bir çalışma yürütmüştür. Araştırmanın bulguları hem babalar hem de anneler arasında eğitim düzeyinin yüksek olmasının çocuklarının akademik başarılarını olumlu yönde etkilediğini göstermiştir. Böyük ve meslektaşları (2011) babaların eğitim durumunun öğrencilerin bilimsel süreç becerileri puanları üzerinde etkili olduğunu bulmuşlardır. 5-14 yaş arası çocuklar üzerinde yürütücü işlev performansları, ebeveynlerin eğitim düzeyi ve çocuğun devam ettiği okul türü arasındaki ilişkiyi inceleyen başka bir çalışmada Ardila ve ark. (2005), ebeveynlerin eğitim düzeyinin, çocukların devam ettiği okul türüne kıyasla yürütücü işlev testi performansının daha güçlü bir yordayıcısı olarak ortaya çıktığını bulmuşlardır.

Kunt ve arkadaşları (2015) okul öncesindeki çocukların bilimsel süreç becerilerini çeşitli değişkenler açısından inceledikleri çalışmada bulgular, ebeveynlerin eğitim düzeyi ile çocukların bilimsel süreç becerileri puanları arasında pozitif bir ilişki olduğunu ortaya koymuştur. Puanlar, annesi ve babası üniversite mezunu olan okul öncesi çocuklarda en yüksek iken, annesi ve babası ilkokul mezunu olan çocuklarda en düşük puandır. Bu bulgular, ebeveyn eğitim düzeyinin okul öncesi dönem çocuklarının bilimsel süreç becerileri puanları üzerinde olumlu bir etkiye sahip olduğunu göstermektedir.

Ebeveynler çocuklarına rol model olduklarından ve onlara çeşitli fırsatlar sunduğundan, ebeveynlerin eğitim durumu çocukların gelişiminde etkilidir. Ek olarak, daha yüksek eğitim düzeyine sahip ebeveynler daha yüksek bilimsel okuryazarlık becerilerine sahiptir. Ayrıca, eğitim düzeyi yüksek olan ebeveynler, kaynakları erişilebilir kılma ve çocukları yararına etkin bir şekilde kullanma bilgi ve becerisine sahiptir (Germann, 1994; Hortaçsu, 2010). Sonuç olarak, bu tür hanelerin çocukları bilim ve fen eğitimine karşı daha olumlu bir tutum geliştirebilir, ev içinde aktif olarak bilişsel gelişim faaliyetlerine katılabilir, akademik başarılarına ve yeteneklerine katkıda bulunan deneyimler kazanabilir, değerleri benimseyebilir ve bilimsel süreç becerilerinin kazanılmasını teşvik edebilir (Germann, 1994). Bu çalışmanın bulguları literatür ile uyumludur.

Adım 2'de, ebeveynlerin yaşları dahil edildiğinde, genel model %12,3'lük bir toplam varyansı açıklamıştır. Ancak bulgular, ebeveynlerin yaşının çocukların bilimsel süreç becerilerini istatistiksel olarak yordamadığını göstermiştir.

Alan yazında anne baba yaşı ile çocukların bilimsel süreç becerileri arasındaki ilişkiyi araştıran çalışmalara rastlanmasa da ebeveynlerin yaşları ve çocukların farklı alanlardaki gelişimleri ile ilgili araştırmalar mevcuttur. Keil ve arkadaşları (2009) bilimsel süreç becerilerinin matematik becerilerinin gelişimine katkı sağladığı sonucuna varmıştır. Tayfun ve Aydoğan (2021), Montessori eğitimi alan ve almayan çocukların matematik becerilerini karşılaştırdıkları çalışmalarında, ebeveynlerin yaşları ile çocukların puanları arasında anlamlı bir ilişki olmadığını bulmuşlardır. Ayrıca Ergül (2014) çocukların ölçme ve veri analizi-olasılık alanlarındaki matematiksel muhakeme becerilerini incelemeyi amaçladığı çalışmasında ebeveynlerin yaşlarının çocukların ölçme ve veri analizi-olasılık becerileri üzerinde bir yordayıcı olmadığını bulmuştur. Mevcut çalışmanın bulguları literatürdeki çalışmalarla benzerlik göstermektedir.

Adım 3'te ebeveynlerin bilimsel okuryazarlık becerileri dahil edildiğinde, modelin bir bütün olarak açıkladığı toplam varyans %24'tür. Ebeveynlerin eğitim düzeyleri ve yaşları kontrol edildikten sonra, bilimsel okuryazarlığın çocukların bilimsel süreç becerilerinin en etkili yordayıcısı olduğu görülmüştür.

Çocukların bilimsel süreç becerileri ile ebeveynlerin bilimsel okuryazarlıkları arasındaki ilişkiyi inceleyen çalışma sayısı az olmakla birlikte, ebeveynlerin eğitim durumlarının ilişki göstermesi dikkat çekicidir. Bu doğrultuda alanda bu ilişkiyi inceleyen çalışmalara ihtiyaç vardır. Ayrıca ebeveynler, çocuklarının bilimsel süreç becerilerini soru sormaya, gözlem yapmaya ve deney yapmaya teşvik ederek desteklemede çok önemli bir rol oynamakta, böylece çocukların bu etkinliklere katılmaları ve muhakeme becerilerini geliştirmeleri için fırsatlar yaratmaktadır (Kefi, 2018). Çocuklar, özellikle ebeveynleriyle vakit geçirdiklerinde, günlük aktiviteleri sırasında sıklıkla bilimle ilgili konularla karşılaşırlar. Ebeveynlerin çocuklarının sorgulama, gözlemleme, deneme eğilimlerini geliştirmeleri ve böylece kendi muhakeme becerilerini geliştirmeleri önemlidir. Bu, çocuklara bilimsel süreç becerilerini etkili bir şekilde uygulamaları için fırsatlar sağlamayı gerektirir (NSTA, 2009). Bu nedenle, ebeveynlerin çocuklarının doğal merakını beslemeleri ve bilimsel süreç becerilerini araştırma faaliyetlerinde aktif olarak kullanmaları için onlara fırsatlar sözlü iletişim ve fiziksel jestleri müze ziyareti boyunca fen ve matematik içeriğiyle çocukları meşgul etmek için teşvik ettiklerini bulmuşlardır. Ebeveynlerin jestleri bile çocukları cesaretlendirebilirken, onların bilimsel okuryazarlıkları potansiyel olarak çocukların bilimsel süreç becerilerine ve gelişimlerine katkı sağlayabilir.

Marcon (1999) ebeveynlerin daha fazla dahil olduklarında, çocukların erken gelişimlerinin ve temel becerilerinin geliştiğini ve onları okulda başarıya hazırladığını belirtmektedir. Örneğin, çocukların fen becerilerinin ebeveynlik stilleri ile ebeveyn katılımı arasındaki bağlantıyı nasıl etkilediğini araştıran bir çalışmada, Lin ve arkadaşları (2023) ebeveynlerin katılımının, çocukların bilimsel problem çözme becerileri ile ebeveynlik stilleri arasında aracı görevi gördüğünü bulmuştur. Ebeveynlerin çocuklarının eğitimine aktif katılımlarının onların gelişimlerini ve başarılarını olumlu yönde etkilediği sonucuna varılabilir. Comer & Haynes'e (1991) göre, çocukların psikoeğitimsel gelişiminde etkili faktörler olarak ebeveynlerin ve okulların önemi, onların işbirlikçi çabalarının faydalarının altını çizmektedir. Ebeveynler sosyal ve duygusal destek sağladıkça, okullar bu deneyimleri artıran ve devam eden büyümeyi kolaylaştıran ortamlar yaratmaktadır (Comer & Haynes, 1991). Ebeveynlerin çocuklarının eğitimine katılımını kolaylaştırmak, ebeveynlere sosyal destek ve kişisel güçlendirme yolları sunabilir. Böylece, çocukların öğrenimi için önem taşıyan olumlu bir okul ve topluluk ortamının geliştirilmesine katkıda bulunabilir (Reynolds & Shlafer, 2010). Ayrıca, ebeveyn katılımı, çocukların gelişimi dikkate alınarak ve çocukların yaşamlarında etkili yetişkinler arasında iyileştirilmiş ilişkilerin geliştirilmesini teşvik ederek okulları geliştirmeye yönelik kapsamlı bir ekolojik stratejiye entegre edildiğinde optimum etkililiğe ulaşabilir (Comer & Haynes, 1991).

Sonuç olarak, ebeveynlerin bilimsel okuryazarlık becerileri, çocuklarının bilimsel süreç becerileri üzerinde önemli bir etkiye sahip olabilir ve gelecekte bilimsel okuryazar bireylerin yetiştirilmesine katkıda bulunabilir. Bu çalışma, ebeveynlerin bilimsel okuryazarlık becerileri ve 60-72 aylık çocukların sergilediği bilimsel süreç becerileri ve olası çağrışımları ile ilgili mevcut alan yazına farklı bir bakış açısı katabilir.

J. THESIS PERMISSION FORM / TEZ İZİN FORMU

(Please fill out this form on computer. Double click on the boxes to fill them)

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : İşler
Adı / Name : Bengi Nur
Bölümü / Department : Temel Eğitim, Okul Öncesi Eğitimi / Early Childhood Education

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English): Investigating the Relationship Between Children's Scientific Process Skills and Parents' Scientific Literacy Skills

TEZİN TÜRÜ / DEGREE: Yüksek Lisans / Master ☒ **Doktora** / PhD ☐

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. ☒
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months**. ***** ☐

***** *Enstitü Yönetim Kurulu kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir. / A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.*

Yazarın imzası / Signature .... **Tarih** / Date ....
(Kütüphaneye teslim ettiğiniz tarih. Elle doldurulacaktır.)
(Library submission date. Please fill out by hand.)

Tezin son sayfasıdır. / This is the last page of the thesis/dissertation.