

AN EXAMINATION OF THE RELATIONSHIP BETWEEN PRESCHOOL
CHILDREN'S AND THEIR MOTHERS' MENTAL MODELS TOWARDS THE
ENVIRONMENT

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ABSTRACT

AN EXAMINATION OF THE RELATIONSHIP BETWEEN PRESCHOOL CHILDREN’S AND THEIR MOTHERS’ MENTAL MODELS TOWARDS THE ENVIRONMENT

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This mixed-design study aimed to examine the environmental mental models of preschool children (aged 48–66 months) attending independent public kindergartens and their mothers, as well as to investigate the relationship between these models. An embedded mixed design was employed in the study. This design was used to utilize the strengths of quantitative and qualitative research designs while minimizing their respective limitations. Data were collected from 322 children and their mothers, resulting in a total of 644 participants. The ‘Draw an Environment Test Rubric’ (DAET-R) was used as the data collection tool. The DAET-R scale has four sub-dimensions: human, living, abiotic, and built. Each subdimension is scored from 0 to 3, so the highest possible total score a participant can earn is 12. In this study, children and their mothers drew pictures related to the concept of “environment,” which were then scored using the DAET-R scale. Additionally, participants explained their environmental drawings. Regarding the qualitative analysis, the visual codes in the drawings created by the children and their mothers were

examined. In the quantitative part of the study, the scores received by children and mothers from the DAET-R scale were discussed, as well as the differences between the mean scores. Moreover, to examine the effect of various demographic factors on DAET-R scores, the gender of the children and their participation in environmental activities with their mothers were investigated using an independent samples t-test. Additionally, mothers' education levels and their individual participation in environmental activities were analyzed using an independent samples t-test. Finally, a Pearson correlation test was applied to examine the relationship between children and their mothers. The results show the level at which children and mothers have scientific, developed, and interrelated mental models. Examining the sub-dimension and total scale scores revealed that participants received the lowest scores in the human sub-dimension. This suggests that participants defined the environment primarily in terms of "nature and natural factors", with limited consideration of the human factor in their mental models. However, when the sub-dimension and total scores were examined, children received higher scores in the human dimension, and this difference was statistically significant. Mothers received higher scores in the living and built sub-dimensions and total scores, and this difference was statistically significant. However, the scores obtained from the abiotic sub-dimension were similar for children and mothers, and no statistically significant difference was found.

According to other research findings, a statistically significant relationship was found between the gender of children and their participation in environmental activities with their mothers, affecting their scores on the DAET-R scale. It was observed that girls depicted models related to scientific and other factors (human, living, abiotic, and built) more frequently than boys, and this difference was statistically significant. Differences were also found in the environmental mental models of children who participated in environmental activities with their mothers. These differences were explained by intergenerational transmission theory, social learning theory, and bio-ecological systems theory.

Additionally, the educational level of the mothers positively impacted their environmental mental models. It was observed that mothers with higher education

levels were more likely to create interactive environmental models. Furthermore, participating in environmental activities improved mothers' environmental mental models. Finally, a correlation analysis was conducted on children's and mothers' DAET-R scale scores. A positive but low-level relationship was found between the living sub-dimension and total scores. The qualitative analysis examined the visual codes in the drawings of children and mothers alongside a content analysis. It was found that the participants produced codes mostly in the human-made category. However, human figures were the least frequently drawn category. The most frequently used visual codes for children were the sun, trees, clouds, grass, themselves, playgrounds, and houses with gardens. Similarities and differences were also observed for mothers. Accordingly, they frequently used the visual codes for trees, the sun, grass, houses with gardens, flowers, and children.

Keywords: Environmental Mental Models, Intergenerational transmission, children-mother interactions, environmental drawings, early childhood environmental education

ÖZ

OKUL ÖNCESİ ÇOCUKLAR İLE ANNELERİNİN ÇEVREYE YÖNELİK ZİHİNSEL MODELLERİ ARASINDAKİ İLİŞKİNİN İNCELENMESİ

KURŞUN, AYTEN

Yüksek Lisans, Temel Eğitim, Okul Öncesi Eğitimi Bölümü

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Bu karma desen çalışmasının amacı 48-66 aylık, devlete bağlı bağımsız anaokullarındaki okul öncesi çocukların ve annelerinin çevreye yönelik zihinsel modellerini incelemek ve bu zihinsel modeller arasında ilişkinin olup olmadığını araştırmaktır. Araştırma deseni olarak gömülü karma desen kullanılmıştır. Bu yöntemle birlikte nicel ve nitel araştırma desenlerinin güçlü yanlarından yararlanılması ve zayıf yanlarının da giderilmesi amaçlanmıştır. Araştırmanın verileri 48-66 aylık 322 çocuk ve annelerinden toplanmış olup toplam 644 kişi ile birlikte yürütülmüştür. Veri toplama aracı olarak “Bir Çevre Çiz Test Rubriği” (BÇÇT-R) kullanılmıştır. Bu ölçekte dört alt boyut bulunmaktadır bunlar; insan, canlı, abiyotik ve insanın tasarladığı yapılardır. Her bir alt boyuttan 0-3 arasında puan alınırken, bir kişinin alabileceği en yüksek puan 12 puandır. Bu doğrultuda, çocuklar ve anneleri “çevre” kavramına yönelik resimler çizmişlerdir ve bu çizimler BÇÇT-R ölçeği ile puanlanmıştır. Ayrıca katılımcılar çevre çizimlerini açıklamışlardır. Nitel kısımda ise çocukların ve annelerinin yapmış oldukları resimlerdeki görsel kodlar içerik analizi ile birlikte incelenmiştir. Araştırmanın nicel kısmında çocukların ve annelerin BÇÇT-R ölçeğinden aldıkları puanlar ve ortalamalar arasındaki farklılıklar

tartışılmıştır. Ardından çeşitli demografik bilgilerin BÇÇT-R skorları üzerindeki etkisini incelemek amacıyla çocukların cinsiyeti ve anneleriyle birlikte çevre etkinliklerine katılma durumları bağımsız örneklem t-testi kullanılarak araştırılmıştır. Ayrıca annelerin eğitim düzeyleri ve bireysel olarak çevre etkinliklerine katılım düzeyleri de bağımsız örneklem t-testi kullanılarak analiz edilmiştir. Son olarak ise çocuklar ve anneleri arasındaki ilişkiyi incelemek için Pearson korelasyon testi uygulanmıştır. Elde edilen bulgular, çocukların ve annelerin bilimsel, gelişmiş ve etkileşimli zihinsel modellere sahip olma düzeylerini göstermektedir. Ölçeğin alt boyutlarından alınan skorlar ve toplam puanlar incelendiğinde, katılımcıların insan alt boyutunda en düşük puanlar aldığını, çevreyi “doğa ve doğal” unsurlarla daha fazla tanımladıkları ve insan faktörünün zihinsel modellerde sınırlı yer aldığı görülmüştür. Alt boyutlardan alınan puanlar ve toplam puanlar incelendiğinde insan boyutunda çocuklar daha yüksek puanlar almıştır ve bu fark istatistiksel olarak anlamlıdır. Canlı, insan yapımı alt boyutları ve toplam puanlarda ise anneler daha yüksek puan almıştır. Bu fark istatistiksel olarak anlamlıdır. Ancak abiyotik alt boyutundan alınan çocuklar ve annelerin puanları birbirine yakındır ve istatistiksel olarak anlamlı bir fark bulunamamıştır.

Diğer araştırma bulgularına göre, çocukların cinsiyetleri ve anneleriyle birlikte çevre etkinliklerine katılım durumları, onların DAET-R ölçeğinden aldıkları puanları etkileme düzeyinde istatistiksel olarak anlamlı bir ilişki bulunmuştur ve kız çocuklarının erkek çocuklarından daha bilimsel ve diğer faktörlerle (insan, canlı, abiyotik ve insan yapımı) ilişkili modeller çizdikleri görülmüştür ve bu fark istatistiksel olarak anlamlıdır. Bununla beraber anneleriyle çevre etkinliklerine katılan çocukların çevresel zihinsel modellerinde de farklılıklar görülmüş ve bu kuşaklararası aktarım teorisi, sosyal öğrenme ve biyo-ekolojik sistemler teorileriyle birlikte açıklanmıştır. Ayrıca annelerin eğitim düzeylerindeki farklılıklar da çevresel zihinsel modellerini olumlu yönde etkilemiştir ve daha yüksek eğitim düzeyindeki annelerin etkileşimli modeller çizmeye eğimli olduğu bulunmuştur. Bununla birlikte, annelerin çevre etkinliklerine katılıyor olmaları da onların çevresel zihinsel modellerini geliştirmiştir. Son olarak ise, çocuklar ve annelerinin DAET-R ölçeğinden aldığı skorlar üzerinden korelasyon analizi yürütülmüştür; canlı alt boyutunda ve total skorları arasında olumlu ancak düşük seviyede ilişki bulunmuştur.

Nitel kısımda ise çocukların ve annelerin çizimlerindeki görsel kodlar içerik analizi ile birlikte incelenmiş ve en çok insan yapımı kategorisinde kodlar ürettikleri bulunmuştur. Bununla birlikte çizimlerde en az çizilen kategori insan figürleri olmuştur. En sık yer verilen görsel kodlar çocuklar için sırasıyla sıklıkla güneş, ağaç, bulut, çimen, çocukların kendileri, oyun alanları ve bahçeli evler olmuştur. Anneler için de benzerlikler ve farklılıklar gözlemlenmiştir; buna göre sırasıyla sıklıkla ağaç, güneş, çimen, bahçeli ev, çiçek ve çocukları çizmişlerdir.

Anahtar kelimeler: çevresel zihinsel modeller; kuşaklararası aktarım, anne–çocuk etkileşimleri; çevre çizimleri; erken çocuklukta çevre eğitimi





*To my mother and father,
who have always believed in me, trusting my choices wholeheartedly, and supported
me unconditionally—even when the path I followed was unfamiliar to them.
And to every child who dreams of a greener world,
And to every educator who plants the seeds of change.*

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CHAPTER 1

INTRODUCTION

Environmental organizations offer various definitions of the term “environment.” UNEP defines it as the surroundings and the relationships among components such as water, soil, and living organisms. Similarly, the EPA (2018) emphasizes the interaction of external elements, including built structures, though it excludes social and economic aspects. In contrast, the NAAEE (2004) adopts a systems approach by integrating physical, social, and economic factors that influence human behavior. UNICEF (2015) highlights the significance of environmental conditions for children’s health and development. Although it does not provide a precise definition, it considers environmental sustainability a basic right for all children and emphasizes early education to promote pro-environmental attitudes and behaviors (UNICEF, 2015, 2021). Likewise, IUCN defines the environment as an interconnected system and emphasizes conservation efforts such as land and water protection, biodiversity, education, communication, and policy development at multiple levels. These perspectives collectively underline the complex interplay between natural, built, and social environments, and their implications for human well-being and sustainability. Protecting the environment is essential for the health and future of humanity. UNEP (2020) emphasized children’s environmental rights, while WHO (2017) reported that millions of children under five die each year due to preventable environmental factors such as air pollution and poor sanitation. Young children are especially vulnerable due to their developmental stage and greater exposure through play. As a result, environmental hazards can impair their cognitive and physical development and have long-term consequences (WHO, 2020). Nevertheless, improvements between 2002 and 2013, such as better nutrition and infection control, reduced child mortality from environmental causes from 37% to 26%. These findings stress the importance of addressing environmental issues to ensure both child well-being and

the sustainable use of natural resources. Climate change further intensifies environmental risks. The IPCC (2023) reported rising temperatures, melting glaciers, ocean acidification, and increased greenhouse gas emissions due to unsustainable practices. In response, environmentalists argue that today's children must be equipped to address these challenges, emphasizing the role of early education in fostering ecological awareness and responsibility (Duvall & Zint, 2010; Palmer, 1999). However, Palmer (1999) also warns that modern human behavior increasingly harms the environment, requiring educational efforts to promote sustainable attitudes and behaviors.

The basis of environmental problems lies in the actions taken by humans (Taylor et al., 1992; Takala, 1991; Bulte et al., 2005; Gardner & Stern, 2002; Chawla, 2009; Fahlquist, 2009; Frantz & Mayer, 2013; Edo et al., 2024). Individuals' decisions, economic preferences (Frantz & Mayer, 2014), behaviors, consumption habits, routine behaviors, and general life patterns affect environmental awareness (Takala, 1991). For example, with the efforts of UNEP, 65 million people participated in World Environment Day (2022), which shows that organizations and political parties should promote environmental education and environmentally friendly behaviors. As defined by the Tbilisi delegation (1977), environmental education should increase citizen's understanding of modern environmental problems and challenges and their ability to modify and perform environmental behaviors.

The reason for starting early is that the National Association for the Education of Young Children (NAEYC) emphasizes that brain connections are most rapidly formed in early childhood, with the first three years being especially important (Shonkoff, 2000). Also, early childhood experiences in nature and outdoor environments have a significant impact on children's environmental knowledge and behaviors, particularly during a critical period for learning and brain development. Additionally, it was shown that children who have outdoor experiences are better connected to nature and exhibit more environmentally friendly behaviors (Otto and Pensini, 2017; Dopko et al., 2019). Furthermore, early exposure to nature not only shapes children's motor, emotional, and cognitive development (Amoly et al., 2014) but also has lasting effects on their health throughout their lives (Chan, 2013). Thus,

Smyth (2006) has illustrated that motivation for pro-environmental behaviors begins in early childhood experiences. As supported by Evans et al. (2018), spending time in nature in childhood is associated with increased pro-environmental behaviors in adulthood. In addition to spending time individually, Tanner (1980) suggests that childhood experiences, including exposure to nature-themed literature and interactions with family members, significantly influence attitudes and behaviors in adulthood (Stevenson et al., 2014). However, according to Tindall and Scott (2003), females are more active than males in individual environmentally friendly behaviors (such as recycling and energy conservation), whereas males participate in collective activity behaviors. These differences were considered in our study, as the roles of mothers and gender differences of children in developing environmental mental models.

Parents play a significant role in environmental education and forming the environmental mental models accordingly. As Wells and Lekies (2006) indicated, early life experiences significantly influence an individual's life trajectory and include factors such as family, health, and education. Despite the positive effects of time spent in nature and the importance of early experiences, children's connection with nature has alarmingly declined (Scott, 2015). To achieve UNICEF's (1977) goal of raising environmentally responsible citizens, both educators and parents are encouraged to actively provide these meaningful experiences for children (Li & Chen, 2015). Although parents support environmental education, simply transferring information may not be sufficient to raise awareness. Instead, hands-on experiences in outdoor settings are also crucial (Hungerford & Volk, 1990). Interactions between children and parents promote joint participation in environmental activities, which facilitates the transmission of behaviors (Jia & Yu, 2021). Spending time in nature not only supports physical and mental health but also enhances environmental responsibility and social well-being (Lackey et al., 2019; Kabisch et al., 2017; WHO, 2012). In some cases, children's environmental knowledge may even exceed their parents' and influence their behavior, indicating a reciprocal relationship (Žukauskienė et al., 2022). This transmission process is not one-way (Maccoby, 2007; Grønhøj & Thøgersen, 2009; Branje et al., 2020). Children can also shape their parents' behaviors, leading to mutual influence (Kuczynski & Parkin, 2007). In this

context, socialization within the family increases environmental awareness and knowledge (Singh et al., 2020). Parents are therefore advised to adopt learning programs that help children develop respect for nature (UNESCO, 1978). Socialization agents like parents shape children's actions, beliefs, and values, which are outcomes of interaction and interpretation (Kuczynski & Parkin, 2007). With the support of their families, children can achieve environmental goals set by organizations such as UNESCO's goals they may not achieve independently. One of the most powerful influences in this process is intergenerational transmission, where environmental values and practices are passed down through family socialization (Matthies et al., 2012; Grønhøj & Thøgersen, 2009, 2012; Kong & Jia, 2023). This influence is particularly strong in early childhood, as children are more receptive to parental guidance (Collado, 2017). Duvall and Zint (2007) emphasize the practicality of intergenerational learning, especially when adult education resources are limited. However, not all findings are consistent. Some studies have found weak or negative correlations between parents' and children's environmental knowledge and behaviors (Evans et al., 2007; Collado et al., 2015), possibly due to developmental readiness. In contrast, when both parents and children have high environmental knowledge, concern, and motivation, pro-environmental behaviors are more likely to occur (Kong & Jia, 2023; Casaló & Escario, 2016; Grønhøj & Thøgersen, 2009, 2012, 2017). Collado (2017) also compared peer and parent influences on children's environmental behaviors and found that parents had a stronger impact. Girls were more influenced by social agents than boys. Lastly, effective communication plays a critical role in supporting environmentally responsible behaviors in children (Matthies et al., 2012; Jia & Yu, 2021).

However, according to TÜİK (2023), 93.2% of children in Türkiye now grow up in urban areas, a significant increase from the 75% reported in Tanner's (1980) earlier study. As Louv (2010) points out, children today spend less time in nature, leading to what he calls "nature-deficit disorder," which may negatively affect both their physical and emotional well-being. This growing disconnection highlights the need to support children's engagement with nature through environmental education. Several studies emphasize the importance of early nature experiences in shaping environmental attitudes and behaviors. Place (2016), for instance, found that many

conservationists had grown up surrounded by nature, had access to environmental books, and were influenced by a parent or grandparent who cared deeply about the environment. Similarly, D'Amore (2016) showed that spending time in nature with others, such as through family nature clubs, fosters pro-environmental behaviors (D'Amore, 2016; Evans et al., 2018; Tanner, 1980). In these settings, children not only model their parents' behaviors but are also encouraged through praise and shared experiences (D'Amore & Chawla, 2017).

In addition, mental models, defined as critical cognitive structures that shape how individuals perceive the world and influence their behavior, play a key role in how environmental values and knowledge are interpreted and passed on to children (Langan & Fox, 2001). While Langan-Fox et al. (2001) define mental models as types of information stored in memory for a specific purpose, Norman (1988) defines them as simpler structures that explain how something works and can be transferred between individuals through interactions. Krcmar and Hight (2007) emphasize that mental models are formed and developed through interaction with the environment beginning at birth. In line with this, Baillargeon (1991) observed that 4-month-old babies develop mental models and can predict the behavior of objects in their environment. This study demonstrates that mental models are formed at a young age and evolve through experience. Some studies have been conducted to investigate the possibility of changing and developing mental models externally. For instance, Krcmar and Hight (2007) indicated that when children aged 3 to 6 are exposed to aggressive media, their mental models of aggression develop, which shape their future behaviors. Furthermore, mental models can be developed and influenced both positively and negatively. This idea is supported by Nermessian (2002) who emphasizes that an individual's prior knowledge, reasoning skills, and observation of the behavior of others shape more complex mental models. In the context of environmental education, Shepardson et al. (2007) argue that while individuals' environmental literacy should be developed, mental models should not conflict with scientific models. Moreover, it was found that students with more knowledge about environmental issues display more proactive environmental behaviors, whereas this effect is reversed in students with low knowledge levels (Kuhlemeier et al., 1999). Similarly, Rickinson (2001) concluded that environmentally friendly behaviors were

more commonly observed in schools with teachers who had a positive attitude toward the environment. It is stated that once mental models have been identified, they can be positively changed through education. Hence, Ausubel et al. (1978) claim that teachers should help develop their mental models by identifying incorrect or incomplete models. This process is critical for shaping students' attitudes and behaviors toward the environment. In conclusion, mental models play an important role in people's decision-making and behaviors. Individuals' environmental actions are mainly determined by their existing mental models, which can be refined and enhanced through education. Educators, parents, and others around the children have crucial roles in identifying incomplete or inaccurate mental models and providing guidance for their positive transformation. As a result, children become more aware of the environment and perform environmentally friendly behaviors.

In conclusion, understanding children and their mothers' environmental mental models is significant because mental models shape and influence how people perceive and respond to the current environmental issues (Shepardson et al. 2007). Furthermore, previous research focused on the importance of early exposure to nature and parental involvement in promoting environmental issues (Place, 2016). Therefore, the present study aims to examine the environmental mental models of 48–66-month-old children and their mothers by analyzing their verbal and visual representations. The study investigates their overall and subdimension scores from the DAET-R, explores differences based on demographic variables such as child's gender, mother's education level, and participation in environmental activities, and compares the visual codes in their drawings. This approach seeks to contribute to the understanding of how environmental mental models are formed and potentially transmitted across generations.

1.1. Significance of the Study

Environmental education is significant to protect children's health, ecosystem vitality, and integrity. In this manner, governments and environmentalists made important efforts to protect the environment (Breiting & Mogensen, 1999). However, current research shows that, to encourage environmentally friendly behaviors and

prevent environmental degradation and damage, understanding and personal commitment are needed, especially at an early age (Stern, 2008; Sia et al., 1986). In addition to the precautions taken by governments and environmental organizations, individuals also need to raise awareness by themselves. Similarly, UNESCO (1978) emphasized the importance of fostering critical thinking by starting early age and equipping children with the necessary skills to understand and realize the environmental issues. Although environmental education is a lifelong process that begins at an early age (Ernst & Burcak, 2019), the research area generally focuses on the primary and secondary school levels (Sia et al., 1986). Despite its importance, early environmental education is underfunded and underemphasized because most efforts are generally focused on older age groups (Somerville & Williams, 2015; Sia et al., 1986). Therefore, more research on early childhood education for sustainable development is needed to support effective practices that integrate environmental protection, human rights, and experiential learning outdoors (Siraj-Blatchford et al., 2010), and more systematic research has also been supported (Environmental Protection and Security Panel, 2010). Children under the age of eight are considered leaders in future environmental development due to their influence and capacity for learning (Ardoin & Bowers, 2020). In early childhood, children's intrinsic motivation and curiosity support their exploration of the natural world (Ardoin & Bowers, 2020; Bjerckness et al., 2024), and their brains are especially receptive to environmental knowledge and experience (Tierney & Nelson III, 2009; Davis & Green, 2009). These early experiences not only shape neurological growth but also physical, psychological, and social development. Active interactions with nature offer valuable opportunities for hands-on learning, both for children and for the adults guiding them (L'Ecuyer, 2014; Bjerckness et al., 2024). In support of early intervention, Grønhøj and Thøgersen (2009) found that although younger children tend to hold more positive attitudes toward environmental issues, they are less likely to engage in environmental behaviors than older individuals. Similarly, Johnson et al. (2021) reported that older generations displayed more frequent recycling and protection behaviors despite limited environmental knowledge. Yet, Arnold et al. (2010) argued that today's youth have greater potential to influence change due to better access to information and more effective decision-making processes. As Ardoin and Bowers (2020) emphasized, environmental education should promote not

only individual awareness but also broader social transformation. As a result, these findings emphasize the importance of early childhood as a critical period for forming and shaping environmental mental models as it was aimed to investigate in the current study by using Draw an Environment Test-Rubric (DAET-R) scale.

Mental models, as cognitive frameworks shaped by experience, guide individuals' understanding of environmental issues and influence their decisions and actions (Forrester, 1971; Shepardson et al., 2007). In environmental education research, drawing has emerged as a valuable technique for identifying and visualizing these models (Moseley et al., 2010). Although the DAET-R scale has been applied to various groups including pre-service teachers (Moseley et al., 2010; Ahi et al., 2017), undergraduate students (Liu & Lin, 2014), and young children (Ahi, 2015), there is limited research examining the environmental mental models of parents, particularly mothers, using drawing-based visual representations. This creates an important research gap, especially considering the significant role mothers play in shaping children's environmental thinking and behavior. Also, drawing is used in this study not only as a measurement tool but also as a way for young children to express their environmental mental models and interconnections between human, living, abiotic and built sub-dimensions. It is considered a pre-writing communication method that enables children to convey complex ideas and experiences before they acquire formal writing skills (Hall, 2009; Ring, 2006). As an activity commonly practiced in early childhood, drawing helps reveal children's inner worlds, emotions, and social understandings (Brooks, 2009; Matthews, 2003). Visual codes in children's drawings have been widely used in studies to explore environmental perceptions (Barraza, 1999; Özsoy, 2012), awareness (Kanat et al., 2023), knowledge (Meiboudi et al., 2011), concerns (Barraza, 1999), and environmental problems (Sadık et al., 2011). Similarly, recent research has shown how drawings can reflect children's mental models of the environment and serve as tools for understanding their conceptual development (Ahi, 2015; Liu & Lin, 2015; Sak, 2023). As McNeil (2014) notes, drawings can also be used to assess how students mentally structure and interpret key environmental concepts, as it was aimed in the study to be analyzed. Accordingly, the present study also aimed to examine the visual codes in the drawings of children

and mothers to identify similarities and differences in how they represent the environment.

In this process, the role of parents becomes crucial, as they shape children's first environmental experiences and influence how these concepts are mentally represented. Mothers are often the primary source of support, care, and guidance in early childhood, and their behaviors, values, and ways of thinking related to the environment play an important role in shaping how environmental concepts are mentally constructed. Grønhøj and Thøgersen (2009) and Evans et al. (2007) emphasize that children tend to observe and imitate how their parents approach the environment in everyday life. In line with Bronfenbrenner's ecological systems theory, the family, where mothers usually hold a central role, functions as a key microsystem where environmental mental models begin to form through daily interactions. In this study, mothers were asked to define the environment through their drawings and explain their drawings accordingly. Previous studies showed that predictability in maternal care had a significant impact on children's neurobiological development, as it influenced the interplay of the prefrontal cortex, amygdala, and stress response systems (Anderson et al., 2012; Gee & Cohodes; Guadagno et al., 2018). Building on these findings, research has revealed that the mother's presence and close behaviors cause the release of cortisol in the children, which promotes emotional control and fear reduction in children, which shows the importance of the role of the mother in children's lives (Opendak et al., 2020). Hence, caregiver-child interactions during this phase have long-term benefits for the child's future (Ali et al., 2021; Gee & Cohodes, 2021). As Murphy and O'Leary (1989) have examined, parents' behaviors and characteristics affect their children's behavior and adjustment, although the effects may vary from parent to parent. Although previous studies have examined parent-child similarities in environmental attitudes (Cevher-Kalburan, 2009; Leppänen et al., 2012; Soydan & Öztürk-Samur, 2014), mental models differ from attitudes. While attitudes include emotional and evaluative dimensions (Fisbein & Ajzen, 1975; Eagly & Chaiken, 1993), mental models involve internalized, experience-based representations that guide interpretation and decision-making (Clement, 1993). Therefore, the current study focuses on how both children and their

mothers mentally represent the environment and explores potential intergenerational similarities in these mental models, filling an important gap in the current literature.

Another demographic aspect examined in the study is the mothers' educational levels and how these levels influence their mental models. The mother's educational background was significantly associated with children's connection to the environment and the influence on children's behavior (Evans et al., 2018). Therefore, young children raised by mothers who behave more sustainably and have a better attitude towards the environment also exhibit more environmentally friendly behaviors themselves (Evans et al., 2018). However, if their mothers had greater levels of education, they would perform more environmentally friendly behavior (Evans et al., 2007; Saraçlı et al., 2014). Thus, the research and UNESCO's report (1978) showed that there might be a relationship between the parents' education and attitudes through their behaviors. Still, the mother's level of environmental education affects the children's knowledge accordingly, and education should also be provided to the parents as a household milieu (Payne, 2005). Hence, this study examined mothers' education levels concerning environmental mental models.

In addition to examining children's and mothers' environmental mental models, the study also investigates the frequency of environmental activities in relation to these mental models. These activities include simple and meaningful practices such as walking in nature, planting a tree, collecting waste in the park, sorting recyclable materials at home, or growing plants, all of which reflect everyday engagement with the environment. As Allen and Ferrand's (1999) study shows, helping and participating in the environment is viewed as helping ourselves by addressing unwanted environmental issues. However, people may not engage in pro-environmental behaviors until they recognize that they should take responsibility and become aware of environmental degradation. To achieve this, parents should model and perform positive environmental behaviors for their children, as children can learn from and follow their parents' behaviors toward the environment (Chawla, 1999). Samuelsson (2011) states that children have the developmental capability to understand concepts related to sustainability and the environment, but full comprehension requires active involvement and experiential learning. The social

environments of teachers, families, and peers who are vital in fostering these experiences and promoting conversations about the environment enhance this learning in addition to children's own experiences (Samuelsson, 2011; Chawla, 1988). In this context, mothers serve as crucial role models in transmitting environmental behaviors and knowledge by taking environmental responsibility and encouraging emotionally supportive and sustainable practices for their children. To explain the mother's role in developing and transmitting environmentally appropriate behaviors, Bronfenbrenner and Morris (2006) emphasize the importance of the microsystem, which includes close relationships between children and their parents, shaping behaviors through reciprocal learning. Parents act as facilitators in environmental settings and strengthen bonds with their children while fostering positive environmental behaviors, as children often seek approval (Bixler et al., 2002; Torell & Biel, 1985). Early experiences with family foster a lifelong interest in environmental values and support protective behaviors toward environmental places (Kals et al., 1999; Fang et al., 2022). Environmental activities during childhood, especially those involving direct parent-child interaction and socialization through shared experiences, influence future behaviors in adolescence (Arnold et al., 2009) and adulthood (Price et al., 2022). Parental involvement is therefore critical in shaping children's early environmental behaviors, which eventually lead to pro-environmental practices (Collado et al., 2017). That is why individuals who become environmental activists often report spending time in nature with influential role models such as family members or teachers (Tanner, 1980; Chawla, 1998; Wells & Lekies, 2012). Although previous studies have explored parental influence on environmental attitudes and behaviors, limited research has investigated how environmental activity frequency connects with environmental mental models, particularly during early childhood. In this regard, the study focuses on how the frequency of mothers' participation in environmental activities, both individually and together with their children, relates to their environmental mental models.

Another demographic aspect examined in the study is the mothers' educational levels and how these levels influence their mental models. The mother's educational background was significantly associated with children's connection to the environment and had an influence on children's behavior (Evans et al., 2018).

Children raised by mothers who behave more sustainably and have a better attitude toward the environment also tend to exhibit more environmentally friendly behaviors (Evans et al., 2018). In addition, higher levels of maternal education have been linked to increased environmentally responsible behaviors (Evans et al., 2007; Yilmaz et al., 2014). UNESCO (1978) and Payne (2005) emphasized that environmental education should not only be provided to children but also to parents, as the household context plays a critical role in shaping children's environmental knowledge and practices. For this reason, the present study examines mothers' education levels in relation to their environmental mental models. However, limited research has focused on how mothers' educational backgrounds are associated with their environmental mental models, which leaves a gap in understanding how environmental mental models are constructed and potentially transmitted within the family context.

In addition to mental models, and ecological systems theories, this study also focuses on the intergenerational transmission theory which highlights how children inherit environmental values and motivations through everyday interactions within the family (Grønhøj & Thøgersen, 2009). This process reflects the long-lasting influence of previous generations and operates through both genetic and social pathways (Branje et al., 2020). According to Maccoby (2007), parents play a central role in socialization, during which emotional responses, values, and behaviors are passed down between generations. Research has revealed parent-child similarities in areas such as food preferences (Breen et al., 2006; Guidetti & Cavazza, 2008), divorce patterns (Diekmann & Engelhardt, 1999), educational attainment (Eccles, 2005; Hertz et al., 2007), gender roles (Juni & Grimm, 1993), emotional tendencies (Cole et al., 2000), and cognitive skills including math, literacy, and language (Brown et al., 2011; Sullivan et al., 2021; Heineck & Anger, 2009). Emotional intelligence (Costa et al., 2018; Cabello et al., 2023) and intellectual ability (Scarr & Weinberg, 1977; Bouchard, 1998; Grönqvist et al., 2017) also show intergenerational patterns. Similarly, environmental concern, pro-environmental behavior, and attitudes are shaped by parents' influence (Meuusen, 2014; Katz-Gerro et al., 2020; Leppänen et al., 2012). However, limited research has focused on the relationship and the similarities or differences in environmental mental models between mothers and

children, leaving an important gap in understanding how such models may be transmitted within generations.

To sum up, this study investigates the environmental mental models of 48–66-month-old children and their mothers through their drawings and the DAET-R scale. Mental models are internal representations that include a person's past experiences, knowledge, perceptions, and schemas, and they help individuals make sense of the world through problem-solving processes. Measuring these models is important for understanding how people think about environmental issues. Mental models are not shaped only individually, they are also formed and transmitted through social learning, intergenerational transmission, and the systems in which individuals live. Therefore, one of the main goals of this study is to examine the relationship between the environmental mental models of children and their mothers. Considering the important role of mothers during early childhood, this study also investigates how their environmental experiences and ways of thinking are reflected in their children. In addition, some demographic variables were also addressed in the study including the child's gender, participation in environmental activities with the mother, the mother's education level, and her individual participation in environmental activities. Finally, the visual codes in the drawings of children and their mothers are analyzed to reveal similarities and differences between them. The research questions addressed in this study are presented below:

- 1.** How do children's and their mothers' visual codes in their drawings about the environment correspond to or differ from each other?
- 2.** What are the environmental mental model scores of 48–66-month-old children and their mothers as measured by the DAET-R, and are there significant differences between their mean scores?
 - 2.1** Do children's and their mothers' mental model scores related to the environment differ based on various demographic variables, including children's gender, mothers' educational level, and their participation in environmental activities individually and together?
 - 2.2.** Are there any relations between the children's and their mother's total and subdimension (human, living, abiotic and built) scores in mental models?

1.2. Definition of the Important Terms

Environmental Education: The Tbilisi Declaration (1977) the environmental education is described as the process of educating and motivating individuals who aim to enable people to perceive the problems in the environment, to have knowledge and awareness about them, and to have knowledge and expertise in solving these problems and who feel responsible for the environment. In addition, UNESCO (2010) defined it as educational programs that encourage the creation of a sustainable world where the environment is protected as a result of increased awareness of environmental problems.

Early Childhood Environmental Education: NAAEE (2016) uses early childhood environmental education as a concept that aims to increase children's feelings, awareness, skills and knowledge about the natural world and also their environmental tendencies. The aim of environmental education in early childhood is to increase children's environmental experiences, reinforce them with education starting at an early age, and raise individuals who are sensitive to environmental problems and solution-oriented in the future (Davis & Elliott, 2014).

Pro-environmental behavior: Reducing people's propensity to harm the environment and increasing knowledge of the need to create good behaviors are the goals of pro-environmental behavior (Kollmus & Agyeman, 2002) and rebuilding the construction and the surrounding environment (Teixeira et al., 2023). These practices include utilizing non-toxic materials, recycling, cutting back on energy and water consumption, and selecting items that are good for the environment (Kollmus & Agyeman, 2002; Teixeira et al, 2023).

Parental Influence: In contrast to directly educating the children, parents' actions, attitudes, and ways of thinking influence the intended actions, choices, and decision-making process of the children as well as their growth (Nebor, 1986).

Systems approach: Systems thinking is not about learning a concept separately and grasping its features one by one, but about seeing the system holistically (Sanneh,

2018, pp. 6-8). Accordingly, it includes predicting the behaviors that systems may cause after they are recognized and understood, and the possibility of changing them (Arnold & Wade, 2015). It is also understood by recognizing the elements of the system, noticing the connections, and understanding its purpose as a whole (Meadows, 2008, pp.11).

Mental Models: Mental models are subjective impressions that people develop as a result of interactions with the outside world; they are predicated on the individual's experiences and worldview (Jones et al., 2011). Mental models stand for one's approach to thinking about a certain topic, as well as one's capacity for inquiry and forecasting (Gentner et al., 2001). Behavior is influenced by the models that an individual gathers from the outside environment to assist in decision-making and logical thinking (Jones et al., 2011).

CHAPTER 2

LITERATURE REVIEW

2.1. What Are the Environmental Issues Faced in Today's World?

The environment is defined as the elements around humans, and in this respect, the built environment is defined as a place where there are structures, as well as natural environments, such as air, soil, water, and all other resources (European Environmental Agency (EEA) Glossary). From this perspective, the environment can be considered as a whole, encompassing the surroundings in which a person lives and the elements that constitute the environment, which are in a complex and reciprocal relationship with each other, and individuals evaluate these elements in the way they perceive and understand them (EEA, Glossary). However, the environment is not only composed of physical elements; it also includes human factors. Interactions occur between the factors that shape the environment. As a result, environmental events have the potential to negatively impact individuals' lives, while individuals' actions can also have negative effects on the environment.

According to UNICEF USA (2019), weather-related disasters like rainstorms, floods, and hurricanes risked the USA's economy by about \$155 billion in 2018. According to UNICEF, technological and economic developments are necessary to improve the quality of life of citizens and reduce environmental damage to humans. The Intergovernmental Panel on Climate Change (IPCC) has reported a temperature difference of 1.1 °C between 1850 and today's temperature due to having a lifestyle that through practices that harm nature, and it was found that increased the use of fossil fuels in lead increased the amount of carbon dioxide and greenhouse gases. Therefore, these anthropogenic factors damage natural areas and forests, causing higher temperatures. In addition to the harmful effects of climate change on the

planet's natural systems and resources, it also has serious effects on the physical and mental health of children (UNICEF, 2023; Currie & Deschênes, 2016; WHO, 2018; Oppenheimer and Anttila-Hughes, 2016). According to these reports, climate change seriously affects the quality of life and health of children due to constantly changing weather conditions and increasing global temperatures. In addition, they claim that these problems are more severe in developing and low-income countries (UNICEF, 2019; UNICEF, 2023). According to UNICEF (2019), melting ice, rising wind temperatures, deterioration in agricultural areas, and numerous diseases all contribute to climate change. Through this report, children with vulnerable bodies and weak immune systems are unable to survive these extreme weather conditions and contagious diseases. Furthermore, climate change causes infectious diseases, and because this is disregarded for financial reasons, children have become the most vulnerable targets (UNICEF, 2019; UNICEF, 2023). The UNICEF (2023) and IPCC (2014; 2023) consider implications of climate change on children as direct effects such as exposure to extreme heat and extreme weather conditions such as drought and fire, storms and floods, and rainfall.

Secondly, associated effects with the ecosystems include worsening illness outbreaks, vector-borne diseases, inadequate diet and nutrition, unequal opportunities for schooling, and migration and displacement in search of water. Finally, the effects associated with human actions and institutions that negatively impact on mental health and create an environment of climate anxiety about the government's powerlessness to address the issues that are currently generating stress and depression, as well as gender, which primarily affects girls' exposure to violence and early marriage and also occupational stress and not being able to follow outdoor exposures. Additionally, children may suffer from heatstroke and other forms of heat exhaustion in extreme temperatures, which might endanger their abilities and choices to play outside, exercise, and engage in outdoor learning and exploration (Oppenheimer & Anttila-Hughes, 2016). Similarly, the UNICEF (2023) report argues that even children in developed countries suffer as a result of the lack of protection. For example, children in Europe, Canada, and the United States suffer from asthma and breathing problems as a result of air pollution and forest fires. However, the African continent is classified as "extremely high" or "high" risk

(UNICEF, 2023), confirming that all children are affected, but the rates of exposure vary. Furthermore, according to Currie and Deschênes (2016), the reason why adequate financial support and practices to reduce climate change cannot be implemented is that current politicians do not support them, believing that the costs will be paid in the current order and the results will be seen in the future, rather than in the present. This is also supported by the UNICEF report that children affected by climate change receive just 2.4% of climate investment, which indicates an underestimation of them. As a recommendation for climate change awareness, according to UNICEF, although it is difficult for parents to talk to children about climate change and helps them avoid the anxiety and fears that may cause them, children can learn about this issue from their environment. Since this issue is unclear for children, they may feel emotions such as anger, anxiety, or sadness, but parents should inform children about this issue and explain the precautions that can be taken; the problem should be explained in detail. In the suggestions given for this, parents should first become aware of this issue and be equipped to answer the child's questions. The child should be asked what he knows about it and his feelings should be learned, and the child should always be encouraged to talk about it. When explaining this topic, parents should start simply and give examples from daily life. Pictures and necessary videos can be viewed from secure sources. They should be encouraged to go out with the child and explore, respect, and protect nature. While outside, parents should show the child interesting nature elements and appreciate nature. The child should be taught how to solve environmental problems, and small steps should be taken. For example, water usage at home, reducing garbage, recycling, etc. Finally, to encourage the child, important activists can be mentioned, and other people's actions can be talked about to influence their behavior.

There are also other reasons for the environmental problems, and the first one stems from the economic systems and products. Green growth is a concept that refers to the development of environmentally friendly technology and products (Andres & Mealy, 2021) as well as the promotion of their use in other developing countries (Smulders et al., 2014). According to Andres and Mealy (2021) renewable technologies should be employed to decrease climate change. Technological advancements such as environmental monitoring devices aim to reduce present production's environmental

pollution and contribute to a more sustainable future. Furthermore, industrialized countries improve their environmental performance by exporting ecologically friendly products while also promoting growth in other environmental areas, which friendly countries also support. In this regard, the production of environmentally friendly products should be balanced by providing long-term investments to developing countries (Smulders et al., 2014). As a result, Bowen and Hepburn (2014) emphasize supporting green growth and reducing the environmental impacts of economic actions to achieve global prosperity.

While social and economic development seeks to raise and enhance the welfare of the population, because of its reliance on natural resources, economic growth has a negative impact on the environment (Moon, 1990). Firstly, compost contaminates the air, soil, and water (Chen et al., 2019). Secondly, economic development and fast urbanization go hand in hand (Chatterjee & Chattopadhyay, 2020). Lastly, the economy itself contributes to environmental pollution. Urbanization consequently leads to environmental degradation (Azam & Khan, 2016; Destek & Ozsoy, 2015; Capps et al., 2016; Adams & Klobodu, 2019) and pollution (Liang et al., 2019; Sun et al., 2022). Sun et al. (2022) combined urbanization, environmental pollution, and the health of the residents in their correlational analysis. They discovered that there are advantages and disadvantages to urbanization. Sun et al. (2022) combined urbanization, environmental pollution, and the health of the residents in their correlational analysis. They discovered that there are both advantages and disadvantages to urbanization for human health. Urbanization improves medical services and conditions, but it also has a negative impact on people's health because it reduces green space and pollution in the environment. Furthermore, the health of ecosystems is significantly impacted by urbanization. Similar findings were obtained in a study conducted in Turkey by Ozsoy and Destek (2015), which shows that energy consumption and urbanization have a long-term impact on the pollution of the environment but have no influence in the short term. As a result of this study, economic progress exacerbated pollution, whereas the economic downturn did not lessen it. It was determined that the amount of energy consumed influenced pollution. As a result, the literature has indicated that economic developments promote urbanization and, consequently, produce environmental degradation due to

the rapid use of natural resources in economic development, which has a severe impact on people's health.

As urbanization and economic developments cause air pollution, 99% of people in the world think that the air is dirty and unhealthy living in these places; it is one of the biggest threats to children's health and negatively affects their future (UNICEF). According to UNICEF's data, 20% of newborn children pass away due to air pollution, and it can also cause other complications and damage the brain and lungs. In addition to having lower body defense systems, they also take in more air because they breathe faster and are exposed to more polluted air. To prevent this, UNICEF encourages cycling and reducing public transport to reduce carbon footprint and reduce air pollution. At the same time, children should be made aware of environmentally friendly behavior by families. In addition, local governments should be made aware of the issue of reducing pollution, especially near schools and playgrounds. Therefore, environmental problems and their consequences are related to human behavior, and as we change behaviors starting from the family and turn them into more environmentally friendly behaviors, the probability of these problems arising decreases, but the probability of these problems arising by individuals decreases as it is taken precautions and act with respect for the environment.

2.2. Environmental Education

Environmental education refers to the set of behaviors that individuals adopt to protect the environment. In other words, environmental education helps individuals gain awareness, knowledge, and commitment to learn to access information about environmental problems and carry out plans to solve them (NAAEE, 2010; EPA, 2023). According to the EPA (2023), there are some distinctions between environmental education and information. Environmental information consists of facts and data. Environmental education, on the other hand, encourages citizens to think critically and creatively about environmental issues. It also develops the necessary skills for this process, particularly decision-making, and promotes a worldview about environmental issues (EPA, 2023). Moreover, the EPA (2009) indicated that environmental education extends beyond just raising public awareness.

However, environmental education aims to foster sensitivity, environmental knowledge, understanding, intended attitudes, motivation to take action, problem-solving abilities, and active citizen participation. Accordingly, environmental education requires an individual's supportive social environment and interactions in addition to environmental knowledge (EPA, 2009).

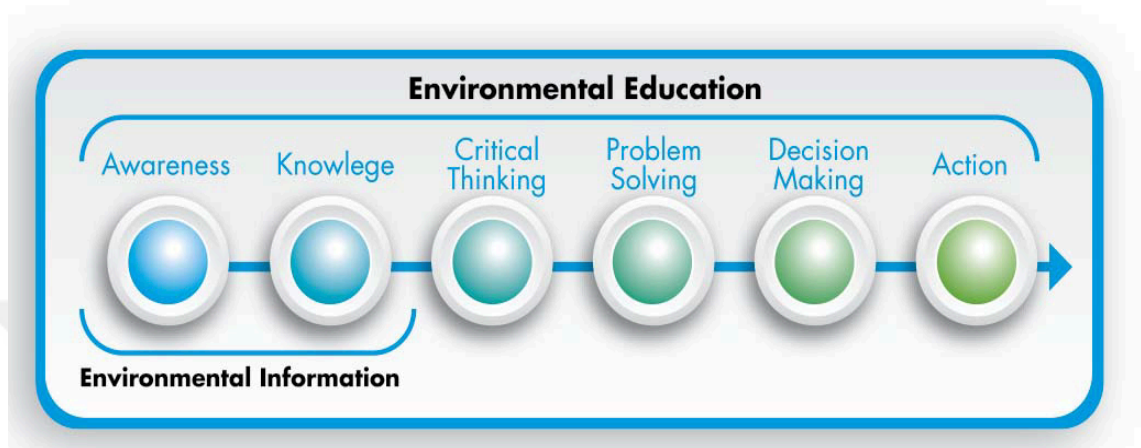


Figure 1. EPA (2009) Environmental Education Highlights (p.2)

This graphic illustrates how social interactions contribute to environmental awareness and how external sources support environmental education accordingly. The report indicates that the goal of environmental education is to enable individuals to become more environmentally sensitive, as they also become aware of environmental issues. In addition to this awareness, individuals are encouraged to engage in critical thinking to develop a deeper understanding and evaluate potential solutions.

Following this process, the individual develops strategies to address the issue and acquire the necessary skills. This is followed by decision-making and taking proactive steps to address the environmental issues. The goal of teaching these procedures is to make children aware of and informed about their environment, enabling them to make decisions and take action. In addition to environmental education, the concept of sustainability was first introduced in the Brundtland Commission Report (1987). This definition emphasizes meeting the daily needs of today's population without reducing the resources and opportunities available for

future generations. It was aimed to establish a balance between humans and nature and emphasized the importance of consuming only necessary resources and avoiding excessive consumption. As a results, this report also emphasized the need for equitable resource distribution for future generations. According to this report, two basic principles were emphasized: meeting today's needs without endangering the needs of future generations and utilizing technology and social institutions to achieve this goal (Brundtland Commission Report, 1987). Thus, education for sustainable development focuses on providing everyone with benefits equally and fairly from education and social development, including environmental education (Pavlova, 2008). Additionally, this report adopts a holistic approach by emphasizing that problems are required to be examined with past and future knowledge rather than being addressed separately. Furthermore, the importance of the family as the basic social agent was emphasized to promote environmentally friendly behaviors, as well as the idea that global problems need to be solved in the closer environments of the individuals.

In 2005, UNESCO published a report that includes strategies for managing greenhouse gas emissions, air pollution, rising sea levels, as well as related marine issues (UN Decade of Education for Sustainable Development, 2005). Furthermore, due to water waste and excessive food consumption, individuals who live in developed countries cause a larger carbon footprint, and they are more likely to contribute to environmental pollution and degradation. Nevertheless, as Wals and Benavot (2017) indicated, improved access to environmental education can help change these attitudes and practices in these countries. Furthermore, the report focuses on inequalities in educational opportunities between men and women. Thus, the aim of the policies aimed at reducing environmental problems and poverty is to empower women, provide a division of labor in work and home environments, pay equal wages, and improve educational opportunities for everyone while they have access to healthy nutrition, which contributes more to the future society (UNESCO, 2012; United Nations, 2015). In addition, the sustainability report includes changing the perceptions of society while at the same time prioritizing the improvement of the quality of life of everyone. Additionally, it was also aimed to be a global movement that includes individual participation. In this way, it is aimed to increase individual

knowledge together with public awareness of collective action that affects societies. In addition, this strategy is more focused on young people, which aims to ensure that future citizens are committed to sustainable development goals by providing practical experiences taught by competent educators in this field. Therefore, this report emphasizes that decreasing the negative impacts of climate change and achieving global peace are the two most basic goals, and to achieve them, providing education at an early age is essential. In addition, it was aimed that there is a need for social transformation and collective information on environmental problems and that children should have access to effective media content and also have knowledgeable people in this field as the most successful approaches.

In 2015, following the ten-year plan, UNESCO released the Global Action Programme (GAP) report, which is designed to promote the accomplishment of sustainable development objectives and increase the accessibility of this environmental education for a larger number of individuals. This program aims to increase youth awareness while offering local knowledge and problem-solving strategies for sustainable and environmental development. To evaluate the efficacy of the previously implemented programs, an online poll with 97 GAP key partners was conducted for this study, with an emphasis on the results of previously implemented projects. According to education results, while the aim was only 3.7 million, almost 37 million people worldwide took part in sustainable and environmental education and activities. As previously intended, this study also found that social solidarity and interpersonal learning improved locally. Additionally, the study discovered that when the local organizations identified and appraised the environmental issues, they could resolve their problems through the environmental interventions to address local issues. Thus, teachers and local leaders played important roles in reaching out to society, promoting local development, and socially transforming knowledge.

After this successful report, as indicated in the UN General Assembly Resolution Report (2017), there are some actions and plans that the citizens and governments follow through the education for a sustainable future. The sustainable development goals are divided into three categories: economic, social, and environmental, including the aspects of lifelong learning and high-quality education (p.1-3).

According to this report, every citizen should be able to access education, pursue lifelong learning, and actively participate in society in order to acquire the knowledge and opportunities needed to carry out sustainable development goals. Different than the UNESCO (2005) report, this resolution, states should financially support educational institutions to provide environmental training, produce policies, follow, and support research to achieve these practices.

After this declaration, it was also published the “Education for Sustainable Goals for 2030 (EDS for 2030) which is aimed to be implemented between 2020 and 2030. The primary objective is to accomplish the following 17 sustainable development goals in the field of education: lowering the rate of poverty, balancing the use of global resources, such as water, reducing famine and the deaths associated with it, ensuring individuals’ mental and physical well-being, providing opportunities for regular education, reducing gender disparities in environmental justice, and promoting peace and inclusion, as the same with the previous reports. However, the differences were the manner of producing energy sources with an environmentally friendly lifestyle, promoting fair behavior and economic development, promoting environmentally friendly technology and industry, cities, production, and consumption, and taking precautions to reduce the effects of climate change through education, conserving water resources, and biodiversity. This report also included social support and participation, as indicated in the previous reports (ESD for 2030, UNESCO,2005). Additionally, this program highlights the value of cognitive learning by helping residents and students understand sustainability and the challenges and requirements associated with it so they may plan their behaviors and look for solutions. The social and emotional learning areas that follow are where students develop empathy and a feeling of accountability through compassion, which inspires them to alter their behaviors. However, this report was criticized and assessed by the International Council for Science (ICSU, 2015). According to ICSU (2015), it is unclear how these stated goals would be met, and certain goals should be reviewed in society to achieve the others. They claimed that some aims are inextricably linked, such as meeting the hunger and malnutrition target in target 2, while also achieving economic development in target 8. Target 2 can only be met if job opportunities are developed for these individuals. Although the goals cannot be

separated from each other, they are intended to be achieved together for a sustainable world.

To sum up, through the reports that were related to sustainability and environmental education, it was emphasized that children should participate equally in environmental education, as well as that their development levels should be supported in terms of cognitive and social aspects, and the importance of states. Additionally, the reports emphasized the importance and role of mothers in environmental actions and affecting future generations. Equality of opportunity was emphasized in all reports, especially in education and the economy, and environmental problems were focused on. While other reports highlighted local development plans for solving environmental problems, the latest published plan mentions methods and techniques for achieving these goals.

2.2.1. Environmental Education in Early Childhood Education: The Starting Point

According to UNICEF's sustainability and climate change action plan report (2023), although children constitute the most at-risk group of environmental problems, the focus of the plan is on children's development to perform pro-environmental behaviors and the least impact from this crisis. In this respect, every child should have hope for the future and believe that they can solve problems. Thus, environmental education in early childhood should focus on environmental protection and provide these skills to children (NAAEE, 2010). The debilitating problems and the tragedies and sorrows environmental problems create should be avoided in children, because this can create sadness, helplessness and fear in children, in this respect, problems should be evaluated positively (NAAEE, 2010). The reason why, children and young people will be the transmitters and representatives of environmental actions in the future, and the necessary skills must be acquired for them (UNICEF, 2023). It was first proposed at the Tbilisi conference (1977) that environmental education be a lifelong practice that begins in preschool. It was also underlined that environmental awareness should be promoted in the early years by assisting the children in making discoveries that will enable them to

recognize and solve environmental problems in the immediate community. At the same time, it was highlighted that critical thinking and problem-solving skills should be cultivated, as well as the creation of appropriate learning settings (Tbilisi conference, 1977). Therefore, it is important to emphasize that environmental education begins in preschool and that children need support from their families and close groups. To support this idea, according to Harvard University's research report (2007), child development research states that education provided from birth to age 5 is necessary for a sustainable and conscious society and attributes this to brain development in early childhood. Experiences gained at an early age form the targeted basis for the future social structure, and the development of neural connections is prominent and serves the future (NAAEE, 2010). For the kids, this report continued the concept of "serve and return," which is defined as the most prominent complement of this process. If children are not surrounded by individuals, family, or others in society who provide reliable answers, the expected development in the brain slows down and is reflected in problems in behavior (Harvard University Report). It also includes the serve and return process, in which the children discover nature by asking the adults around them questions in the form of "serve." It answers those questions with a wealth of information about nature, thereby improving both the children's interest in nature and their brain development through environmental literacy. In this respect, the children's interactions with the environment during brain development are necessary to form brain structures and ensure learning. Moreover, children interact with their environment with a sense of wonder and discover nature enthusiastically (NAAEE, 2010). To support the idea that the early childhood era is the perfect time for teaching environmental knowledge and sustainable education goals, the study was conducted on economic improvements, earnings, criminal activity, and academic attainments and achievements in the 1960s. The high-scope approach was implemented for young kids through the early childhood program. The follow-up studies conveyed when they were 27 and 40 years old showed that early childhood programs provided benefits and better outcomes for these children (Nores et al., 2005). This study demonstrates how early childhood programs may benefit children from low-income families by lowering their likelihood of engaging in criminal activity, increasing their wages, and ensuring that they pay their fair share of taxes and welfare. That is why the environmental education programs aimed at early

childhood years as a starting point (Tbilisi Conference, 1977; NAAEE, 2010; Wilson, 1994, 1996; Merrick & Braus, 2013, MoNE, 2024).

As it has the same goals intended for later life goals as much as older children and adults. These goals firstly aimed the children's development from head to toe, including social and intellectual development through the rich experiences gained in the natural environment (Merrick & Braus, 2013). According to NAAEE's Early Childhood Guidelines for Excellence program (2010), the primary goal of this program is to develop environmentally literate citizens who not only possess fundamental knowledge but also have supportive and caring attitudes toward the environment, which begin to develop during the early years.

According to Benavot and Walts (2017), children may understand environmental concerns through education and be aware of the required behaviors, and individuals' actions can be improved through environmental literacy. According to NAAEE (2010), children who establish an emotional bond with the environment and understand the interaction with nature would become environmentally literate individuals in support of this, the NAAEE (2010) program emphasizes that the good attitude and compassion formed in early childhood are vital towards the environment, even when knowledge about environmental challenges is gained. In addition, this curriculum emphasizes links with nature and hands-on experiences in the development of healthy attitudes and actions. Also, Wilson (1996) agrees with this notion that environmental education should focus on real-life experiences that help to create later positive attitudes and behaviors. Wilson (1996) argued that children can only learn when they interact with the environment. In this respect, in the early years, children should frequently interact with the environment by adults and educators. Vadala et al. (2007) discovered that spending time outdoors and engaging in activities can lead to environmental learning. Outdoor games provide children with experiences such as interacting with animals, exploring, climbing, and increasing their experiences with new difficulties, which encourages them to be more curious about nature (Vadala et al., 2007). As a result, environmental education and achievement should begin in early life, and direct interactions with nature broaden the child's knowledge, awareness, and interests toward it.

Moreover, the updated version of the Turkish MoNE's early childhood education program (2024), included the objective of sustainability education and development in the schools. Under the heading of social and emotional achievement, the goal of gaining the habit of protecting the resources necessary for sustainable living is stated in achievement 16. Its indicators include protecting and respecting living beings. Again, in this report, the role of the family in planning and implementing the child's education was mentioned, and its assistance to schools was emphasized and its role in reinforcing the knowledge taught at school and applying it at home was stated. In addition, in this program, the suitability and necessity of the preschool period for informing about recycling, saving practices and consumption are also emphasized (MoNE, 2024). In addition, in the updated program, physical development was discussed together with health and gaining knowledge about the environment and keeping it, clean and protective behavior were shown among the developmental characteristics of 36-month-old children. In addition, in the 14th achievement in this development area, the objective of making arrangements in the living space was added to the acquisition of using tools for cleaning the environment. It was also mentioned that teachers should be role models in displaying behaviors that will encourage them to change their attitudes towards the environment within science activities. In addition, it is aimed to organize trainings for parents and school staff to raise awareness about the environment and climate change. As a result, sustainability has become one of the objectives to be taught with the new program, and it has been emphasized that families and teachers should be role models in this regard and that they should be given the necessary training in this regard. The acquisition of recycling and reuse behaviors is described in the 17th learning aim, which follows the first and incorporates the concept of sustainability. The goal of this purpose is to teach youngsters how to distinguish recyclable items from others. Furthermore, the distinction between rubbish and waste is examined, with a focus on the "do not throw away - repair" approach. Furthermore, indicators such as obtaining new materials from used materials and building a "recycling center" are advised, as is the preparation of exhibitions and posters to bring this goal to the attention of families. Its goal is to develop children who understand the environment and behave in a way that protects it. Therefore, as part of the recently revised curriculum, young children will learn about sustainable practices, environmental protection, recycling, and

energy conservation. Furthermore, recommendations on teaching these skills to educators and families have been given in this context, highlighting the significance of families for environmental sustainability.

2.3. Theoretical Framework of the Study

This study primarily draws on intergenerational transmission theory and mental models' theory to examine the relationship between children's and their mothers' environmental mental models. In addition, other theoretical frameworks related to socialization processes are also discussed.

2.3.1. Intergenerational Transmission

Intergenerational transmission is defined as the transfer of certain characteristics and conditions that parents have gained and possessed through their own experiences to their children through various transmission channels, and the manifestation of these attitudes and value-based behaviors in the children (Bowers & Yehuda, 2016; Branje et al., 2021; Tosun et al., 2021). Intergenerational transmission involves the interaction of multiple processes such as social learning, biological inheritance, bio-social predispositions, and the transmission of social capital between generations (Besemer et al., 2017). According to this theory, although the genetic structure shared by the child and the mother plays an important role, its influence on this transmission is relatively limited (Bowen, 1978; Branje et al., 2021). In addition, through the conceptualization of multigenerational transmission, Bowen (1978) examined differentiation processes of children and parents and found that some of the children differentiated more, others differentiated less, and the majority remained at a similar level to their parents without showing any differentiation. These similar levels of differentiation within the family system are transmitted across generations and can have an impact on the psychological functioning of individuals and their attitudes towards relationships with others. In addition, when parents are role models for children in the socialization process, children tend to learn similar reactions and roles (Bowers & Yehuda, 2016). Supporting this, Schönpflug (2001) indicated that certain conditions and factors that affect the process of intergenerational transmission

and referred to these as “transmission belts”. Accordingly, some transmission belts can make this transmission easier or more difficult. These transmission belts are the parenting styles applied by mothers and fathers to children, the quality of positive relationships and marriage within the home environment, and the level of education of the parents, birth order, whether there are siblings, and the specific period of adolescence that affect the transmission. Additionally, Schönplflug (2001) found that collectivist values (humanism, security, universalism etc.) were transmitted more than individual values, and the level of education of the fathers affected this transmission in this process.

Among various factors affecting intergenerational transmission, genetic factors have also been considered. Previous studies have emphasized that Holocaust survivors transmitted trauma and stress to their children through gametes, during pregnancy, during the development of the fetus, and may be also related to care given after birth (Bowers & Yehuda, 2016). As a result, factors during pregnancy (prenatal) may contribute to the transmission of stress to the next generations. Building on this, twin studies have been conducted to examine whether genetic or environmental factors are more significant in intergenerational transmission. For example, in a study investigating physical abuse, antisocial behaviors were observed in children who were physically abused. According to the findings, more than half of these antisocial tendencies and abuse were explained by genetic features, whereas 44% were explained by environmental conditions, which included physical abuse (Jaffee, 2004). Thus, the study indicates that the parents’ antisocial behavior can be genetically transmitted to the children, and these parents may be more likely to abuse their children, which may cause the children to exhibit antisocial behaviors in return. As a result, genes also determine the types of environments individuals are exposed to. In this case, there is a passive gene-environment relationship, and children grow up in an environment that the parents have arranged according to their own genetic characteristics (Wilson & Hyun-Rhee, 2022). In the evocative gene-environment relationship, the children receive reactions from their family environment based on genetically inherited traits. For example, an anxious parent may show anxious reactions to the child and reinforce the child’s genetic predisposition to anxiety (passive gene-environment). Also, the same child may receive negative and harsh

reactions from others because of these anxious tendencies and behaviors (evocative gene-environment). Finally, the children may choose environments where people with similar genetic predispositions (selective gene-environment). Through the same example, the children with a genetic tendency to anxiety may feel more comfortable in environments where others also share similar tendencies and may prefer to spend time together in such environments (Wilson & Hyun-Rhee, 2022). However, another twin study on the genetic transmission of anxiety found that anxiety was primarily transmitted through environmental means and argued that genes solely were not sufficient to explain this transmission (Eley et al., 2015). In this context, the children may develop anxiety by observing and modeling the parents' behavior with a passive gene-environment relationship. Moreover, the child may receive controlling and critical reactions from the parent with an evocative gene-environment relationship which trigger the children's anxiety. Furthermore, through a bidirectional interaction the children's anxiety reinforces the parent's anxious behavior. In contrast, Polderman et al. (2015) examined twin studies over 50 years and found the highest genetic transmission in physical conditions such as eye diseases and ear, nose, throat, and skin problems, while the body's cellular characteristics were most affected by environmental characteristics such as cell division and protein synthesis. Furthermore, the lowest genetic influence was observed in socio-cultural characteristics such as social values, environmental attitudes, reproduction, and social values, while the contribution of common environmental factors in these areas was significantly high.

In addition to genetic inheritance, studies have found that epigenetic mechanisms are also effective in intergenerational transmission. Epigenetics refers to the activation or deactivation of genes, and it is affected by life experiences (Howland & Glynn, 2024). Thus, when epigenetics reaches the egg or sperm, it can be transmitted on to other generations (Howland & Glynn, 2024). Consequently, even if the child never experienced trauma personally, exposure to trauma in previous generations may cause them to be biologically sensitive to trauma (Bowers & Yehuda, 2016). For example, a stress-related gene was found to be activated in the children of Holocaust survivors, and stress was transmitted in this way across the generations (Bowers & Yehuda, 2016).

Additionally, neurobiological factors affect how individuals engage in parenting and the occurrence of various pathological traits in future generations (Howland & Glynn, 2024). Bos (2017) examined parenting and caregiving behaviors and various hormones and neuropeptides. According to this review, oxytocin increases the likelihood of secure attachment, and the hormones serotonin (emotional regulation), dopamine (motivation), cortisol (stress), testosterone (aggression), prolactin (maternal behavior), and vasopressin (protection) can influence parenting styles and be transmitted across the generations.

In addition to biological factors, spending time with others in social contexts helps transmit certain values and traits (Jaffee, 2004; Schuengel, 2015; Branje et al., 2020; Tosun et al., 2021). For instance, a study of intergenerational self-control transmission found that children tend to have higher levels of self-control when their mothers' model strong self-regulation skills. However, there was no such relationship observed with fathers. This effect is even greater when both parents exhibited high levels of self-control, and it was emphasized that parenting style and genetic transmission contributed this process (Bolger, Meldrum & Barnes, 2018). Similarly, Mustillo, Wilson, and Lynch (2004) also examined volunteering behaviors with mothers and their daughters, and the education level of the girls and the socioeconomic levels of their families were also examined. In this process, the role modeling of the mother's volunteering behaviors ensured that the children took their mothers as examples, through the observations, they reproduced the roles in this transmission process. Thus, the mother's volunteering supported the children to volunteer at the initial level, but it was not effective in the long term (Mustillo et al., 2004)

In the intergenerational transmission process, parents alone were not effective; the socioeconomic condition of the parents, the welfare level of the country, and the structures of the institutions all had an impact. (Mustillo et al., 2004; Goodman et al., 2011; Warmuth et al., 2021). Building on this, a meta-analysis on attachment styles revealed that secure and disorganized attachment patterns are transmitted across generations. While genetic influences played a minor role in this process, environmental factors had a significantly greater impact. The parents and children

are at-risk groups among the factors influencing this process; for instance, the parents' history of depression, low socioeconomic status, and their early age have negative effects. In addition, the increase in the children's age also had a positive effect because if the interaction history is continuous and stable, this relationship is formed gradually and develops cumulatively (Mustillo et al. 2004).

In addition to socialization processes, parents' social capital, such as the professions of the family, their level of education, cultural and educational opportunities, out-of-school learning environments and extracurricular courses also support intergenerational transmission (Warmuth et al. 2021, Arndt & Jensen, 2021; Strohmeier & Weiss, 2021). In the study conducted by Warmuth et al. (2021) in Austria, parents' work-related attitudes and values were transmitted implicitly; parents did not communicate with children directly through the socialization process but were transmitted to children through observations of daily life.

However, the same study conducted in Germany, children perceived their families as explicit role models through socialization. In addition, parents used their social capital to guide their children toward their professions or toward higher-prestige professions and provided them with the necessary training and opportunities (Warmuth et al., 2021).

Parenting styles have also been effective in this process. In a study conducted in Australia (Warmuth et al., 2021), it was observed that parents with an authoritarian style, authoritarian and tolerant in Denmark (Arndt & Jensen, 2021), authoritarian and supportive in Germany, and permissive in Switzerland (Rapp & Nebel, 2021) actively influenced the intergenerational transmission of work-related attitudes. In addition, the improvements in the country's welfare system, such as access to free education and parental leave, have positively affected this transmission. In addition, policy developments in Denmark regarding women's ability to work while raising children caused increased women's employment rates and helped them contribute to family's SES. In addition, these studies have emphasized that education alone is not sufficient in intergenerational transmission and highlight the importance of families' supportive attitudes, social connections, and the opportunities they provide.

Grusec, Goodnow, and Kuczynski (2000) proposed four key principles regarding the process of parents transmitting values to children. First, they suggested that parents should know and understand their children, and since this relationship is mutual, and shaped by the reactions and comments of the child to the parent, the process should be flexible. Second, there should be warmth, attachment, and mutual harmony in parent-child relationships. Third, it is critical that children integrate and accept their parents' values as part of their socialization goals, and that they can keep these values in the absence of the parent. Finally, there should be diversity in socialization methods, for example, routines that are regularly applied in everyday life support the transmission of values from the parent to the child. In contrast, methods that depend on external motivation, such as rewards generally less effective and have limited long-term impact. As a result, flexible methods that are created according to the child's needs and mutual interaction tend to be more effective in transmitting the desired values, rather than a style with strict rules and unchanging rules that the parent has determined in advance. In conclusion, these four suggestions support the intergenerational transmission theory and emphasize the importance of the family in the transfer of values.

2.3.2. International Intergenerational Transmission Studies

Cicchetti and Rizley (1981) proposed that child maltreatment can be transmitted across generations, presented a developmental and interactional model explaining this process, and provided a theoretical basis for intergenerational transmission studies. In later studies, Assink et al. (2018) examined child maltreatment in a meta-analysis and found that parents who were abused in childhood were more likely to abuse their own children as parents. Similarly, studies on violence found that children who witnessed violence between their parents during childhood had a tendency to engage in violence in their relationships when they were 18-25 years old (Black, Sussman & Unger, 2010). According to the results of the study, instead of generalized modeling, and accepting aggression as a normal behavior and implementing it, they reflected specific types of violence in their own relationships through specific modeling. For example, if they were exposed to physical violence, they tended to reproduce physical violence specifically (Black et al., 2010; Kalmuss, 1984).

Accordingly, the family is considered the primary agent of socialization and has an important role in the transmission of behaviors (Black et al., 2010). In the criminal-behavior transmission, this tendency was also observed in the children of parents who committed crimes, and this tendency was 2.4 times higher than in families where there were no criminal behaviors (Besemer et al., 2017).

According to the results of this meta-analysis, mothers were more influential in the intergenerational transmission of criminal behavior, and they were found to be more likely than fathers to transmit such behaviors to their daughters and then to their sons. This result can be attributed to the role of mothers as the primary caregivers and the absence (imprisonment) of the mother from the child (Besemer et al., 2017). These results suggested that the mother has a more dominant and important role in intergenerational transmission. In addition, studies were conducted with war veterans with post-traumatic stress disorder and its transmission through their children, and the meta-analysis found that distress and family functioning were transmitted intergenerationally, while no difference was found in self-esteem (Dekel & Goldblatt, 2008). In another Holocaust study, Yehuda and Lehrner (2018) investigated the intergenerational transmission of trauma and reported that the trauma experienced by the mother before pregnancy can be biologically and epigenetically transmitted to the child by creating differences in eggs and sperm.

In addition, the experiences that develop with the child's environment after birth and the family experiences can also trigger trauma. On the other hand, these traumas are not permanent but are changed with environmental support (Yehuda & Lehrner, 2018). In addition, the intergenerational transmission of attachment studies showed that attachment styles between parents and children were similar, and that this transmission of attachment differed depending on the psychosocial risk level of the child and the age of the child (Verhage et al., 2016). This transmission is lower in adopted children (Verhage et al., 2016). These findings emphasized that biological foundations as well as the environment influenced intergenerational transmission. Furthermore, some studies have shown that poverty (Bird, 2010) and depression (Gotlib, Goodman and Humphreys, 2020) are transmitted across generations.

Finally, environmental studies have examined the intergenerational transmission of pro-environmental behaviors and knowledge. A study with parents, 78% of whom were mothers, and their children (average age 10) found that both parents' and children's environmental behaviors improved as their own environmental knowledge increased (actor effect). Furthermore, parents' knowledge positively influenced their children's environmental behaviors (partner effect), whereas the children's knowledge did not affect their parents' environmental behaviors (Kong & Jia, 2023). Likewise, Liu and Kaida (2024) examined intergenerational environmental behaviors through environmental attitudes and found support for the actor effect, in which the environmental attitudes of the individual themselves are more influential on their own behavior than those of their parents. However, in this study, a bi-directional relationship between environmental behaviors of both children and parents was found, as well as psychological barriers to environmental behaviors. Previous studies on environmental anxiety supported these results; a relationship was found between children's anxiety and parents' anxiety, while girls were more anxious and tended to be more influenced by their parents (Casaló & Escario, 2016). In conclusion, knowledge and behaviors within the family potentially influence the child's environmental behaviors.

Another study examined intergenerational environmental behavior and family socialization patterns (Katz-Gerro et al., 2020). The study examined the intergenerational transmission of environmental behaviors across three different countries (Israel, South Korea and the United States) and also found a significant relationship between the child's environmental behaviors and those of the parents, while also finding a significant relationship in the forms of socialization. While South Korea exhibited the lowest transmission, group participation and reciprocity socialization styles were found to support environmental behaviors. Thus, the interaction and involvement of the child in joint environmental activities with the family were more effective than socialization techniques such as rewards and punishments or explicit teaching. In addition to parents, the study focused on the previous generation of grandparents (G3), and found significant relationships between parents and children, and between grandparents and parents in the transmission of environmental behaviors, while a weak but significant relationship

was observed between grandparents and grandchildren, which represents an indirect transmission (Marrese et al., 2023). In this respect, environmental behaviors are consistent across generations and family socialization is also influential, as well as individual knowledge acquisition (Marrese et al., 2023). Environmental values and environmental behaviors were also examined in the literature, in addition to environmental knowledge and behaviors. According to Scopelliti, Barni and Rinallo (2022), emotional attachment to the environment and environmental identity are effective in sustainable lifestyle and ecological behaviors, while mothers' environmental values affect children's daily environmental activities (recycling and waste reduction), while fathers' values support behaviors that require more commitment (activism). Accordingly, the values of mothers and fathers positively affect environmental behaviors with their own values. As a result, the intergenerational transmission theory was effectively used in environmental issues and supported the intergenerational transmission of environmental issues (attitudes, concerns, behaviors, etc.).

2.3.3. Intergenerational Transmission Studies in Türkiye

When studies on intergenerational transmission in Turkey are examined, the national studies are generally consistent with the international literature. Several intergenerational transmission studies in Türkiye focused on intergenerational transmission of social traumas (Sevinç-Yalçın & Öztürk, 2018; Kaymak, 2018; Derin, 2018). For example, Derin (2018) collected data from women across three generations and emphasized that parenting style can have an important role in child trauma and attachment levels. Another national study also focused on earthquake trauma (Canel & Balcı, 2018). In this study, parents communicated and conveyed their feelings and concerns to their children, which caused children to have anxiety and negative earthquake feelings even if they did not experience the earthquake. Thus, it was emphasized that trauma can be transmitted through communication and socialization, as well as unconscious transfers and behaviors such as overprotection in daily life (Canel & Balcı, 2018). Similarly, it was found that families who lost their children transferred their grief and trauma to the next children by adding more responsibility on them (Çabuk, 2020).

In addition, three generations were examined on birth perception including grandmothers, mothers, and their children (Reyhan & Dağlı, 2022). It was found that individuals in previous generations (G2-G3) significantly affected children's perceptions, and it was emphasized that these perceptions are transmitted through conversations (Reyhan & Dağlı, 2022). In another intergenerational transmission study, exposure to intimate partner violence was examined with intergenerational transmission through women, and it was emphasized that the participants normalized exposure to this violence and experienced it in their own relationships through methods such as internalization, modeling, and repetition (Özen & Ar, 2024). In addition, another study supports these findings, women provided information about their partners and reported whether their partners' mothers had been exposed to violence. According to results of the study, men who witnessed violence during the childhood increased their tendency to commit violence, but this tendency was found to decrease with increasing educational level. In this transmission process, both modeling and direct exposure can occur (Beşpınar, Beşpınar- Akgüner & Arslan, 2020). Similar to violence, the studies on anxiety were examined, it was emphasized that anxiety was transmitted, and its tendency increased in adolescents and adults in a study conducted over three generations and with family conflict. In the study conducted over these three generations, in addition to genetic factors, social interactions such as positive development experiences until adolescence and aggressive behaviors were considered as mediating variables. (Akat, 2024). In another anxiety study, it was found that anxiety was transmitted between generations through both genetic and environmental factors, but parenting styles also mediated the transmission of anxiety (Tokatlı, 2022). In parallel with the international literature, poverty was associated with intergenerational transmission and individuals who experienced poverty in their childhood were also more likely to experience poverty in adulthood, and it was transmitted and affected by education (Öylü, 2016). There are also studies on child maltreatment and abuse. Kızıltepe (2021) worked with a group of adolescents and their mothers. More than half of the participating children and mothers stated that they were abused, and two-thirds of the abused mothers behaved abusively to their children. In both studies (Öylü, 2016; Kızıltepe, 2021), the factors affecting the process included the mother's level of education,

socio-economic status, and having a stressful life through significant attributions. In the current study, the educational level of the mother is also examined.

In addition, the literature was examined the relationships between grandmothers and grandchildren during early childhood period, it was found that daily life skills were transmitted to children by grandmothers through example, verbal instruction and modeling (Altan & Tarhan, 2018). Moreover, it was also observed that the learning process is not one-way, and children also teach their grandmothers behaviors such as using technology, learning new songs, and showing tolerance. In this respect, the study reveals a bidirectional learning relationship (Altan & Tarhan, 2018). There is a limited number of national studies covering intergenerational transmission related to environmental issues. For instance, mother-daughter dynamics were examined in relation to sustainable consumption behaviors and attitudes, with a particular focus on parent-child communication (Eşsiz, 2020). According to this study, sustainable consumption behaviors and attitudes are transmitted between generations, and communication was important in this transmission, but no significant effect was observed in terms of peer-learning. In a related study, Cengizoğlu (2023) explored the bidirectional relationship of intergenerational learning during the preschool period. The study found that compost was a novel topic for both children and mothers. It was observed that both social agents learned about compost through active experiences, shared conversations, and discussions. Thus, these shared conversations had a positive impact on learning and reinforced new knowledge. However, in contrast, Demirci (2023) examined the environmental consumption, resource conservation, waste management and activist behaviors that mothers and fathers implemented with their children, and the frequency of these behaviors with their children was limited, they used methods such as explanation, modeling and warning, and according to the findings of the study, mothers participated in these behaviors with their children more than fathers. Thus, intergenerational transmission was limited because both mothers and fathers preferred to do environmental behaviors individually (Demirci, 2023). When the studies conducted in the intergenerational transmission area are examined, parents play a significant role in shaping children's behaviors via modelling and active communication, providing

examples with their behaviors and providing explanations and spending time together.

2.3.4. Social Learning Theory

Kelder, Hoelscher, and Shegog (2017) noted that Bandura indicated that reducing behavior acquisition to stimulus-response circulation was unnecessary to explain basic learning systems. Instead, Bandura (1977) suggested that behavior acquisition is related to the cognitive process of thinking after observing social behaviors and models around a person. Bandura (1977) also illustrated that individuals can internalize behaviors to be used later by observing others, provided that the model has a high status and is admired by the observer.

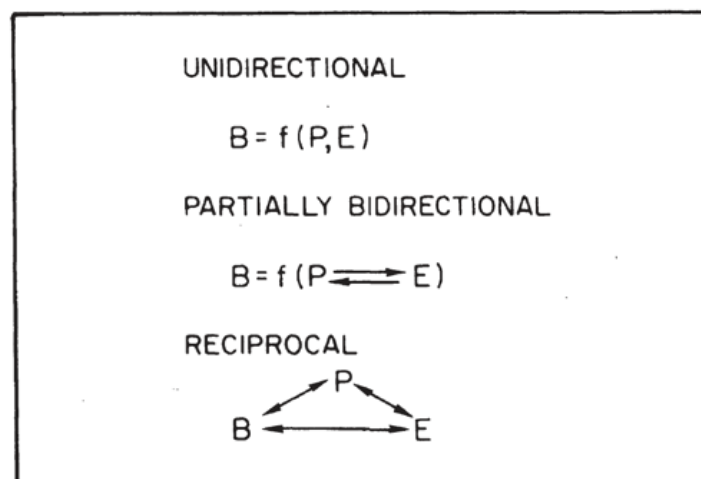


Figure 2. Model of Causality in Social Learning Theory (Bandura, 1985, p.81)

Bandura (1985) indicates that reciprocal determinism affects the individual's behaviors rather than a one-sided determinism. Since personal motivations and desires are influenced by internal and external factors, the bidirectionality of these interactions affects behavior. Currently, research in this field focuses on which type of interaction is more dominant and effective in the decision-making process instead of whether interaction exists (Bandura, 1985).

According to social learning theory, internal processes are not effective alone; they are also influenced by external processes, including observing others and social

contexts. These factors are important for acquiring information and shaping behavior. In a later study, Bandura (1989) divided the individual's actions into three categories: autonomous agency, mechanical agency, and emergent interactive agency. The autonomous agency argues that a person makes decisions independently of external factors and that internal motivations shape them. In contrast, the mechanical agency model posits that individuals only make decisions in response to environmental stimuli. In this model, a person lacks internal motivation and a sense of self. According to this model, behavior is not self-directed, but rather a conditioned response to external cues and the expectations of others.

Based on this concept, Bandura (1986, 1989) developed the emergent interactive agency theory. According to this concept, individuals are not completely independent or dependent on their environment. However, human behaviors are considered in a three-way interaction where individuals are not only influenced by their environment and the other people around them, but also by their motivations and internal processes. This process requires active observation and interaction with others, which is also called as socialization. However, Bandura's social learning theory adopts the triadic reciprocity concept in which behavior, cognitive, personal factors, and the environment are considered together and determine behavior (Scott et al., 2024). The effectiveness of these three factors varies from person to person. For some, a certain path is effective and changes their lives forever, while for others, it can create a new experience. In this respect, various abilities have been classified according to how people use these triadic reciprocity features (Bandura, 1985). For example, in terms of symbolizing capability, a person sees others as guides who provide experience and help with future actions. Also, environmental factors are more effective for the person with this ability. Additionally, individuals turn their experiences into symbols and these symbols represent the experiences they gain from the outside world. Symbols can be words, pictures, or thoughts.

According to Bandura (1985), individuals foresee the results of their behaviors in advance and plan for the future based on the symbolic information they have acquired (Bandura, 1986; 1991). This also means they can motivate themselves to achieve predictable results. Consequently, they make predictions related to personal,

determined goals, as well as self-evaluations (Bandura, 1986, 1989). Forethought capability is also related to self-efficacy. Thus, individuals decide what they can do, think about the possible results, and make goals (Bandura, 1991). As self-efficacy increases with the achievement of these goals, individuals set higher goals for themselves and are more likely to achieve them (Bandura, 1989). Additionally, stability in self-motivating behaviors is exhibited by individuals who do not set goals. Those who set low or challenging goals show greater effort than those who do not set goals (Bandura, 1991). Furthermore, Zimmerman (2002) emphasized that individuals engaged in self-regulated learning progress through three stages. According to Zimmerman (2002), Bandura's forethought capability is the first stage. During this stage, individuals proactively engage in the learning process, producing strategies and performing behaviors that consider their strengths and weaknesses (Zimmerman, 2002). Before learning efforts, a cognitive process takes place, and performance occurs at a subsequent stage. According to Zimmerman (2002), the performance part is divided into two: self-control and self-observation. In the forethought stage, the individual turns thoughts into actions (Alam & Mohanty, 2024), and the strategies and methods used are considered self-control. Self-observation is the personal record of putting these situations into action (Zimmerman, 2002). The final stage is the self-reflection phase, in which the individual evaluates the entire process and forms a reaction to the behaviors. As a result, individuals with strong forethought capabilities foresee the results of their behaviors in advance and decide whether to perform an action accordingly. Considering the environmental models of the children and their mothers in this study, as well as the children's interactions with their mothers, the children and their mothers can predict the possible effects of their behavior on the environment. In this way, they can develop self-control and performance skills for pro-environmental behaviors. A child's environmental behaviors are shaped by social agents, such as their mother. Children observe external factors and make decisions through bidirectional interactions with intrinsic motivations.

2.3.5. Bronfenbrenner's Bio-Ecological System Theory

Bronfenbrenner exemplifies the ecological environment as Russian nesting dolls in the early studies and emphasizes that the development of the individual is affected by

each nested system from the immediate systems to broader contexts (Bronfenbrenner, 1979, p.3-4). Instead of considering the systems in isolation, the theory focuses on interrelation and the integrity of these systems, and the ways in which these ecological systems shape an individual's life circumstances. Also, ecological transitions in the development of the individual are highlighted and they are related to significant life events and experiences such as graduating from school, starting a new job, and having children (Bronfenbrenner, 1979).

According to this theory, there are four systems; the first is the microsystem which refers to immediate environments where individuals engage in directly in their daily lives. These places include daily settings where routine activities are carried out, such as home areas or local park areas (p.22). The microsystem is followed by the mesosystem, and this system includes interactions of two or more microsystems, such as the school environment of children. In this respect, two systems interact between home and school, and the result of these interactions affects the children's academic life.

The mesosystem is followed by the exosystem, unlike previous systems the individual does not affect the systems, but the events and decisions in this system actively affect the individual's life, such as parental relationships in the workplace, working hours, policy decisions made about natural areas and parks. The macrosystem, which is the furthest layer of the ecological systems, includes the subcultures and religious beliefs, ethnic identity, and national ideologies. For example, approaches to natural areas and conservation between the two countries may be different and may affect children's development from different perspectives.

Similarly, Bronfenbrenner (1986) explained in a later study how external systems influence the family through meso-exo and chronosystems and added the chronosystem model to this paradigm. Chronosystem is defined as psychological and developmental changes that affect the individual over time (Bronfenbrenner, 1986). In addition, changes in this system are divided into two categories as normative and non-normative, and normative changes refer to predictable developments that are expected to occur over time and also the age-related changes through the life cycle of

individuals, such as entering puberty. However, non-normative changes include unexpected life events and affect significantly the person's psychology, such as serious illness and parental divorce.

Bronfenbrenner (1986) proposed three research paradigms to examine the role of families in research: the social address model, the process-context model and the person-process-context model. The differences of these three models can be summarized as follows: the social address model examines issues and influences from a broader perspective, such as country, culture, and race. In contrast, the process-context model focuses on how environmental influences affect family processes and functioning, for instance, how socioeconomic status affects parenting. The last model is person-process-context, which includes personal characteristics and differences as the subject of research. For example, in the current study, the effects of gender on mental models are examined through the person-process- context model while educational background and participation in environmental activities are explained through the process-context model.

In later studies, the "time" component is added to this model (Bronfenbrenner & Morris, 2007). Accordingly, microtime means recent interactions, mesotime includes longer-term interactions such as weeks and months, and finally macrotime involves the changes between generations (Bronfenbrenner & Morris, 2007). In addition, continuous activities, which have certain purposes and goals and are meaningful to the person, such as participating in environmental activities, are defined as "molar activities" (Bronfenbrenner, 1979). Furthermore, a relationship is established when the same molar activities are engaged in together. This is referred to as a "joint activity dyad." (p.56). In the current study, environmental activities that children and their mothers conduct together can fall into this classification. Accordingly, when a change or development occurs in one member of the dyad, the other member is also affected by this development. From this perspective, the current study focused on dyadic relationships in terms of shared mental models with an emphasis on whether the environmental development of one party affected the other in terms of their relationship. In addition, findings from twin studies indicated that neither environmental factors nor genetic similarity alone were sufficient, and both were

interconnected at the mesosystem level (Bronfenbrenner, 1986; Bronfenbrenner & Ceci, 1994). Through the genetic impacts, the bio-ecological model was introduced as a new update of earlier ecological theory by focusing on proximal processes, which is close and immediate relationships in the microsystem (Bronfenbrenner & Ceci; Bronfenbrenner & Morris, 2007). Accordingly, there is a relationship between the proximal process and heritability. When the children are exposed to close relationships in their environment, heritability rate may be higher, and the children's developmental outcomes may improve (Bronfenbrenner & Ceci, 1994). As a result, the quality of the close and supportive environment or proximal processes determines whether the genetic potentials are realized, as behaviors, emotional reactions, and processes that require attention are shaped by these proximal processes.

Finally, Bronfenbrenner and Ceci (1994) emphasized that establishing close relationships and the quality of these relationships may have a greater impact on the children's development than external environmental factors such as socio-economic status, education level. Considering the interaction in our study, the focus is on the proximal processes of children and mothers and how these processes are reflected in their mental models from a microsystem perspective generally but also including the other systems.

2.3.6. Systems Approach

Instead of considering a situation or problem as singular and independent parts, addressing it holistically within systems through complex connections and interactions over causalities and probabilities is called a systems approach (Arnold & Wade, 2015; Clayton, Radcliffe, 1996, p.12; Dyball & Newell, 2023, p.12; Wylie et al., 1998). Systems thinking is also mentioned in the NAAEE (2022) program as a necessary underpinning for environmental education and is defined as breaking down more complex issues into smaller parts and examining the relationship and impact of these parts, and arguing that more complex issues in environmental education become better understood with the inclusion of biology (flora, fauna), chemical, physical components as well as familial processes, and that system approach based education should be provided. In more detail, systems are interconnected, and their

outcomes cannot be predicted without considering other components; therefore, to resolve complex relationships, it is necessary to identify these relationships. (Arnold & Wade, 2015).

Additionally, the system approach requires a purpose. However, the system's components are first identified, and then a process is followed to explain possible relationships (Arnold & Wade, 2015). Accordingly, a change in a component affects the other components and causes a change together (Arnold & Wade, 2015). After all, cause-effect chains are formed between the components, and these chains are open to interaction while affecting each other, and each chain can also affect itself, which is called a feedback loop. Through these feedback loops, individuals make sense of situations and problems from different perspectives, they can see the interaction between these differences (Reynolds & Holwell, 2020). Additionally, the system approach provides an understanding of the interrelationships between parts, perception of different perspectives, and a sense of the balance of power in these relationships. (Reynolds & Holwell, 2020). When evaluated in terms of mental models, to understand deeply a subject or question, individuals use the mental models they acquired about that subject previously (Dyball & Newell, 2023, p.37). When these models are inadequate to solve the problems and to understand the problems, the wrong models are formed unintentionally. However, the system approach also provides a holistic solution by making sense of the reasons for the problems by going from the part to the whole by supporting better problem-solving and decision-making skills (Dyball & Newell, 2023). In addition, the system approach allows for the prediction of the results of behaviors by relying on the internal representations that individuals form to understand complex systems, in which models are integral to the system approach process (Dyball & Newell, 2023, p.37). In addition, the system development occurs through feedback loop mechanisms between its components (Arnold & Wade, 2015). When the literature was reviewed, the management of water systems and the socio-economic components were also examined together, including both natural and human-built structures. At the same time, since the water system interact with other fields such as engineering and geography, a management strategy was developed by considering the relationship between each component in a holistic way. In this way, decision-

making processes were strengthened and enabled more sustainable outcomes (Simonovic, 2008). In another study, the subject of urban climate change was addressed using the system approach, and cities were evaluated by dividing their infrastructures (energy systems, schools, transportation, etc.), and holistic solutions were developed. (Da Silva, Kernaghan & Luque, 2012). In addition, the natural environment was also considered as a system, and children initially learn the system approach in order to develop their environmental understanding (Wylie et al., 1998). Therefore, systems thinking progresses in parallel with the children's own cognitive skill development (Wylie et al., 1998). In the previous studies using the DAET-R scale (Moseley et al., 2010, 2020; Desjean-Perrotta, 2013; Liu & Lin 2015), the systems approach was implemented and the environment was evaluated through the interaction of human, living, abiotic, and built components, and it was observed that the vast majority of participants could not adequately reflect the systems approach to the environment. The current study also aimed to evaluate the systems approach through children and their mothers.

2.3.7. Mental Models Theory

The research focused on understanding mental models, and it was indicated that individuals cannot explain something without first understanding it. This understanding may be influenced by obtained belief and knowledge (Johnson-Laird, 1983). For example, if someone understands how a computer works, they have mental representations of it. For example, one person may represent television as just a box that shows simple images, while the technician who repairs it may have a deeper understanding and a more detailed mental model (Johnson-Laird, 1983). Thus, with the help of mental models, individuals make sense of and predict future events and choose appropriate actions accordingly (Dyball & Newell, 2023, p.37). As an example, Holtrop et al. (2021) indicate that patients have mental models of how doctors would treat, question, and examine them. Likewise, a doctor can know the task required, how to use his equipment, and how to receive information from other patients while performing his task, which are considered as mental models (Langan-Fox et al., 2001). Thus, learning occurs when an individual interacts with a system, resulting in the acquisition of knowledge (Cañas et al., 2001). Accordingly,

these expectations, beliefs, and prior experiences shape these mental models, and cultural mechanisms also affected this process (Holtrop et al., 2021). Thus, Langan-Fox et al. (2001) described mental models as categories of knowledge stored in a person's mind for a specific purpose, stating that they are used to predict, explain, and solve problems. While Rapp (2005) defines mental models as internal representations, they are beyond superficial understanding and have a deeper effect on understanding concepts and ideas and solving problems. Accordingly, mental models are formed without awareness and are therefore implicit (Dyball & Newell, 2023, p.37). Also, mental models are related to the terms describing, explaining, and predicting, which means producing explanations based on observations about the system and understanding how it works, as well as making predictions for the future based on these explanations and creating possibilities based on the person's general knowledge. (Rouse & Morris, 1986). Therefore, the features of the model determine its utility, and new information can update it. In this sense, mental models are not stable and can change over time (Jones et al., 2011).

As a result, Johnson-Laird (1983) noted that while most models in people's thoughts are high-level simulations, they are better than simulations but less effective than pictures since they involve subjective judgments (p.3-4). Accordingly, mental models are defined as people's conceptualizations of the activities expected of them and the subjects they must learn (Norman, 1983). People interact with their surroundings, and models can emerge from interactions with other people, technology, and media (Norman, 1983). Similarly, Johnson-Laird (1983) indicates that humans build mental models to help them understand the world; these models are simpler and a representation of reality. Jones et al. (2011) supported this idea and explained that representations are formed as a result of the internalization of external reality. The emphasis is not on what each person perceives in these models, but on the images and cognitive frameworks that are formed based on prior experiences and observations. (Jones et al., 2011). For example, Morrow et al. (1987) presented maps to the participants in their study and described the rooms and objects in the building they were in. With the help of a computer character, this character moved between rooms and told a story, which was interrupted at certain points and asked where the objects shown were. They were not given this information, but they made inferences

using maps they had previously looked at and tried to memorize through the internal representation, moving beyond the surface knowledge to make decisions and comprehension. Thus, this shows that information is encoded and associated with information previously encoded in memory, which is used together and integrated to simulate the new situation.

Moreover, Norman (1983) proposed four different considerations for mental models. First and foremost, the target system is the field in which the individual learns and performs. The mental model also helps describe the system's behavior and allows us to generate explanations and predictions based on these definitions (Jonker et al., 2010). A conceptual model, on the other hand, is defined as a representation of the target system that is intended to be conveyed or taught to the individual, and it is underlined that it is utilized by teachers and scientists (Staggers & Norcio, 1993).

The mental image component is considered as an impression and is not required to be in the created model. Mental models, on the other hand, are considered as images produced by people after interacting with the target system and are considered differently from the conceptual model. Finally, it is about how scientists make sense of these models. (Staggers & Norcio, 1993). In conclusion, Holtrop et al., 2021 state that models provide us with insights into the real world, examine how it works, and provide us with expectations for future events, as well as a person's views and conceptual understanding. Johnson-Laird (1983; 2004) claims that these models are imitations of reality. Mental models are likewise dynamic, evolving gradually over time (Norman, 1983; Johnson Laird, 1983). According to Johnson-Laird (1983), certain mental models can only be learned through cultural education and the environment, and they may be artificial. According to Norman (1988), mental models are conceptual models in people's minds. Each person may have different models about the same thing, and in this respect, it is subjective (Normani, 1988; Jones et al., 2011). Accordingly, a mental model includes the interest of how something works and is an explanation in a simpler form, and these models can be transferred between people (Norman, 1988). Because they contain selective representations, they are schematic and provide flexibility in understanding (Nermessian, 2002). For example, mastering the laws of mathematics is something

that a person cannot do on his own and requires the assistance of others (Johnson-Laird, 1983, p.11).

In other words, people can develop models through target interaction, and these models do not show that they are correct, but they may be functional for the person (Norman, 1983). It was emphasized that propositional reasoning also depends on mental models, and this is implicitly obtained when making decisions and choosing between alternative situations models are used (Johnson-Laird et al., 1992; Jones et al., 2011). In addition, the new information obtained can be modeled and form the basis of the individual's behavior. (Jones et al., 2011).

In addition, these models are also manipulated by individuals (Moray, 1999). As a result of interaction with the system, the individuals can modify these models until he reaches a functional and applicable result for themselves (Norman, 1983; 1988). These modifications are shaped by the person's technical knowledge and previous experiences (Norman, 1983; 1988) and are also effective in shaping their perception and understanding of the world (Jones et al., 2011).

Johnson-Laird (2004) characterized Craik (1943) as the person who laid the groundwork for mental model theory, and it was proposed three major principles of mental models based on Craik (1943)'s ideas. First, when thinking and questioning, people develop a mental model based on their knowledge and experiences. Another point to consider is that, while mental models are symbolic and visual, they nonetheless represent reality. Finally, and most significantly, mental models are regarded by the person as true and represent truth; the person does not believe they are incorrect, and so they are difficult to modify.

Observations that support these ideas were made by Norman (1983), who stated that models are incomplete representations, but also that these models help people manage situations. In addition, models are forgotten when they are not used, in this respect models are dynamic, have no boundaries and can also be mixed (Greca & Moreira, 2000). Models may not be scientific because they are not the same as information and pure facts, and it has been suggested that superstitious thoughts can

still exist. Finally, it was underlined that people prefer to engage in physical activity rather than deal with mental difficulties and forming mental models (Norman 1983).

Jones et al. (2011) described the mental model as a cognitive representation and indicated that people benefit from analogical reasoning while developing cognitive representations. For example, when discussing an event, a person may employ models that he or she has previously used for another event when confronted with a new situation (Jones et al., 2011). In addition to, analogical thinking researchers have debated the topic of memory and mental models. There are two distinct relationships between memory and mental models. While the first theory holds that mental models are produced and kept in working memory, another contends that they are stored in long-term memory (Cañas, et al., 2001). According to Johnson-Laird (1983), schemas are old generic information that is stored in long-term memory, whereas mental models are information that is stored in working memory and used to build new symbolic visualizations (Cañas et al., 2001). According to Cañas et al. (2001), individuals recollect information in long-term memory and combine it with working memory to produce a mental model and representation.

Furthermore, Johnson-Laird (1983, p.104) underlined that using a small number of mental models makes it easier to draw conclusions, and that these models are collected and manipulated in working memory. This means that more activities are loaded into working memory, and as people remember their past experiences, their performance with mental models improves (Johnson-Laird, 1983). Analog thinking and the application of mental cues facilitate persons' productivity (Johnson-Laird 1983, p. 33). Nermessian (2002) contended that mental models can arise as a temporary structure formed in long and working memory to understand a scenario. Long-term memory mental models are made up of reasoning skills and information representation. Furthermore, Nermessian (2002) asserts that the quality, processing, and originality of mental model's people utilize are tied to the person's reasoning skills and previous knowledge, which develop with new learning. Accordingly, mental models can be improved, and more reliable models can be created by editing them with scientific methods (Dyball & Newell, 2023, p.39).

2.3.7.1. Shared Mental Models

As Reinfried (2006) points out, the learning of knowledge is environmentally and individually constructed, and that formal education can raise awareness of the issue and promote constructivism. In literature, the concepts of shared and team mental models are also used interchangeably (Widmann & Mulder, 2020). Shared mental model concept refers to the similar models of individuals in the same team and pursuing the same goal (Langos, 2001). It also refers to the shared knowledge of team members and mental models that are adopted as the most fundamental element of problem solving (Cannon-Bowers & Salas, 1998). Also, according to Bossche et al. (2011), shared team mental models are mental representations that resemble each other and have similar contents. Furthermore, Johnson et al. (2008) emphasized that the students should work interdependently to develop desired knowledge and skills and that this approach can be more effective and related to Bandura's social learning theory. Additionally, individuals who study and learn together tend to develop shared mental models, suggesting that teamwork can enhance collective understanding and performance (Cannon-Bowers & Salas, 1998). In this context, the shared team mental model is the transfer of the experience of the experienced to those who need to learn. Langan-Fox (2000) argues that experts, managers and employees have similar mental models. Additionally, Johnson et al. (2008) mentioned that team dynamics such as knowledge, skills, and attitude should be shared so that they can dialogue more successfully and learn collaboratively.

Vangrieken et al. (2016) and Widdman and Mulder (2019) identified several factors that contribute to the development of shared team mental models. Firstly, knowledge sharing involves individuals exchanging knowledge and experience, as well as expressing belief and trust in each other. Furthermore, individuals are encouraged to offer new ideas and ask questions (Vangrieken et al., 2016). Secondly, team reflexivity refers to potency, meaning that individuals should act together and produce strategies and methods to improve their current situation and vision (Widdman & Mulder, 2019). At last, storage and retrieval can be described as the process of saving information received as a result of exchanging thoughts and using it in other future situations. Furthermore, Widdman and Mulder (2019) conducted a

study of vocational school teachers using an interdisciplinary approach. The researchers assigned tasks to groups of teachers and measured their shared mental models. They found that greater coherence in these models improved the efficiency of the groups of instructors. Their findings demonstrate that colleagues or others work together efficiently to complete tasks when they share information and develop similar mental models.

2.3.7.2. International Mental Model Studies

Taylor et al. (2004) studied children in grades 7 and 8 to teach astronomy using mental models. They used four phases of astronomy education, beginning with children's prior experiences and existing mental models and ending with the creation and reflection of new mental models. When the mental model-building approach was implemented, it was found that the previous knowledge and mental models can be changed, and problems can be solved together through collaborative learning (Taylor et al., 2004). Addressing misconceptions in mental models, Reinfried (2006) conducted a study with undergraduate students aiming to develop mental models of groundwater systems. In the pre-test phase, it was found that 75% of the students had incomplete or unclear knowledge about groundwater, and most of them gained this knowledge from schools and parents. Also, this article used the four phases of mental modeling as Taylor et al. (2004) applied. According to Reinfried (2006), recognizing incorrect information and prejudices is the beginning of constructing teacher-guided mental models. In this respect, learners begin to rebuild their models using a constructivist approach. In addition, one of the important findings of this study was that teachers and students jointly created a common mental model, and as Reinfried (2006) stated, individuals can use the mental models of more knowledgeable others when creating their own models. Thus, scientific understanding can be enhanced by engaging students in model-based instructional interventions. In another study, Adbo and Taber (2009) conducted a longitudinal study on chemistry education given to Swedish students aged 7-15, and the mental models they created were examined. Accordingly, students explained new situations by combining past knowledge and different mental models in accordance with the constructivist approach. For example, when describing the atom, they used the

concept of heating and its effect on substances, which they had learned before. However, on some issues, they had difficulty explaining situations because they could not establish a connection between mental models. In addition, previous misconceptions were also reflected in themselves newly formed models. It was suggested that following the intervention, instructional techniques aimed at correcting these misconceptions and improving conceptual understanding shown to be more effective. Tversky (1991) examined how individuals construct mental models from written texts without any specific training. The study found that mental models are formed spontaneously and meaningfully by using previous knowledge. Similarly, mental models and schemas used by students while solving geometry problems were examined (Chinnappan, 1998). In this study, a relationship was found between mental models and schemas. Schemas are general information stored in long term memory and individuals recall and activate these schemas in the relevant subject (Chinnappan, 1998). However, mental models are dynamic and temporary, they are used to solve problems by using and organizing the information generated from the schema. In this study, it was found that successful students used more schemas, and these schemas were related, and they created more holistic mental models while solving the problem. Unsuccessful students used fewer schemas and created unrelated models.

Similarly, Levy, Lubell, and McRoberts (2018) examined the mental models of agricultural professionals on sustainable agriculture. It was found that experts generally produced simple mental models and observed limited system thinking. In these results, there was a positive relationship between education and mental models. In another expert-based study, perceptions of adaptation to climate change and related mental models were examined (Otto-Banaszak, 2011). According to the results of the study, different types of participants (manager, farmer, researcher, etc.) had different types of mental models, and since there were no shared mental models among the participants, the solution to the problem was not effective, so shared mental models should be developed through education (Otto-Banaszak, 2011). Similarly, mental models on soil use and management were investigated in different groups, and different mental models were found between farmers and researchers, and it was emphasized that these models are transferred through communication.

Panagiotaki et al. (2009) re-examined the mental models used by children to explain the shape of the world by Vosniadou and Brewer (1992). In both studies, when drawings and explanations were used, it was found that children had incomplete and inaccurate mental models. However, Panagiotaki et al., (2009) argued that not every explanation contained a mental model but was fragmented information, and in this respect, the way the questions were asked should be clear and unambiguous.

When mental model studies related to environment were examined, greenhouse effect models of seventh grade students were examined and it was found that mental models were affected by courses and changed over time but were mostly incomplete or partially correct (Shepardson et al., 2011). In another study, Sterman and Sweeney (2007) examined the mental models of MIT students about climate change. Although participants had a sufficient level of knowledge, they struggled to establish connections between different components and factors influencing climate change. Unlike previous climate change studies, Bessette et al. (2017) focused on what individuals actually knew, concerned and valued, rather than solely on what they thought about climate risk management. These values were shaped by the negative impact on the economy, the decrease in environmental welfare, and the possibility of spatial change. According to this study, mental model studies and policies should be rearranged based on people's value priorities, not scientific knowledge, because individuals tend to make decisions based on these mechanisms. Unlike other mental model studies, Judson (2011) added the element of family involvement in mental model development and organized school field trips. It was observed developments in children's mental models with the increase in active experiences in the environment. However, within the participation of environmental activities with their family, they perceived the environment as deserts as ecological systems interconnected with other factors. Thus, in addition to actively experiencing nature, they have been able to broaden their mental models and bring them into a relational dimension by engaging in talks about these experiences. As a result, instead of providing information-based education, mental models are developed by first identifying incomplete conceptions and then having dialogues with their families to improve them, and by sharing information and experiences through socialization. Another significant study in the field was conducted by Moseley et al. (2010), in

which the “Draw an Environment Test Rubric” (DAET-R) was developed. In this study, preschool teacher candidates were asked to draw their responses to the question “What is the environment?” and explain their drawings. These drawings were evaluated through rubrics; according to the results, the elements in the living category were drawn most frequently, but these drawings were object-oriented and not interactive with other factors. In this study, the human figure was drawn limited way, and the percentage of systematic drawings was low throughout the study. Desjean-Perrotta (2013) compared the mental models of 4th-grade students and preservice teachers using the DAET-R scale and found that the results were generally similar, but the frequency of drawing humans was higher in preservice teachers. The study emphasized that it was often difficult to distinguish between the drawings of students and those of preservice teachers, which raised concerns about the development of environmental literacy. As a result, the need for intervention-based studies was highlighted. Moseley et al. (2020) conducted an experience-based intervention study with children in the 10-11 age group using the DAET-R scale, and the children participated in outdoor field trips, which continued for four months. As a result of these experiences, children’s awareness of the living and abiotic sub-dimensions increased and included more elements, while a decrease was observed in the frequency of human and built environment elements. However, these field trips did not contribute to children’s perception of interaction with other factors and the role of humans in ecological balance. This limitation was attributed to several factors, such as insufficient communication, absence of exploratory activities, along structured activities. In this study, the human figure was drawn limited way, and the percentage of systematic drawings was low throughout the study. Desjean-Perrotta (2013) compared the mental models of 4th-grade students and preservice teachers using the DAET-R scale and found that the results were generally similar, but the frequency of drawing humans was higher in preservice teachers. The study emphasized that it was often difficult to distinguish between the drawings of students and those of preservice teachers, which raised concerns about the development of environmental literacy. As a result, the need for intervention-based studies was highlighted. Moseley et al. (2020) conducted an experience-based intervention study with children in the 10-11 age group using the DAET-R scale, and the children participated in outdoor field trips, which continued for four months. As a result of

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Liu and Lin (2015) investigated the relationship between environmental mental models, emotional attachment, and behavioral commitment among university students using the DAET-R scale. The study found that only one in three students included human figures in their drawings, and very few students were able to develop environmental models within the system approach. It was also observed that students who produced more systematic representations tended to show stronger emotional bonds and had stronger environmentally friendly behavior intentions. Similarly, Staples et al. (2019) studied children aged 6–12 through drawings and provided environmental awareness training. An increase was observed in their awareness, while the awareness of girls and low-income children improved more significantly than other groups. In this study, drawings were used as in the current study, and it was emphasized that these drawings minimized age, language, and cultural barriers, making them a more inclusive method, and facilitating access to environmental awareness, emotional attitudes and system thinking capacities (Staples et al., 2019). Similarly, Kalvaitis and Monhardt (2012) studied 6-11 age group on environmental mental models and found that younger children conceptualize nature as a social space and frequently draw themselves playing outdoors. In addition, while drawing family members was more frequent in the younger age group, older children were more likely to picture natural landscapes without humans. The reason for this is that while nature was a socialization area in the younger age group, a more abstract understanding process regarding nature developed in the older age group and was evaluated through individual relationships (Kalvaitis & Monhardt, 2012). Therefore, it is critical to investigate the interactions and cognitive processes that individuals form with their natural environment. There is a similarity between the written data and drawings in this study, but Wuellner, Vincent & Felts, (2017) found that human

figures not included in writing were present in the drawings, which suggests that mental models can be revealed more effectively with drawings. As a result of the environmental education provided, changes were observed in the environmental mental models of some of these students.

2.3.7.3. Mental Model Studies in Türkiye

In Turkey, there are many studies on mental models, including studies on pre-service teachers on mental models of stars (İyibil & Sağlam-Arslan, 2010), STEM education (Çiftçi & Topçu, 2021), science education (Günay & Bakır, 2019), (Nakiboğlu, Karakoç & Benlikaya, 2002), light and sound (Uzun & Karaman, 2016), shadow (Çoban & Şengören, 2009), global warming (Yel & Karakuş, 2019), chemical reactions (Yüce, 2013). Other studies conducted with students addressed similar concepts, such as examining students' mental models of the sun, earth and moon (Kurnaz & Değirmenci, 2012), as well as global warming (Emli & Afacan, 2017), the structure of the atom (Akaygün, 2016; Taylan- Yıldız, 2006), solar and moon eclipse (Harman, 2016), solar system (Baybars & Çil, 2019), earth and space (Aksan & Çelikler, 2019; Çelik & Tekbıyık, 2016), and stars (Ayvacı, et al. , 2023).

On the pre-school level, studies have been conducted on the shape of the world (Saçkes & Korkmaz, 2015) and the concepts of day and night (Özgül, Akman & Saçkes, 2018), the concept of space (Ayvacı et al., 2018; Çetin et al., 2012), the desert (Ahi, 2016) and the environment (Ahi, 2015; Ahi & Kahriman- Pamuk, 2021). Considering all these studies, preschoolers were found to be the least studied. In the study on the mental model of the shape of the world, the children represented the world in shapes such as circles and squares, as in studies abroad, and these models were defined as naive models and these models require to be developed (Saçkes & Korkmaz, 2015). In the following study, Özgül et al. (2018) found that all children had synthetic models (a combination of scientific foundations and observations) of day and night and the shape of the earth. The difference between the two studies was probably due to the multidimensional nature of the measurement tools. Children from preschool to fourth grade were examined for mental models of space, and significant differences between grades were found, which supported the idea that

abstract thinking increased as the children's age increased (Ayvaci et al., 2018). Also, the pre-school children's conceptions of the "desert" concept were examined, and the percentage of the children with scientific models was much higher than in other studies, which indicates that children have an understanding of the concept of desert but are unable to define it within the context of the ecosystem (Ahi, 2016).

When the mental model studies on the environment were examined, Taşkın-Ekici, Ekici & Çokadar (2014) studied pre-service elementary teachers' mental models, and Ahi, Balci & Alisinanoğlu (2017) studied primary and preservice pre-service teachers' mental models. Ahi et al. (2017) found a significant difference between grade differences and DAET-R scores, with more interactive models constructed as the level of grade increased. Both studies found that living and abiotic elements were more frequently depicted, whereas human figures were less frequently represented and were mostly considered non-interactive. In another study, Şaşı and Balcı (2021) investigated the mental models of third and fourth-grade elementary school students using this scale, which showed that children's mental models were also not interactive. In this study, however, it was observed that children in the older age group had more developed mental models and age may be an important factor in the development of these models. Similarly, Cavas (2011) carried out an experience-based environmental education for sixth-grade students and organized visits to a wildlife park. Following this education and visits including active experiences, environmental attitudes of the students improved while relational representations were observed in their mental models. Furthermore, diversity and details were evident in the animal species used in the drawings.

The environmental studies in the pre-school field examined children's environmental perceptions with the draw and tell method and found that over half of the children included the clean environment, while one fourth of the children included the polluted environment, and air pollution was the most frequently addressed issue (Günindi, 2012). Although plant and animal figures were frequently included in the drawings, they were limited in variety and educational programs were emphasized to be implemented accordingly. According to research investigating the concept of environment, socio-economic background affects environmental perceptions, and the

fact that children frequently drew artificial elements showed that this perception may be limited to the places where they live (Halmatov, Sariçam & Halmatov, 2012; Taşkın & Şahin, 2008). Moreover, it was stated that preschool children can only perceive the environment as “place”. Halmatov et al. (2012) studied preschool children’s perception of the concept of environment in three different cities (Istanbul, Ağrı and Kilis) and reported urban differences. Accordingly, children living in Istanbul drew more built environments (parks, houses), whereas children in Kilis and Ağrı included mountains, sea, fields and swings, even if there was no sea.

Moreover, pre-school children’s mental models of environmental pollution were examined, and the most frequently drawn pictures of individuals who pollute the environment and were generally referred to land pollution, which supported the idea of drawing the areas they could observe. In other mental model studies, the human figure was limited, however, in this study, human figures were frequently drawn as polluters (Bay et al., 2020). Regarding the studies using the DAET-R scale in the preschool field, Ahi (2015) and Sak (2023) conducted thesis studies. Both thesis studies developed an education program for the development of mental models. The results of both studies showed that the interactivity in children’s mental models was improved, while the study of Sak (2023) found that children’s explanations showed causality. Furthermore, Ahi & Kahriman- Pamuk (2021) studied the children’s mental models of the environment in forest schools where the children spent more time in the environment, so their drawings frequently depicted living and abiotic elements, while built and human elements were almost not present in their drawings.

CHAPTER 3

METHODOLOGY

The data collection and analysis methods employed in the study were presented in this chapter. The chapter began with the design of the study, which was followed by detailed information about the study population and sample. In addition, the measurement tools used for the data collection process were introduced, and an explanation of the data collection procedures and stages was provided. Finally, the data analysis procedures were explained in detail, which also included the statistical techniques conducted to examine the research questions and the validity and reliability of the findings.

3.1. The Design of the Study

The mixed method approach is utilized in this study to reach both preschool children's and their mothers' depth of understanding of the mental methods related to the environment. According to Creswell (2012), using both quantitative and qualitative research methods together provides a better understanding of the research than data obtained from a single type. It enables the strengths of both types to be utilized and the weaknesses to be eliminated. While quantitative data obtained through ratings and numbers provide frequency and statistical explanations, qualitative data obtained from open-ended questions offer different perspectives and explanations (Creswell, 2012). By using these two methods together, an improved and in-depth understanding of the study and the question can be achieved for multiple purposes (Johnson et al., 2007; Morse & Niehaus, 2009; Creswell & Clark, 2011). Mixed-methods research includes triangulation, which is the use of at least two different approaches to investigate a topic or issue in order to create consistent and trustworthy results (Creswell & Clark, 2011) In the current study, both

quantitative DAET-R scale and the qualitative analysis of the participant's drawings were used as two ways to collect data for the research questions. This is because relying solely on one approach can lead researchers to reach limited and biased conclusions (Greene et al., 1989).

In addition, some researchers consider the mixed method as two independent completed studies, like two different studies related to the same study, and others consider it as multiple studies (Morse, 2010). An embedded correlational design model is employed in this study to gather qualitative and quantitative data, strengthening the research's quantitative weakness and providing comprehensive details on the variables that are measured (Palinkas et al., 2011; Creswell, 2012; Fetters et al., 2013). The quantitative approach in this study is enriched with qualitative data. The qualitative component provides more information and context for the research questions. By combining these methods, the study intends to examine the two types of data (qualitative and quantitative) in order to assess their consistency and to mutually support the interpretation of quantitative findings in answering research questions.

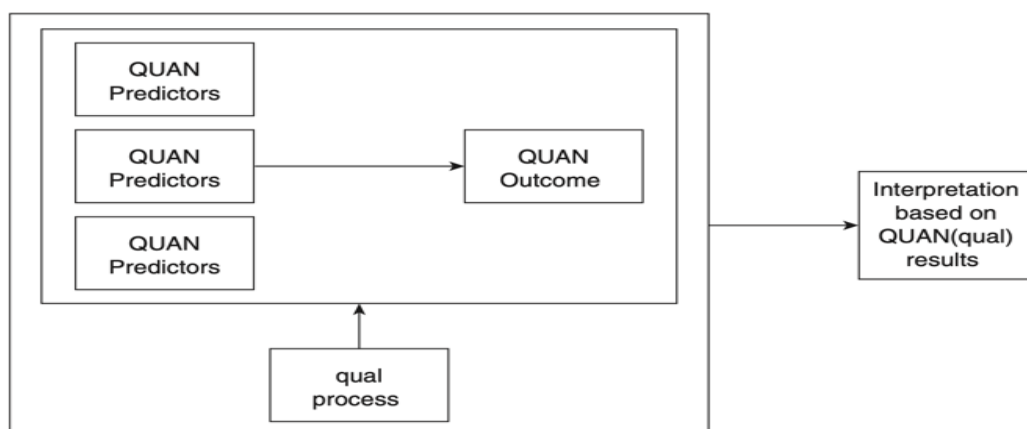


Figure 3. The Embedded Parallel Design (Creswell, 2012)

The most advantageous elements of both methods may be used to collect data for this study quantitative data permits generalizations, while qualitative data provides in-depth content information (Fetters et al., 2013). According to Creswell (2012), in mixed-method research, the researcher gives more importance to one type of data

than the others due to personal experiences, the expectations of the readers, or the research problem. In the current study, regarding embedded design, the children's and the mother's explanations for their drawings and visual codes are supplementary and explanatory sources for the main quantitative results. Furthermore, the sequence of the study is concurrent, and both qualitative and quantitative data are collected at the same time. First, the children were asked to draw their mental models of the environment and were then asked to explain their drawings. Similarly, mothers were provided with the necessary forms and asked to complete the same procedures, drawing their mental models of the environment and providing written explanations for their drawings.

In this study, a correlational research design was used to determine the relationship between two or more variables and to find out how they change together (Creswell, 2012). Thus, the variables were not manipulated but only the presence, direction, and strength of the relationship were tested (Creswell, 2012). Accordingly, this design was used to evaluate the relationship between children's and their mothers' environmental mental models.

3.2. Population and Sample

In the current study, the target population consisted of children aged 48 to 66 months and their mothers. The accessible population was defined as those individuals from the target population who could be reached within the scope of the study due to logistical and time constraints (Porter, 1999). From this accessible population, participants were selected using purposive sampling based on predetermined criteria relevant to the research objectives. In this study, a city in the Southeastern Anatolia Region was selected considering the logistic and time limitations. Three independent public preschool institutions located in the same neighborhood were included in the scope of the research.

Purposive sampling (Patton, 2002), which is popular in social sciences, focuses on the researcher's beliefs and experiences and provides the researcher with a subjective framework (Guarte & Barrios, 2006). In research, purposive sampling allows

researchers to effectively identify and use sources in the environment and select information-rich participants from specified criteria (Patton, 2002). Purposive sampling ensures that the participants are chosen for the study's goals and objectives rather than using a random selection technique (Campbell et al., 2020). Participants who can provide detailed information for the study's specified criteria (purpose, question, and data) are referred to as information-rich cases (Patton, 2014). Additionally, non-probability sampling is referred to as purposeful sampling in quantitative research (Patton, 2014).

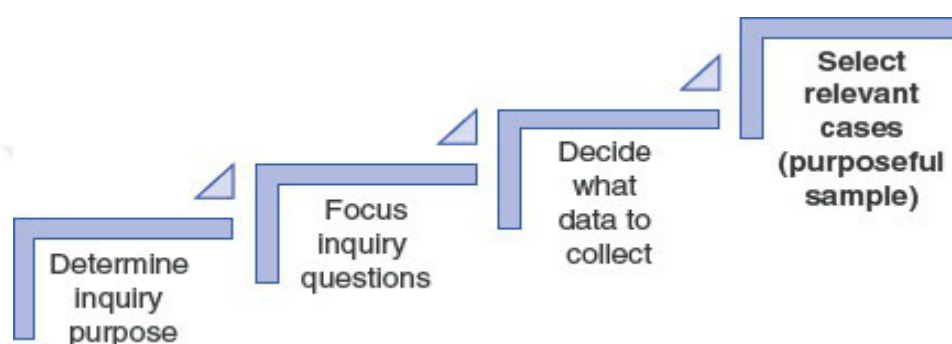


Figure 4. The Process of Purposeful Sampling Design (Patton, 2014, p.404)

In the current study, the criterion-i purposeful sampling method is used. Criterion-i sampling has purposeful sampling features, but it also consists of random sampling features such as selecting the participants from the predetermined schools (Palinkas et al., 2015). Participants selected according to the criteria can also have detailed information about the selected phenomenon and enrich the study (Palinkas et al., 2015). The criterion-i purposeful sampling applied to the schools was defined as follows: (1) schools with principals and teachers who are willing to conduct research; (2) Schools with similar socio-economic levels. Additionally, certain standards were applied for the selection of mothers and children; (1) Voluntarily participate in the quantitative and qualitative parts of the study to draw a picture of the questions posed and be willing to answer the qualitative ones; 2) Living in the selected city; (3) Must have a child aged 48-66 months attending the chosen schools; (4) Must allow her child to participate in the study.

In this study, mixed-method study was conducted with 322 children and their mothers to provide an in-depth understanding of the participants' environmental

mental models. Repetition of similar themes over the course of the data collection process led to data saturation. This improves the study's dependability and supports the validity of its conclusions. Data saturation is defined by Glaser and Strauss (1999) as the absence of additional data to be developed by the researcher and indicates that similar data are repeated (p. 61). In studies using content analysis, the researcher conducts interviews until data saturation is reached in qualitative studies (Francis et al., 2010).

3.2.1. Demographic Information of the Children

In the current study, 322 children joined the study overall, and the children were divided into two groups according to their ages: 48-60 months and 61-66 months. 19.9% of the total participants were between 48 and 60 months (64 children), and the majority (80.1%) were between 61 and 66 months (258 children). The children lived in the same neighborhood and attended three different independent public preschools. According to the data, there were 160 girls (49.7%) and 162 boys (50.3%), and their school attendance duration varied from 0–11 months to 19 months and over. Table 1 provides detailed explanations of the demographic information.

Table 1. Demographic Information of the Children

Variables	Groups	Frequency (f)	Percentage (%)
Gender	Girl	160	49.7
	Boy	162	50.3
Children's Age	48-60 months-old	64	19.9
	61-66 months-old	258	80.1
Duration in Early Childhood Institutions	0-11 months	47	14.6
	12-18 months	158	49.1
	19 months and over	117	36.3
Place Child Lived Longest	Village/Town	8	2.5
	City center	314	97.5
Type of Residence	A house with garden	6	1.9
	Apartment	316	98.1
Child-Mother Participation in Environmental Activities	Never	123	38.2
	At Least Once	199	61.8

According to the obtained demographic information, 14.6% ($n = 47$) of children attended early childhood institutions for 0–11 months, 49.1% ($n = 158$) for 12–18 months, and 36.3% ($n = 117$) for over 19 months. According to this information, half of the children only attended for two semesters. When examining where the children lived the longest, almost all of them, 97.5% ($n = 314$), lived in the city center, while only 2.5% ($n = 8$) lived in a village or town. Additionally, almost all of the children, 98.1% ($n = 316$), lived in apartments, while only 1.9% ($n = 6$) lived in houses with gardens. Regarding participation in environmental activities with their mothers, it was found that 38.2% ($n = 123$) of children and their mothers never participated, it was reported that more than half of them 61.8% ($n = 199$) participated at least once.

3.2.2. Demographic Information of the Mothers

A total of 322 mothers participated in the current study, and their children were between 48 and 66 months old and attended independent public preschools. When the demographic information obtained from the mothers was examined, the first step was to look at the distribution of the mothers' ages. Among them, 21.7% ($n = 70$) were 30 years old or younger, 36.6% ($n = 118$) were between 31 and 35 years old, and 41.6% ($n = 134$) were 36 years old or over. Thus, it can be concluded that most of the mothers were 31 years old or older. Additionally, the majority of the mothers ($n = 202$) had an associate's degree or below, while a smaller proportion ($n = 120$) had an undergraduate degree or above. A large proportion of the mothers (85.1%, $n = 274$) lived in households with five or fewer people, while 14.9% ($n = 48$) lived in households with six or more people. The number of children the mothers had was also examined. It was found that the majority of them (66.1%, $n = 213$) had two or fewer children, while 33.9% ($n = 109$) had three or more. In the demographic information form, it was also asked where the mothers had lived longest during their childhood. A low percentage of the mothers (10.9%, $n = 35$) reported living in rural areas or towns, while 89.1%, ($n = 287$) reported living in urban or city centers. The mothers' place of residence during childhood was also examined. It was determined that 32.6% ($n = 105$) lived in houses with gardens, and the majority (67.4%, $n = 217$) lived in apartments. In addition, it was asked on the demographic information form whether they were members of non-governmental organizations, and it was

concluded that only 5.3% ($n=17$) of the mothers were members of these organizations, while almost all of them (94.7%), ($n=305$) were not members. Finally, the participation of the mothers in environmental activities individually was examined and it was determined that 38.2% ($n=123$) did not participate at all and 61.8% ($n=199$) participated in environmental activities at least once (**Table 2**)

Table 2. Demographic Information of the Mothers

Variables	Groups	Frequency (<i>f</i>)	Percentage (%)
Mother's Age	30 years and below	70	21.7
	31-35 years	118	36.6
	36 years and above	134	41.6
Education Level	Associate degree and below	202	61.7
	Undergraduate degree and above	120	37.3
Number of People Living in the Household	Five or less	274	85.1
	Six or more	48	14.9
Number of Children	Two or less	213	66.1
	Three or more	109	33.9
Place Mother Lived Longest During Childhood	Rural/Town	35	10.9
	Urban/City center	287	89.1
Type of Residence During Mother's Childhood	House with garden	105	32.6
	Apartment house	217	67.4
Membership Nongovernmental Organizations (NGO)	Yes	17	5.3
	No	305	94.7
Mother's Participation in Environmental Activities	Never	123	38.2
	At Least Once	199	61.8

3.3. Data Collection Tools

In the quantitative phase of the study, two instruments were employed. First, the Demographic Information Form was used, followed by the Draw an Environment Test Rubric (DAET-R). Moreover, in the qualitative phase, a content analysis protocol was utilized. Detailed information was provided in this section.

3.3.1. Demographic Information Form for Mothers and Their Children

A demographic form was created to collect socio-demographic data on the children and their mothers. The form includes questions about the mother's age, education

level, the place she lived the longest as a child (e.g., rural or urban), the type of residence she lived in the longest (e.g., apartment, house with garden), her membership in environmental civil organizations, and her participation in environmental activities on her own and with children. Similar questions were included for the children, such as the duration of preschool attendance, the number of people in the household, the number of children in the family, the place where the child lived the longest, and the type of residence where the child lived the longest.

3.3.2. The Draw-An-Environment Test Rubric (DAET-R)

Moseley, Perrota, and Utley (2010) studied the pre-service early childhood teachers' mental models of the environment, and the study improved and developed another scale that shows similarity with the four levels of mental models (Shepardson et al., 2007). In Moseley et al.'s (2010) study, the central hypothesis is to reach environmental knowledge and literacy to comprehend environmental concepts. To achieve environmental understanding and prior knowledge, it is important to identify previous experiences and beliefs about the environment through mental models. In this context, drawings serve as the primary method for representing these models. Thus, it was aimed to reach ideas and beliefs that affect individuals' behaviors about the environment. In the explanation part, the participants were asked to write "my drawing of the environment". In the DAET-R scale, there are four sub-dimensions: human, living, abiotic, and built, including a total score derived from these sub-dimensions. Each sub-dimension is scored on a scale ranging from 0 to 3 points. In the Human sub-dimension, figures such as mother, father, friends, relatives, or sellers may be included in the drawings to represent human presence. In the Living sub-dimension, both flora and fauna are expected to be depicted. For example, trees, flowers, grass, cats, squirrels, and other animals or plants. The Abiotic sub-dimension involves the representation of non-living factors, such as water, the sun, mountains, and soil. In the Built Environment sub-dimension, factors that are human made are expected to be drawn, such as bridges, cars, houses, and factories.

If a specific factor is not illustrated in the drawing such as the complete absence of any figures, the participant receives 0 points for that category. Simply indicating the

presence of a factor through written or verbal expression does not result in the earning of any points. In addition, no assumptions should be made based on symbols or indirect clues. For example, drawing a house without explicitly including a human figure does not justify awarding points for the human category; such cases must still receive a score of 0. A score of 1 is received when the factor is present without interacting with any other factors. A score of 2 is received when the factor interacts with another factor, but the ecological or environmental impact of this interaction is not emphasized. The maximum score of 3 is received when the factors clearly cause an effect on each other, indicating their environmental consequences.

Furthermore, the creators of the scale provide specific examples that clarify the scoring. In the human category, a drawing that includes only a human figure without any interaction (e.g., a person standing alone) earns 1 point. If the human is shown engaging in an action, such as cutting down a tree or fishing, it is scored as 2 points. To receive 3 points, the drawing must depict not only the action (e.g., cutting trees) but also its environmental consequences, such as deforestation, loss of biodiversity, or global warming. In addition, the total scores on the DAET-R scale range from 0 to 12 and are grouped into three levels. Scores between 0 and 4 fall into the “factor present” category, meaning that factors (such as a flower, house, or cloud) are drawn, but there is no interaction between them. Scores between 5 and 8 indicate that one or more factors interact with others. For example, drawings may show smoke coming from a chimney or children picking flowers. Scores between 9 and 12 represent the highest level, showing a systems-based understanding where two or more factors clearly interact and affect the environment such as drawings about water pollution or air pollution.

Content validity and intercoder reliability were evaluated. In Moseley et al., (2010) study, three independent raters scored 118 drawings separately, and the percentage of agreement between raters was between 81.4% and 93.2%. The agreement rate among the raters was between 75% and 83%. Additionally, Pearson product-moment correlation coefficients ranged from .68 to .93 for the subdimensions and from .86 to .92 for the total score. These results suggest that the DAET-R scale is a consistent and reliable tool

The current study used Ahi's (2015) translation of the DAET-R scale. Ahi's study was designed as an intervention study, applying pre- and post-tests to 52 children aged 48–66 months. In the study, each child was asked to draw an environment before undergoing training. Then, the children were asked to explain their drawings in a semi-structured interview. Following this, training was administered, and the scores and answers from the semi-structured interview were compared. No changes were made to the scoring or sub-dimensions of the scale to remain consistent with the original. This translation and adaptation study has four subdimensions: human, living, abiotic, and built. The scoring system ranges from 0 to 3 for the subdimensions, and total scores range from 0 to 4, 5 to 8, and 9 to 12. The categorization of the scores is the same as in the original scale. In Ahi's study, the reliability study for the Turkish version of the DAET-R found the Pearson correlation coefficient to be .87 and the intercoder reliability coefficient to be .91.

3.4. Pilot Study

Since this study was applied to both young children and mothers, a pilot study was conducted to test the applicability of the DAET-R scale and the understandability and reliability of the instructions by both groups. First, the study examined the practicality of giving mothers written forms to fill out and send back. It was evaluated whether the mothers could clearly understand and respond to the questions and whether their answers provided meaningful understandings of their environmental mental models. Then, a pilot study was carried out before the main study with 15 children (F=8, M=7), ages 48–66 months, and their mothers who were enrolled in independent public preschools in a city in the Southeastern Anatolia Region. To choose participants who were approachable and readily available, convenience sampling was employed. The purpose of the pilot study was to assess the practicality and clarity of the prompts utilized in the children's drawing activity as well as the directions given to mothers and children. Before the pilot study was conducted, the forms were sent to the mothers, and first, the mothers were expected to return their forms. Afterwards, the children of the mothers who returned the forms were taken to an empty classroom in the school, and each child was asked to close their eyes and "What comes to mind when you think of the environment?", and the

children were given pastel crayons and colored pencils to draw their environmental drawings. It was ensured that the children did not see each other's drawings, and then the children were asked to explain their pictures. The descriptions of the pictures were written by the researcher, and the visual codes in the picture were noted with arrows by the researcher on the picture. It was also investigated whether the children's drawings accurately represented the mental models of the environment. Based on these findings, it was found that the questions and the prompts are understandable and applicable to both groups.

3.5. Data Collection Procedure

Before the main data collection, official permissions were obtained. Ethical approval for the study was granted by the Middle East Technical University Applied Ethics Research Center under Protocol No 005-ODTÜAEK-2024 in the spring semester of the 2023–2024 academic year. Then, permission was obtained from the Turkish Ministry of National Education to collect data from children and their mothers in independent public preschool education institutions. In addition, the schools and participants were selected using the purposive sampling method. Accordingly, three independent preschool education institutions located in a district with similar socioeconomic characteristics were selected. After obtaining the necessary permissions from the schools, the researcher visited the schools and introduced herself. Additionally, the researcher explained the purpose and procedure of the study and met with the teachers to obtain permission to conduct the study. Before the data collection, the researcher visited the schools regularly to get to know the children and meet the participating children.

For the mother participants of the study, information about the study was shared with the mothers through forms distributed by the preschool teachers. These forms included a consent section for both children and their mothers. The mothers filled out demographic information forms for themselves and their children. They also drew a picture of the environment on the blank page provided and included a description of the drawing. About a week later, the researcher visited to schools to collect the

forms. Before conducting the study with the children, the researcher introduced herself again and explained clearly the details about the study.

The children were taken to an empty classroom at the school and given crayons and colored pencils to draw their representative model of the environment. Also, they were asked to close their eyes and think about the environment via the question of “What comes to mind when you think of the environment?”. They were also informed that they could withdraw from the study at any time. Verbal consent was obtained from each child. The instructions were repeated until the children fully understood the drawing subject. However, there was no time limitation for the drawings, but most of the children completed their drawings in roughly 15-20 minutes. After the drawings, the children were asked to explain their drawings. The researcher took notes on the drawings, marked each factor with arrows, and wrote the children’s descriptions. Each interview took about five to ten minutes. The data collection process was completed in about a month.

3.6. Data Analysis

This study employed an embedded mixed-methods design, in which quantitative data were prioritized, and qualitative data were used to provide support. Since qualitative content analysis is an open-ended data collection method, it is frequently used in educational research and enables textual data to be obtained (Mayring, 2021). Content analysis was applied to the environmental drawings of children and mothers in order to reveal the visual codes they include, and these visual codes grouped according to predetermined environmental categories (human, living, abiotic, and built). Each figure in the drawings was coded according to these categories and frequency tables were created by systematically counting the number of times they were depicted. This analysis process allowed the determination of the environmental components that the participants used most and least in their drawings. However, for the quantitative part of the study, SPSS 28.00 software was used to code and analyze data from children and mothers’ drawings. Statistical tests were conducted to examine whether DAET-R scores differed according to demographic factors. Independent sample t-tests were performed to compare DAET-R scores with categorical variables such as children’s gender and frequency of participation in

environmental activities with their children. In addition to children's scores, mothers' DAET-R scores were analyzed for differences using independent sample t-tests with categorical variables such as education level and frequency of participation in environmental activities independently. Moreover, Pearson correlation coefficients were then used to determine the strength and direction of the relationships between continuous variables related to both mother and child and their DAET-R score. The assumption of normal distribution was checked and applied to ensure that it was met before using the Pearson correlation.

The correlational design of the study was conducted according to Creswell's (2012) effective data analysis guidelines. In this respect, the primary aim of the correlational study is to explain the strength, direction, and significance of the relationship between two continuous variables. In this respect, this study examined the strength, direction, and statistical significance of the relationships between environmental mental models in children and mothers. This design determines possible relationships by analyzing the relationships between two continuous variables. Pearson correlation coefficient was used to measure the relationship between pairs of variables because of interval or ratio scale data (Chong, 2005) through an appropriate variable coding process (Chen & Anderson, 2023; Hahs-Vaughn, 2023) and normal distribution assumption. The scores were obtained from the "DAET-R" scale and were examined as interval scale variables. Moreover, the assumptions of normality were met for all measurement tools, allowing for the use of both the independent samples t-test and the Pearson correlation coefficient.

3.7. Validity

In terms of content-related evidence, validity is defined as the adequacy and appropriateness of the instructions used in the research and whether it confirms the format and the content consistency to answer the research questions (Fraenkel et al., 2012). The study includes the drawings of children aged between 48 and 66 months, making the instrument appropriate for younger children as they can indicate their mental models. Children's descriptions of their drawings were written for each one in order to ensure validity. This allowed the children to explain their models and

understand the parts from the drawings. The instrument's format was created with age-appropriate language and instructions that supported the developmental understanding of young children.

Criterion-related validity assesses a measurement tool's effectiveness and quantifies how well test results align with independent criteria (Cronbach & Meehl, 1955; Fraenkel et al., 2012). In this study, qualitative data descriptions of their drawings were used to support and analyze the quantitative scores obtained from the DAET-R scale. The qualitative responses provided additional context and depth to the drawing scores, facilitating a more comprehensive interpretation of the findings. This method improved the overall analysis by allowing children's mental models of their environment to be understood not only through their drawings but also through their verbal expressions.

According to Fraenkel et al. (2012), to achieve construct-related evidence of the validity, the measured variable should be clearly explained and, the instrument should be able to distinguish people who have higher levels of specific characteristics from those who do not have to perform the intended features (Fink & Hendricks, 2011). In this study, construct-related validity of the variable was used to describe the relationship between children's and their mothers' mental models. Also, these models include previous experiences, ideas, beliefs, behaviors, and environmental knowledge so the hypothesis was that people who scored higher on the scale had a developed understanding of environment as demonstrated by their drawings. Individuals with lower scores (e.g., 0–4 points) provided a less detailed or unrelated understanding of mental models. These hypotheses were evaluated using a scale scoring system, with the descriptions of the drawings used to support the scores' validity by providing additional contextual information.

3.7.1. Threats to Internal Validity

If the relationship between two or more variables is due to another variable, the study has a problem of internal validity (Fraenkel et al., 2012). However, if different threats affect the results of these two variables, the relationship or causality between these

two or more variables cannot be investigated, and correct inferences cannot be reached (Creswell, 2012). As a result, differences in the dependent variable should only be related to the independent variable and should not be affected by different factors (Fraenkel et al., 2012). There are some internal validity issues listed.

Selection threat of the internal validity: All the participants come from similar socio-cultural backgrounds, which is why the same neighborhood was chosen for this study. Thus, the selected neighborhood represents a socio-culturally homogeneous population with similar access to education, income levels, and living environments, and it was ensured that external socio-economic factors do not influence the study results.

Interactions with selections: Since preschool children are in the study group, they may be uncomfortable when a picture is asked to be drawn by them by someone they do not know. In such cases, the researcher obtained help from the classroom teacher. Also, to prevent this situation and strengthen the interaction with the child, the researcher spent two to three weeks with the children, which allowed them to get used to her.

3.7.2. Threats to External Validity

It was emphasized that it is not likely to make generalizations without considering external factors; the data should be generalizable to make correct inferences according to participants, environments, and the education applied (Creswell, 2012). There are some threats to be considered in the study.

3.7.2.1. Interaction of the setting and Treatment

Since the study was applied to 48-66-month-old children and their mothers in independent public preschools, it may not include generalizations to children educated in private schools or with environmental curriculum and experience. Due to differences in educational methods, available resources, and exposure to

environmental issues, these populations might have different levels of environmental literacy or attitudes.

3.7.2.2. Interaction of History and Treatment

The study's findings may have been influenced by semester factors because the data was collected in the spring. Children's levels of environmental awareness and behavior differ based on the semester and the season, weather, the availability of outdoor activities, and environmental education themes. The results may differ if the study was conducted during a different semester, such as summer or winter.

3.8. Reliability

Reliability is generally related to the data measured and collected with a specific instrument at a certain time and obtaining similar scores using the same instrument at later times (Revelle & Condon, 2019). Moreover, the drawings were conducted under the same conditions for all children who participated in the study to provide consistency between them. The researcher implemented the same process for each group of children, providing the same instructions, materials, and time allocation. This standardization increased the reliability of the collection of the data and also decreased the possible implementation and procedural changes that could cause measurement errors. One of the most well-known methods used to test interrater reliability is correlation analysis, specifically through Pearson's product-moment correlation coefficient (Gisev et al., 2013; Goodwin, 2001). In this study, a fully crossed interrater reliability design was employed, where the same participants were independently coded by two raters: the primary researcher and another coder as research assistant from the Department of Early Childhood Education. To ensure consistency, both raters first evaluated the drawings independently. In cases where discrepancies occurred, the explanations provided by the participants were reviewed to clarify any ambiguous elements. Based on these clarifications, the drawings were re-evaluated, and final scores were assigned. The scores assigned by both inter-raters were then compared, and it was observed that they evaluated the participants at comparable levels. Interrater reliability was subsequently assessed using Pearson's product-moment correlation coefficients, which ranged from .73 to .98 for both

children and mothers, indicating a strong level of agreement between the raters (see Table 3). According to Creswell & Creswell (2018), the correlation score between two raters should ideally be between .80 and .90.

Table 3. Pearson's Product–Moment Correlations Between Two Scorers

Sub-Dimensions	Children (r)	Mother (r)
Human	.92	.98
Living	.82	.87
Abiotic	.73	.85
Built	.87	.88
Total	.86	.92

Since there were 322 children and their 322 mothers in the sample, it was emphasized that interrater reliability could be calculated by selecting a subgroup instead of including all participants if coding the sample was expensive or time-consuming (Hallgren, 2012). Additionally, other interrater reliability studies have emphasized that, when using the kappa coefficient, there should be at least 30 participants (McHugh, 2012). Furthermore, Walter, Eliasziw, and Donner (1998) have noted that smaller numbers of participants and observers can still provide sufficient statistical power to obtain high reliability scores. Furthermore, Terwee et al. (2012) considered samples ranging from 50 to 99 participants to be a “good sample size” for interrater reliability. Although a specific range is not provided for quantitative studies, it is believed that 10-20% is sufficient (Wimmer & Dominick, 1997, as cited in Neuendorf, 2002, p. 158). Accordingly, 64 participants (32 children and their mothers) were randomly selected for interrater reliability from a total pool of 644 participants. In the original scale, Moseley (2010) selected one out of every ten papers. In this study, the selection rate was also 10%. Additionally, the percent agreement formula was used, whereby the number of agreements is divided by the total number of agreements and disagreements (Miles & Huberman, 1994, p. 64). Accordingly, the percent agreement was calculated as 86% for the children's scores and 88% for the mothers', showing a high degree of consistency between the coders. Huberman and Miles (1994) considered a percent agreement above 80% to be acceptable.

CHAPTER 4

RESULTS

This chapter presents the findings of this mixed-method study in which both qualitative and quantitative methods were used together. First, preliminary analyses were conducted, and it was checked whether the assumptions were met. In this context, the normality assumption, missing data, and outliers were examined. No violations of normality, missing data, or outliers were detected. Then, descriptive analyses were conducted. In these analyses, basic statistics such as group means, standard deviations, and frequency distributions were calculated and presented. Afterward, an independent sample t-test was conducted to compare the mean differences. Finally, the Pearson correlation coefficient was applied to determine the direction and strength of the relationship between the Draw an Environment Test Rubric (DAET-R) scores of mothers and children. In the qualitative part of the study, the drawings of children and mothers were analyzed using content analysis based on visual codes, in order to identify and interpret the environmental components represented in the drawings. Therefore, the current study aimed to answer the following research questions:

1. How do children's and their mothers' visual codes in their drawings about the environment correspond to or differ from each other?
2. What are the environmental mental model scores of 48–66-month-old children and their mothers as measured by the DAET-R, and are there significant differences between their mean scores?

2.1 Do children's and their mothers' mental model scores related to the environment differ based on various demographic variables, including children's gender, mothers' educational level, and their participation in environmental activities individually and together?

2.2. Are there any relations between the children's and their mother's total and subdimension (human, living, abiotic and built) scores in mental models?

4.1. Visual Codes in Children's and Mothers' Environmental Drawings

In the qualitative part of the study, the drawings of children and mothers about the environment were examined, and the visual codes in their drawings were grouped under four categories (Human, Living, Abiotic, and Built). The findings are presented in Table 4. Among these, the Human category included the lowest number of drawing codes for both children ($f = 362$) and mothers ($f = 165$). While mothers drew "children" most frequently in their drawings ($f = 99$), children also drew themselves most frequently in their drawings ($f = 121$). In contrast, mothers rarely included themselves in their drawings ($f = 19$). In addition, children and mothers depicted teachers least frequently ($f_c = 3, f_m = 2$). Accordingly, these findings may indicate that children focused on themselves and their personal experiences in their drawings while the mother's focus was on other individuals, particularly their children, around her.

The living category included the second-highest number of drawing codes for both children ($f = 550$) and mothers ($f = 829$), which indicates that the living environment was important to the participants in their visual representations. Among the living components, trees were the most frequently depicted by both groups ($f_c = 176, f_m = 255$), followed by grass ($f_c = 120, f_m = 128$) and flowers ($f_c = 102, f_m = 111$). This finding suggests a common focus on flora and natural landscapes. In addition to flora components, participants included a variety of animals in their drawings. Birds and butterflies were frequently depicted by both children ($f = 31; f = 28$) and mothers ($f = 86; f = 33$) and followed by cats and dogs ($f_c = 17, f_m = 47$). Accordingly, children were more likely to represent small animals and familiar animals such as rabbits ($f = 8$), while mothers were more likely to include larger animals through the broad and functional perspective such as fishes ($f = 29$) and cows ($f = 5$), which indicates differences in reflecting environmental mental models.

The Abiotic category included almost equal numbers of drawing codes for both children ($f = 526$) and mothers ($f = 525$). The sun was the most frequently depicted

code by both groups ($f_c = 184, f_m = 129$), followed by clouds ($f_c = 161, f_m = 114$). Children drew the sea more frequently ($f = 54$), while mothers drew rivers and lakes more frequently ($f = 71$) than children ($f = 9$). In addition, mothers drew mountains ($f = 54$) and smoke ($f = 36$) more frequently than children ($f = 9; f = 6$), while children frequently included rainbows ($f = 48$). These findings suggest that mothers emphasized the figure of smoke more frequently, but it may indicate that mothers may be more sensitive to environmental issues such as air pollution, but children have not yet perceived or prioritized these issues in their environmental understanding.

The built category included the highest number of drawing codes for both children ($f = 713$) and mothers ($f = 938$), which indicates that the built environment was important to the participants in their visual representations. The visual codes most frequently depicted by both groups were playgrounds ($f_c = 109, f_m = 136$), followed by houses with gardens ($f_c = 104, f_m = 124$) and cars ($f_c = 54, f_m = 74$). Apartments were drawn less frequently ($f_c = 59, f_m = 62$) and were generally less preferred than houses with gardens. In terms of playground equipment, mothers drew swings more often ($f = 65$) and slides less often ($f = 54$). In contrast, children drew slides more often ($f = 38$) than swings ($f = 33$), which indicates possible differences in preferred play experiences. Mothers included more immobile daily life structures and resting areas, such as benches and fences ($f = 18$), while children tended to draw interactive and playful components such as balloons ($f = 15$) and toys ($f = 11$).

However, pollution was represented more frequently by mothers ($f = 52$) than by children ($f = 14$), suggesting that mothers may be more aware of environmental issues or more likely to visually reflect such concerns. Recycling bins were depicted by both groups ($f_c = 11, f_m = 16$), suggesting a potential environmental awareness in children. Finally, bicycles were the least frequently drawn element by both groups ($f = 5$), reflecting a relatively limited occurrence in children's and mothers' mental representations of the built environment.

As a result, both mothers and children most frequently included codes from the Built category, such as playgrounds and houses with gardens, followed by the Living category codes, such as trees, flowers, and grass, in their drawings

Table 4. Children's and Mothers' Visual Codes in Environmental Drawings

CHILDREN (N=322)					MOTHERS (N=322)				
	Codes	<i>f</i>	Codes	<i>f</i>		Codes	<i>f</i>	Codes	<i>f</i>
Human	Children themselves	121	Sisters	15	Human	Children	99	Sellers	3
	Mothers	50	Brothers	12		Adults	42	Teachers	2
	Fathers	30	Grandmothers	4		Mothers themselves	19		
	Friends	20							
Living	Trees	176	Rabbits	8	Living	Trees	255	Turtles	10
	Grass	120	Bears	6		Grass	128	Oranges	8
	Flowers	102	Dinosaurs	5		Flowers	111	Watermelons	4
	Birds	31	Ladybugs	4		Birds	86	Sheep	8
	Butterflies	28	Seagulls	3		Apples	50	Cows	5
	Apples	24	Cows	3		Cats and cogs	47	Bees	5
	Cats and dogs	17	Ducks	2		Butterflies	33	Ladybugs	4
	Cherries	11	Lions	2		Fishes	21	Sea stars	3
	Sheep	8				Cherries	14	Horses	3
						Ducks	13	Seagulls	3
Abiotic						Rabbits	13	Frogs	2
						Chickens	11		
	Sun	184	Smoke	9	Abiotic	Sun	129	Sand	26
	Clouds	161	Mountain	9		Clouds	114	World	27
	Sea	54	River	9		River	71	Rainbow	15
	Rainbow	48	Moon	4		Mountain	54	Lake	10
	Sand	24	World	7		Smoke	36	Rock	10
	Rock	11	Lake	5		Sea	34		

Table 4. (Continued)

Built	Playgrounds	109	Dried/Cut trees	10	Built	House with garden	124	Benches	18
	House with garden	104	Play Ball	9		Cars	74	Recycle bins	16
	Apartment	59	Bicycles	8		Road	74	Reusable energy	14
	Cars	54	Traffic lights	8		Swings	65	Schools	14
	Slides	38	Bird House	7		Apartments	62	Drought	13
	Swings	33	Ships	7		Trash can	55	Supermarket	12
	Roads	31	TV	6		Slides	54	Cafes	10
						Environmental pollution	52	Global warming	7
	Ladders	27	Trampolines	5		Trash	45	Pools	6
	Pools	16	Kites	5		Chimneys	37	Traffic lights	6
	Balloons	15	Seesaws	4		Playgrounds	36	Climbing areas	5
	Trash	14	Forest Fire	2		Play Ball	35	Bicycles	5
	Environmental pollution	14	Amusement parks	5		Dried/Cut trees	27	Toys	3
	School	12	Climbing areas	5		Seesaws	27	Hammocks	2
	Trash Cans	11	Supermarket	5		Factories	20	Balloons	2
	Toys	11	Airplanes	3		Fences	18		
	Chimney	11	Trucks	2					

**Note.* Each participant could provide multiple responses; therefore, the total number of codes exceeds the number of participants.

4.2. 48–66-Month-Old Children’s and Their Mothers’ DAET-R Scores and Differences Between Mean Scores (Overall and Under Each Dimension: Human, Living, Abiotic, and Built)

In order to reveal the environmental mental models of children and their mothers, the DAET-R scale was utilized. The environmental components represented in the drawings of both children and mothers were analyzed based on the sub-dimensions of human, living, abiotic, and built. The scores obtained from these sub-dimensions were subsequently reflected in the total scores section. The minimum, maximum, mean, standard deviation, and total values obtained from the sub-dimensions of this scale (human, living, abiotic, and built) and also the independent sample t-test results were presented in Table 5.

Table 5. Descriptive Statistics for DAET-R Sub-Dimensions and Total Scores

Sub-Dimensions	Groups	Min	Max	M	SD	t	df	p	Cohen’s d
Human	Children	0	2	.85	.88	2.024	642	.043*	.15
	Mothers	0	3	.71	.94				
Living	Children	0	2	1.11	.70	-5.320	642	<.001**	-.41
	Mothers	0	3	1.39	.65				
Abiotic	Children	0	2	1.01	.61	-.634	642	.526	-
	Mothers	0	3	1.05	.74				
Built	Children	0	2	.96	.72	-6.518	642	<.001**	-.52
	Mothers	0	3	1.36	.81				
Total	Children	1	7	3.92	1.31	-4.881	642	<.001**	-.38
	Mothers	1	11	4.50	1.68				

* $p < .05$, ** $p < .001$

The minimum, maximum, mean, and standard deviation values in these four sub-dimensions and the total score of the scale were analyzed. Moreover, an independent samples t-test was performed to test whether there was a significant difference between children and their mothers in the mean scores in terms of subdimensions (human, living, abiotic, and built) and total scores.

Accordingly, the mean score of the human sub-dimension there was a statistically significant difference, and children’s scores ($M = .85$, $SD = .88$) were higher than the

mean score of their mothers ($M = .71$, $SD = .94$) $t(642) = 2.024$, $p = .043$ (two-tailed). The effect size of the mean difference was classified as very small (Cohen's $d = -.15$). This finding suggests that children focused on human figures in their drawings more frequently than mothers.

In the Living sub-dimension, the mean score of the mothers ($M = 1.39$, $SD = .65$) was higher than the mean score of the children ($M = 1.11$, $SD = .70$), and this difference was statistically significant, $t(642) = -5.320$, $p < .001$. The effect size of the mean difference was classified as small (Cohen's $d = -.41$).

On the other hand, in the Abiotic sub-dimension, the scores of the mothers ($M = 1.05$, $SD = .74$) and the children ($M = 1.01$, $SD = .61$) were similar to each other, and no statistical significance was found, $t(642) = -.634$, $p = .526$.

In terms of the built sub-dimension, the mean score of the mothers ($M = 1.36$, $SD = .81$) was higher than the children's mean scores ($M = .96$, $SD = .72$), and this difference was statistically significant, $t(642) = -6.518$, $p < .001$. The effect size of the mean difference was classified as medium (Cohen's $d = -.52$).

Similarly, when the general environmental mental models scores were examined, the total score of the mothers ($M = 4.50$, $SD = 1.68$) was higher than the total score of the children ($M = 3.92$, $SD = 1.31$), and this difference was statistically significant $t(642) = -4.881$, $p < .001$. The effect size of the mean difference was classified as small (Cohen's $d = -.38$).

These results indicate that mothers may have more developed environmental mental models than children. However, the results suggest that the human figure is more common and statistically significant in children's environmental mental models than in mothers. In addition, the scores of children and mothers on the DAET-R scale are presented in Table 6. In this table, the scores of children and mothers on the DAET-R scale are presented with their distribution percentages according to four sub-dimensions (Human, Living, Abiotic, and Built).

Table 6. Scores of Mothers and Children on the Sub-Dimensions of the DAET-R

Point	Human				Living				Abiotic				Built			
	Mother		Children		Mother		Children		Mother		Children		Mother		Children	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
0	193	59.9	154	47.8	18	5.6	64	19.9	76	23.6	59	18.3	50	15.5	92	28.6
1	38	11.8	62	19.3	172	53.4	159	49.4	161	50.0	200	62.1	127	39.4	151	46.9
2	82	25.5	106	32.9	119	37.0	99	30.7	79	24.5	63	19.6	125	38.8	79	24.5
3	9	2.8	0	0	13	4.0	0	0	6	1.9	0	0	20	6.2	0	0

Note: 0 point = Drawing does not contain pictures of factors. 1 point= Figure is present. 2 points= Interactions with other factors. 3 points= System interactions

When Table 6 is examined, in the human sub-dimension, the vast majority of mothers (59.9%) scored 0 in this category; in other words, they did not draw this figure at all. Compared to mothers (59.9%), a smaller percentage of children (47.8%) received a score of 0. The percentage of those who received a score of 1 was 11.8% for mothers and 19.3% for children. In addition, the percentage of children drawing human figures and receiving 2 points (32.9%) was again higher than that of mothers (25.5%). While there were a few people (2.8%) who received the highest score of 3 points from mothers, none of the children received this score.

In the living sub-dimension, the percentage of children receiving 0 points (19.9%) was higher than that of mothers (5.6%). The vast majority of mothers (53.4%) and nearly half of the children (49.4%) received a score of 1, and the percentages were similar to each other. However, the percentage of mothers who received a score of 3 was fairly small; only 13 mothers (4%) received this score, while none of their children received it.

In the abiotic sub-dimension, the percentages of mothers (23.6%) and children (18.3%) who did not draw this figure and received a score of 0 were similar. Half of the mothers received a score of 1, while 62.1% of the children included the abiotic figure in their drawings. Accordingly, the percentage of children who received a score of 1 was higher than that of mothers. However, the percentage of mothers who received a score of 2 (24.5%) was higher than that of children (19.6%). While percentage of mothers who received a score of 3 was low in mothers (1.9%), while none of their children received it.

Finally, in the built sub-dimension, the percentage of children who received a score of 0 and did not draw built figures (28.6%) was higher than the mothers (15.5%), indicating that the children included fewer representations of the built environment in their drawings. However, the percentage of children who received a score of 1 (46.9%) was higher than the mothers (39.4%). In addition, the mothers had higher percentages than the children in receiving scores of 2 and 3. The mothers had the highest percentages of scores of 3 points in the built sub-dimension, 20 mothers (6.2%) included the figure in interaction with other factors, and following a system approach.

As a result, according to the findings, the percentage of children who received a score of 0 was generally higher than mothers. Accordingly, children's environmental models are more inadequate and need further development. Also, the human sub-dimension was the only category in which children obtained higher scores than mothers. While the mothers had the highest scores in the built sub-dimension, it was one of the dimensions in which children received the lowest scores. However, in this sub-dimension, mothers most frequently received a score of 3. Finally, especially in the abiotic and built sub-dimensions, the percentage of children receiving a score of 1 was higher than mothers, but mothers had higher scores (2 and 3 points) in these sub-dimensions.

The total scores obtained were analyzed with three broad categories: (1) "Factor Present" referring to the drawing of a non-interactive figure; (2) "one or more factors interacting with another factor" referring to a drawing that represents an interaction between factors and (3), "two or more factors interacting with systems approach" referring to a presence of the system approach. These findings are given in Table 7.

Table 7. Total DAET-R Scores of Children and Mothers Based on Their Environmental Drawings

Total Points	Category	Mother		Children	
		<i>n</i>	%	<i>n</i>	%
0-4	Factor present	172	53.4	220	69.2
5-8	Factor interacting with one other factor	146	45.7	102	32.3
9-12	Factor interacting with two or more factors with systems approach	4	0.9	0	0



Figure 6. M124 Environmental Drawing

Mother's Total Score on the DAET-R Scale: 6 (Factor interacting with one other factor)

Codes in the picture: Sky, bird, tree, house, rabbit, grass, fence, lake

Drawing description: There are trees around me that give off fresh, clean air, the sky is bright blue, and birds are flying. In the distance, there is a lake between the trees, and cute rabbits are eating the grass.



Figure 7. C283 Environmental Drawing

Child's Total Score on the DAET-R Scale: 6 (Factor interacting with one other factor)

Codes in the picture: The tree, the child itself, sand, the wavy sea, the sun, the house

Drawing description: I took a vacation with my family, and I was waiting for them to come back, and I was playing with sand and building castles.

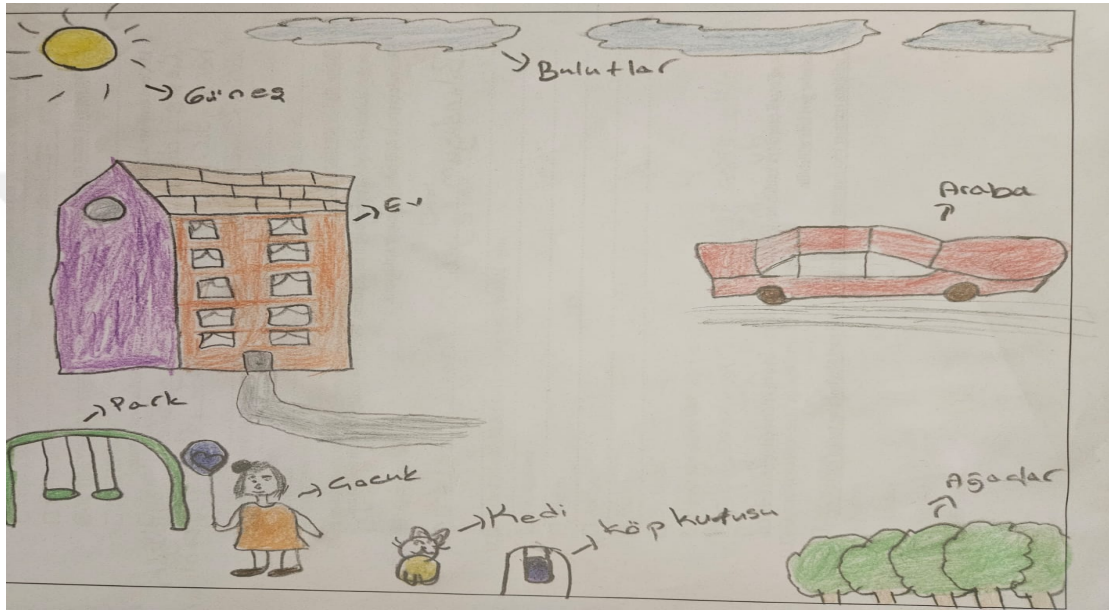


Figure 8. M283 Environmental Drawing

Mother's Total Score on the DAET-R Scale: 6 (Factor interacting with one other factor)

Codes in the picture: Cloud, sun, tree, apartment building, playground, cat, trash bin, child, road, car.

Drawing description: The child is playing in the playground, there is a cat nearby, there is a trash can, there are trees, a car is driving on the road, after playing in the playground, the child will go back home, there are clouds and sun. I drew the events and places around the city where I am.



Figure 9. C79 Environmental Drawing

Child's Total Score on the DAET-R Scale: 6 (Factor interacting with one other factor)

Codes in the picture: Tree, swing, flower, child, house, bench, smoke coming out of the chimney, rainbow, cloud, sun

Drawing description: The child went to the village, picking flowers to give to her mother. Her grandfather made a swing between the trees, and sometimes she swings on it.



Figure 10. M79 Environmental Drawing

Mother's Total Score on the DAET-R Scale: 5 (Factor interacting with one other factor)

Codes in the picture: House with garden, sun, tree, flowers, lake, picnic table, pier, water lily

Drawing description: When I think of the environment, I think of areas far away from people, clean areas without the noise of the city and the sound of cars, an environment where people can find peace, surrounded by flowers and trees.

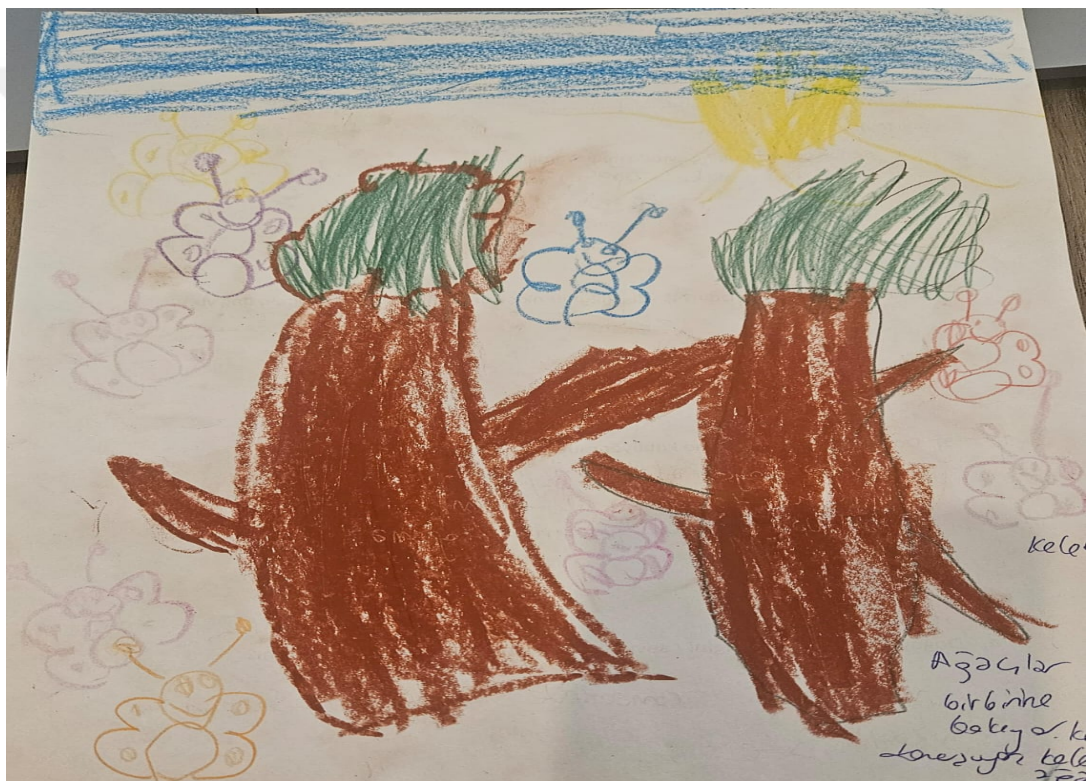


Figure 11. C131 Environmental Drawing

Child's Total Score on the DAET-R Scale: 3 (Factor present)

Codes in the picture: Tree, butterfly, cloud/ sky, sun

Drawing description: The trees look at each other and speak happily, and butterflies also talk to the trees.

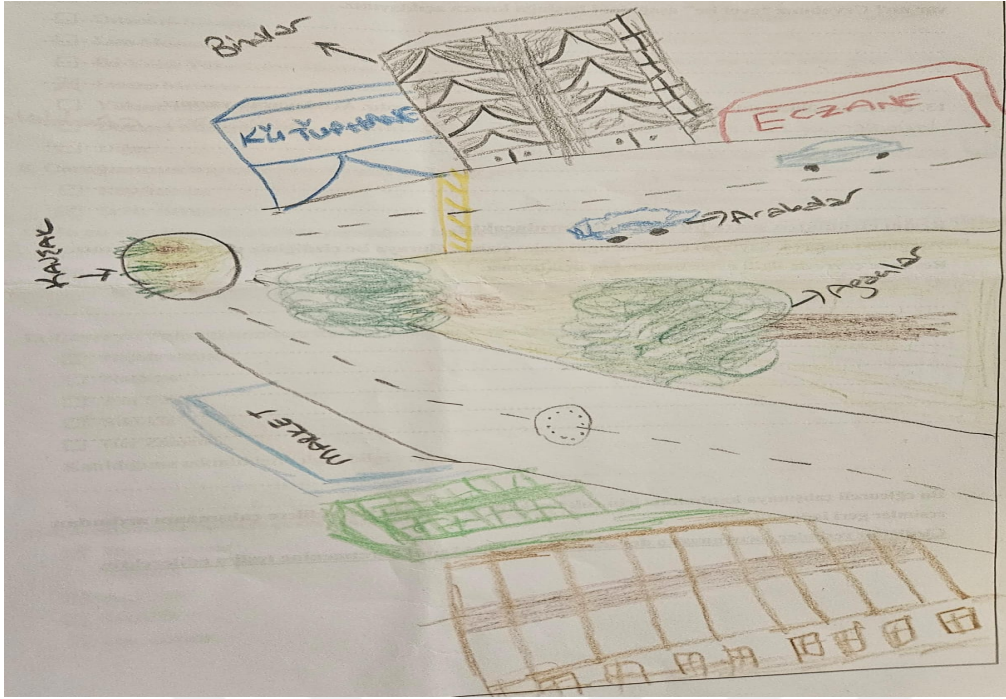


Figure 12. M131 Environmental Drawing

Mother's Total Score on the DAET-R Scale: 3 (Factor Present)

Codes in the picture: tree, grass, car, road, pharmacy, library, apartment buildings, market

Drawing description: The places I see and go around me every day, I usually go to the market, and my neighbors.

4.3. DAET-R Scores of Children and Mothers by Demographic Variables

Before conducting an independent sample t-test, there are some assumptions that must be met. These fundamental assumptions are independence of observations, normal distribution, homogeneity or equality of variances, level of measurement, and random sampling (Pallant, 2016). The distances and variance from the mean score should be similar across the groups, called the “homogeneity of variance assumption” (Tabachnick & Fidell, 2014, p. 119). In order to test this assumption, an independent sample t-test analysis was conducted using the SPSS program, and Levene's test was conducted; these results are presented in Table 8. If the Levene test

result is $p > .05$, the assumption of equal variances is met, and the results in the “equal variances assumed” row are reported (Pallant, 2016). However, if $p \leq .05$, it indicates that the assumption of homogeneity of variances is violated. In this case, the results from the “equal variances not assumed” row should be used (Pallant, 2016).

Table 8. Results for Levene Test for Variables

	Human		Living		Abiotic		Built		Total Point	
	<i>F</i>	<i>Sig.</i>	<i>F</i>	<i>Sig.</i>	<i>F</i>	<i>Sig.</i>	<i>F</i>	<i>Sig.</i>	<i>F</i>	<i>Sig.</i>
Children's Gender	.930	.336	3.411	.066	.018	.893	1.026	.312	5.053	.025
Mother's Education Level	1.152	.284	7.650	.006	.437	.509	.628	.429	7.735	.006
Child-Mother Participation in Environmental Activities	.029	.865	1.999	.158	.187	.666	.155	.694	.003	.960
Mother's Participation in Environmental Activities	3.358	.068	1.127	.289	.278	.599	1.372	.242	1.241	.266

In this study, when the assumption of homogeneity of variances was violated ($p \leq .05$), the values in the second row (equal variances not assumed) were used. According to Gravetter and Wallnau (2016), another fundamental assumption is random sampling. Random sampling is a process in which each individual in the population has an equal probability of being selected. Independent random sampling is a method in which the selection of an individual does not affect the selection of other individuals, and the probability of being selected for each participant remains constant (Gravetter & Wallnau, 2016). In order to meet the Level of Measurement assumption, the dependent variable must be measured on a continuous scale (ratio) or interval level (Pallant, 2016). Accordingly, the DAET-R scale used in this study is a continuous scale, and the scores obtained represent a continuous dependent variable. Based on this, it can be concluded that the assumption was met.

Another fundamental assumption is normality. In order to meet this assumption, the distribution should be symmetrical, and individuals with similar scores should be centered around the mean, while fewer individuals at the extreme values (Gravetter & Wallnau, 2016). Accordingly, most of the scores in the present study were

clustered around the mean, which shows a normal distribution. In addition, the kurtosis and skewness values for all independent variables were within an acceptable range of between +2 and -2, indicating that normality was met. Skewness and kurtosis values are presented in Table 9.

Table 9. Skewness-Kurtosis Values for Variables

	Human		Living		Abiotic		Built		Total Score	
	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis
Children's Gender										
Girl	.235	-1.672	-.329	-.882	-.039	-.248	.148	-1.121	.095	-.382
Boy	.362	-1.671	.008	-.941	.045	-.394	-.019	-1.067	.244	-.446
Mother's Education Level										
Associate degree or below	.839	-.909	.027	-.301	.181	-.733	-.026	-.639	.233	-.393
Undergraduate degree or above	.761	-.939	.359	-.148	.231	-.206	-.126	-.529	.883	1.019
Child-Mother Participation in Environmental Activities										
Never participated	.500	-1.534	-.084	-.849	.055	-.391	.049	-1.068	.282	-.221
At least once	.179	-1.717	-.205	-1.024	-.034	-.280	.071	-1.130	.028	-.480
Mother's Participation in Environmental Activities										
Never participated	1.018	-.592	.297	.079	.240	-.526	-.159	-.663	.473	-.095
At least once	.695	-1.052	.186	-.115	.174	-.493	-.017	-.612	.811	1.424

The assumption of independence of observations states that observations are not affected by previous observations and each observation is evaluated individually (Gravetter & Wallnau, 2016; Pallant, 2016). Accordingly, each individual independently contributed to the study. In this context, the scores obtained from the DAET-R scale of 48-66-month-old children and their mothers were evaluated independently and it was assumed that the responses participants were not affected by environmental and social factors.

4.3.1. Children's DAET-R Scores by Gender Groups

An Independent sample t-test was used to examine whether there was a difference in mean scores between the two groups (categorical independent variables) and to compare these groups (Gravetter & Wallnau, 2016; Pallant, 2016). Two groups were

divided based on the gender variable as girls and boys. The results of the independent sample t-test are presented in Table 10.

Table 10. The Results of the Independent Sample T-Test for the Gender Groups

Sub-Dimensions	Gender	n	M	SD	t	df	<i>p</i>	Cohen's <i>d</i>
Human	Girl	160	.88	.87	.609	320	.543	-
	Boy	162	.82	.89				
Living	Girl	160	1.23	.69	2.981	320	.003*	.35
	Boy	162	.99	.70				
Abiotic	Girl	160	1.09	.60	2.370	320	.018*	.26
	Boy	162	.93	.62				
Built	Girl	160	.91	.73	-1.308	320	.192	-
	Boy	162	1.01	.72				
Total Point	Girl	160	4.10	1.23	2.510	320	.013*	.28
	Boy	162	3.73	1.37				

* $p < .05$

An Independent samples t-test was conducted to compare the human sub-dimension scores between girls and boys. The results in Table 9 showed that there was no statistically significant difference between girls ($M = .88$, $SD = .87$) and boys ($M = .82$, $SD = .89$), $t(320) = .609$, $p = .543$, (two-tailed). In this context, although the girls scored higher than the boys in the human sub-dimension, this difference was not statistically significant.

According to the results of the independent samples t-test for the Living sub-dimension, a statistically significant difference was found between girls ($M = 1.23$, $SD = .69$) and boys ($M = .99$, $SD = .70$), $t(320) = 2.981$, $p = .003$, (two-tailed). The magnitude of the mean difference was moderate (Cohen's $d = .35$). Gravetter and Wallnau (2016) recommend that the effect size should also be included when a statistically significant difference is reported. According to Cohen's effect size criteria (Cohen, 1988) $d = .20$ is classified as small, $d = .50$ as medium, and $d = .80$ as large. Furthermore, when the mean scores were compared, the girls scored higher than the boys in the living sub-dimension.

In terms of the Abiotic sub-dimension, a statistically significant difference was found between girls ($M = 1.09$, $SD = .60$) and boys ($M = .93$, $SD = .62$); $t(320) = 2.370$, p

= .018, (two-tailed). The magnitude of the mean difference was found to be a small effect size (Cohen's $d = .26$). According to the mean scores and independent samples t-test results, girls scored higher than boys and this difference was found to be statistically significant.

When examining the Built sub-dimension, there was no statistical difference between girls ($M = .91$, $SD = .73$) and boys ($M = 1.01$, $SD = .72$); $t(320) = -1.308$, $p = .192$, (two-tailed). On the other hand, although boys scored higher in this category in mean scores, the results of the independent samples t-test indicated that this difference is not statistically significant.

Finally, in terms of total scores, there was a statistically significant difference between girls ($M = 4.10$, $SD = 1.23$) and boys ($M = 3.73$, $SD = 1.37$) $t(320) = 2.510$, $p = .013$, (two-tailed). The effect size of the mean difference was classified as small (Cohen's $d = .28$).

As a result, girls scored higher than boys in the living, abiotic, and total score dimensions and this difference was statistically significant. This result suggests that girls' mental models for the environment are generally more developed and comprehensive compared to boys. Moreover, girls' higher scores in the living, and abiotic sub-dimensions and total score, with a statistically significant difference, reveal that girls' environmental mental models differ significantly from boys.

4.3.2. Children's DAET-R Scores by Child-Mother Participation in Environmental Activities

An independent sample t-test was conducted to examine whether there were significant differences in terms of human, living, abiotic, built sub-dimensions, and total scores based on children's participation in environmental activities. The results are presented in Table 11. For this research question, children were divided into two groups according to their participation in environmental activities: those who "never" participated and those who participated "at least once".

Table 11. The Results of the Independent Sample T-Test for Child-Mother Participation in Environmental Activities

Sub-Dimensions	Groups	n	M	SD	t	df	<i>p</i>	Cohen's <i>d</i>
Human	Never	123	.76	.88	-1.510	320	.132	-
	At Least Once	199	.91	.88				
Living	Never	123	1.07	.68	-.874	320	.383	-
	At Least Once	199	1.14	.71				
Abiotic	Never	123	.92	.62	-2.157	320	.032*	.25
	At Least Once	199	1.07	.60				
Built	Never	123	.97	.72	.152	320	.879	-
	At Least Once	199	.95	.73				
Total Point	Never	123	3.72	1.26	-2.162	320	.031*	.25
	At Least Once	199	4.04	1.33				

* $p < .05$

When the human sub-dimension was examined, there was no significant difference between children who never participated in environmental activities ($M = .76$, $SD = .88$) and children who participated at least once ($M = .91$, $SD = .88$); $t(320) = -1.510$, $p = .132$ (two-tailed). The results indicated that, although children who participated in environmental activities at least once had higher scores in the human dimension, the independent samples t-test results indicated that this difference was not statistically significant.

When the Living sub-dimension was examined, there was no significant difference between children who never participated in environmental activities ($M = 1.07$, $SD = .68$) and children who participated at least once ($M = 1.14$, $SD = .71$); $t(320) = -.874$, $p = .383$ (two-tailed). The results indicated that, although children who participated in environmental activities at least once had marginally higher scores in the living dimension, the independent samples t-test results indicated that this difference was not statistically significant.

When the abiotic sub-dimension was examined, there was a significant difference between children who never participated in environmental activities ($M = .92$, $SD = .62$) and children who participated at least once ($M = 1.07$, $SD = .60$); $t(320) = -2.157$, $p = .032$, (two-tailed). The effect size of the mean difference was classified as

small (Cohen's $d = .25$). The results indicate that children who participated in environmental activities at least once scored higher in this sub-dimension, the independent samples t-test results show that this difference is statistically significant but has a small effect.

In terms of the built sub-dimension, there was no significant difference between children who never participated in environmental activities ($M = .97$, $SD = .72$) and children who participated at least once ($M = .95$, $SD = .73$); $t(320) = -.152$, $p = .879$, (two-tailed). The results of the independent samples t-test show that this difference is not statistically significant and the mean scores of the two groups were similar.

Finally, in terms of total scores, there was a statistically significant difference between children who never participated in environmental activities ($M = 3.72$, $SD = 1.26$) and children who participated at least once ($M = 4.04$, $SD = 1.33$); $t(320) = -2.162$, $p = .031$ (two-tailed). The effect size of the mean difference was classified as small (Cohen's $d = .25$). These results indicated that participation in environmental activities may contribute to higher levels of environmental awareness levels in general among children.

As a result, the results of the independent sample t-test indicated that children who participated in environmental activities at least once with their mothers scored higher in the abiotic sub-dimension compared to the group that never participated. In addition, when the total scores were examined, it was the same with the abiotic sub-dimension that the scores of children who participated in environmental activities with their mothers were higher. These results indicated that participating in environmental activities may contribute to the children's environmental mental model development.

4.3.3. Mother's Draw an Environment Test (DAET-R) Scores by Education Levels

An independent sample t-test was conducted to examine whether there were significant differences in terms of human, living, abiotic, built sub-dimensions, and

total scores based on mothers' education levels. Two groups were defined based on mothers' education level, mothers with an associate degree or below, and those with an undergraduate degree or above. The results of the independent sample t-test are presented in Table 12.

Table 12. The Results of the Independent Sample T-Test for Education Levels

	Education Level	n	M	SD	t	df	p	Cohen's <i>d</i>
Human	Associate degree or below	202	.68	.92	-.815	320	.416	-
	Undergraduate degree or above	120	.77	.97				
Living	Associate degree or below	202	1.37	.60	-.818	320	.438	-
	Undergraduate degree or above	120	1.43	.74				
Abiotic	Associate degree or below	202	0.98	.74	-2.085	320	.038*	.24
	Undergraduate degree or above	120	1.16	.74				
Built	Associate degree or below	202	1.28	.80	-2.150	320	.032*	.25
	Undergraduate degree or above	120	1.48	.83				
Total point	Associate degree or below	202	4.31	1.47	-2.586	320	.017*	.30
	Undergraduate degree or above	120	4.81	1.95				

* $p < .05$

An independent samples t-test was conducted to compare human sub-dimension scores across education levels. There was no significant difference between mothers with an associate's degree or below ($M = .68$, $SD = .92$) and mothers with an undergraduate degree or above ($M = .77$, $SD = .97$); $t(320) = -.815$, $p = .416$, (two-tailed).

In the Living sub-dimension, there was no significant difference between participants with an associate's degree or below ($M = 1.37$, $SD = .60$) and participants with an undergraduate degree or above ($M = 1.43$, $SD = .74$) $t(320) = -.818$, $p = .438$, (two-sided). The mean scores for both groups were quite similar to each other.

However, in the abiotic sub-dimension, there was a statistically significant difference between participants with an associate's degree or below ($M = .98$, $SD = .74$) and

participants with an undergraduate degree or above ($M = 1.16$, $SD = .74$) $t(320) = -2.085$, $p = .038$, (two-sided). The effect size of the mean difference was classified as small (Cohen's $d = .24$). Accordingly, participants with an undergraduate degree or above scored significantly higher in the abiotic sub-dimension.

When the built sub-dimension was examined, the mean score of the participants with an associate degree or below education level ($M = 1.28$, $SD = .80$) was lower than the mean score of the participants with an undergraduate degree or above ($M = 1.48$, $SD = 0.83$). According to the independent samples t-test results, this difference was statistically significant; $t(320) = -2.150$, $p = .032$, (two-tailed). The effect size of the mean difference was classified as small (Cohen's $d = .25$). The results indicate that the mothers with a bachelor's degree or higher education level scored significantly higher in the built sub-dimension.

In terms of total scores, the mean score of participants with an associate degree or below ($M = 4.31$, $SD = 1.47$) was lower than the mean score of participants with an undergraduate degree or above ($M = 4.81$, $SD = 1.95$). According to the independent sample t-test results, this difference was statistically significant; $t(320) = -2.586$, $p = .017$, (two-sided). The effect size of the mean difference was classified as small (Cohen's $d = .30$). These results indicate that mothers with an undergraduate degree or above scored significantly higher in the total scores. Overall, mothers with an undergraduate degree or above scored higher than the associate degree or below group in abiotic, built, and total scores, and this difference was statistically significant. In this context, the mothers' higher education levels may be associated with higher scores on the DAET-R scale.

4.3.4. Mother's Draw an Environment Test (DAET-R) Scores by Independent Participation in Environmental Activities

An independent sample t-test was conducted to examine whether there were significant differences in terms of human, living, abiotic, built sub-dimensions, and total scores based on the mother's participation in environmental activities independently. Two groups were defined based on mothers' participation in

environmental activities independently: mothers who “never” participated and those who participated “at least once”. The results of the independent sample t-test are presented in Table 13.

Table 13. The Results of the Independent Sample T-Test for Mother’s Participation in Environmental Activities

Sub-Dimensions	Groups	<i>n</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	Cohen’s <i>d</i>
Human	Never	123	.60	.89	-1.647	320	.101	-
	At Least Once	199	.78	.96				
Living	Never	123	1.35	.64	-0.961	320	.337	-
	At Least Once	199	1.42	.66				
Abiotic	Never	123	1.00	.74	-.881	320	.38	-
	At Least Once	199	1.08	.74				
Built	Never	123	1.30	.77	-.973	320	.331	-
	At Least Once	199	1.39	.83				
Total Point	Never	123	4.24	1.56	-2.136	320	.033*	.25
	At Least Once	198	4.65	1.73				

* $p < .05$

In the human sub-dimension, there was no significant difference between mothers who had never participated in environmental activities ($M = .60$, $SD = 0.89$) and mothers who had participated at least once ($M = .78$, $SD = .96$); $t(320) = -1.647$, $p = .101$, (two-tailed).

In the living sub-dimension, there was no statistically significant difference between mothers who had never participated in environmental activities ($M = 1.35$, $SD = .64$) and mothers who had participated at least once ($M = 1.42$, $SD = .66$); $t(320) = -.961$, $p = .337$, (two-tailed).

In the abiotic sub-dimension, there was no statistically significant difference between mothers who had never participated in environmental activities ($M = 1.00$, $SD = .74$) and mothers who participated at least once ($M = 1.08$, $SD = .74$); $t(320) = -.881$, $p = .379$, (two-tailed). In the built sub-dimension, there was no statistically significant difference between mothers who had never participated in environmental activities ($M = 1.30$, $SD = .77$) and mothers who participated at least once ($M = 1.39$, $SD =$

.83); $t(320) = -0.973$, $p = .091$, (two-tailed). In the total score, the mean score of mothers who had never participated in environmental activities ($M = 4.24$, $SD = 1.56$) was lower than the mean score of mothers who had participated at least once ($M = 4.65$, $SD = 1.73$). According to the results of the independent samples t-test, this difference was statistically significant; $t(320) = -2.136$, $p = .033$, (two-tailed). The effect size of the mean difference was classified as small (Cohen's $d = .25$). These results may indicate that mothers who had participated in environmental activities at least once scored significantly higher in the total score dimension. Accordingly, mothers' participation in environmental activities may be associated with the development of their mental models towards the environment and it may have contributed to higher total scores.

4.4. The Relationship between Children's and Mothers' Environmental Mental Models Based on DAET-R Scores

To examine whether there was a relationship between the children's and mothers' scores across the human, living, abiotic, built, and total dimensions of the DAET-R, Pearson product-moment correlation analyses were conducted. According to Pallant (2016), there are three basic assumptions for Pearson correlation analysis: normal distribution, linearity, and homoscedasticity. For the normal distribution assumption, the skewness and kurtosis values should be between +2 and -2. The skewness and kurtosis values for the mothers' scores are presented in Table 14.

Table 14. Skewness and Kurtosis Scores for Children and Mothers DAET-R Scores

Sub-Dimensions	Children (N=322)		Mother (N=322)	
	Skewness	Kurtosis	Skewness	Kurtosis
Human	.297	-1.670	.809	-.910
Living	-.156	-.974	.230	-.069
Abiotic	-.007	-.347	.197	-.520
Built	.062	-1.109	-0.051	-.608
Total point	.131	-.442	.725	1.083

According to Table 14, the skewness and kurtosis values for all variables met the normality assumption that these scores were between the necessary and acceptable

range of +2 to 2. Additionally, for the correlation test to be conducted the homoscedasticity assumption requires that the residuals be symmetrically distributed around the regression line (Pallant, 2016). In order to test this assumption, a scatterplot was created. It was observed that the variables were clustered around the line and that there was no curvilinear relationship. Therefore, this assumption was not violated.

Correlational analysis results revealed a significant and positive relationship between the total score of the children and the total score of the mothers on the DAET-R scale ($r = .137, p < .05$) (Table 15). Moreover, the results show a low but statistically significant relationship between the total scores of children and their mothers. As Cohen (1988) suggests, when determining the effect size of the relationship correlation, the coefficient values should be evaluated. Accordingly, a small correlation is classified between $r = .10$ and $r = .29$, a medium correlation is classified between $r = .30$ and $r = .49$, and a large correlation is classified between $r = .50$ and $r = 1.0$ (p.79-81).

Table 15. Correlation Between Mothers' and Children's DAET-R Scores

	Mother Human	Mother Living	Mother Abiotic	Mother Built	Mother Total Score
Child Human	.027				
Child Living		.183**			
Child Abiotic			.060		
Child Built				.092	
Child Total Score					.137*

Note: *. Correlation is significant at the .05 level

**. Correlation is significant at the .01 level

Similarly, a significant and positive correlation was found between the living sub-dimension scores of the children and mothers ($r = .183, p < .01$). The results show that there is a small but statistically significant relationship between the environmental mental model levels of the children and mothers in the living sub-dimension. When the other Pearson correlation coefficient results were examined, there was no significant relationship between the human sub-dimension scores of the

children and mothers ($r = .027$, $p = .634$). In addition, there was no significant correlation between the abiotic scores of the children and mothers ($r = .060$, $p = .285$). Similarly, it was found that there was no significant relationship between the built scores of the children and the built scores of the mothers ($r = .092$, $p = .098$). When the significant correlations in the total score and the living sub-dimension were evaluated, there was a similarity between the environmental mental models of mothers and their children.

The results indicate a potential association between mothers' and children's environmental mental models, indicating that these models may be related and shaped through shared experiences.

4.5. Summary

The findings related to visual codes in children's and mothers' environmental drawings showed that both groups most frequently included elements from the Built category, especially playgrounds and houses with gardens. These were followed by components from the Living category such as trees, grass, and flowers. Pollution-related components such as smoke and recycling bins appeared more frequently in the drawings of mothers, whereas children tended to include more familiar and playful features. In terms of children's and mothers' DAET-R scores and differences between mean scores, mothers scored significantly higher in the Living, Built sub-dimensions and total scores, while children obtained higher scores only in the Human dimension. Most children were placed in the "factor present" category, indicating non-integrated representations, whereas mothers were more frequently categorized in scores reflecting interaction or systems thinking. When examining children's DAET-R scores by gender groups, girls scored significantly higher than boys in the Living, Abiotic, and total score dimensions. No significant differences were found in the Human and Built sub-dimensions. Findings on children's DAET-R scores by child-mother participation in environmental activities revealed that children who had participated at least once scored significantly higher in the Abiotic sub-dimension and in total scores than those who never participated. No statistically significant differences were found in the Human, Living, or Built dimensions. Regarding

mothers' DAET-R scores by education levels, mothers with an undergraduate degree or above scored significantly higher in the Abiotic, Built, and total dimensions than those with an associate degree or below. No significant differences were found in the Human and Living dimensions. Similarly, mothers' DAET-R scores by independent participation in environmental activities showed that those who had participated at least once had significantly higher total scores compared to mothers who never participated. However, no significant differences were found across individual sub-dimensions. Finally, the relationship between children's and mothers' environmental models based on DAET-R scores showed a small but statistically significant positive correlation in the total scores and the Living sub-dimension. No significant associations were found in the Human, Abiotic, or Built dimensions.

CHAPTER 5

DISCUSSION

In line with the main purpose of the study, this chapter discusses the results and comparison of the scores obtained from the drawings of children and their mothers regarding their environmental mental models, based on the sub-dimensions of the DAET-R scale. The scores obtained from the four sub-dimensions of the human, living, abiotic, and built environments were analyzed based on the “Draw-An-Environment Test Rubric (DAET-R)” scale. Additionally, this section discusses the scores obtained from 48- to 66-month-old children and their mothers on the DAET-R scale. It was also discussed whether these scores differ based on various demographic information and whether there is a correlation between the children’s and mothers’ scores, in relation to other studies. Finally, the visual codes, the qualitative part of the study, were evaluated, and the similarities and differences between the children’s and mothers’ codes were discussed. After the discussion, educational implications were included, and recommendations were provided for future studies.

5.1. How Do Children’s and Their Mothers’ Visual Codes In Their Drawings About The Environment Correspond To Or Differ From Each Other?

When the children’s and mothers’ codes in the environmental drawings were examined in the human category, it was found that children most frequently drew themselves ($f=121$), followed by their mothers ($f=50$), fathers ($f=30$), and friends ($f=20$). In contrast, these codes were different in the mother’s drawings, where they most frequently drew children ($f=99$), followed by unspecified adults ($f=42$), and then themselves ($f=19$). When the literature was examined, the human category was generally not divided into specific codes as in the present study (Ahi, 2015; Flowers

et al., 2015) and was instead reported simply as “human”. In the study by Çalış-Şaşı and Balcı (2021), in addition to general human figures ($f=238$), specific individuals, such as teachers, family, and police officers, were also included, but the frequency of drawings is quite low. These findings were similar to the present study; interestingly, the frequency of teacher figures was very low in both studies. Overall, nearly half of the children and mothers did not depict any human figures in their drawings. When the codes in their drawings were examined, a consistent finding emerged that the human category was the least frequently represented among all categories ($f_c = 362$, $f_m = 165$). These findings also correspond with the quantitative data, and in fact, the lowest scores were obtained in the “human” sub-dimension of the DAET-R scale. However, children still included more human figures than mothers in this category. As a result, the human sub-dimension had the lowest representations in the participants’ mental models quantitatively and qualitatively.

When the frequency of visual codes in the drawings of children and mothers was examined, both groups frequently drew environments consisting of plants and animals such as trees, grass, flowers, birds, cats and dogs, and apples. The most frequently drawn figures were consistent with other studies; tree, flower, and grass figures were frequently drawn in the preschool group (Ahi & Kahriman-Pamuk, 2021; Cengizoğlu, Olgan & Teksöz, 2022; Collado, Íñiguez-Rueda & Corraliza, 2016; Çalış-Şaşı & Balcı, 2021; Flowers et al., 2015; Günindi, 2012; Kalvaitis & Monhardt, 2012; Moula et al., 2021). In contrast animal figures were not drawn as frequently as floral components (Flowers et al., 2015; Kalvaitis & Monhardt, 2012; Çalış-Şaşı & Balcı, 2021), while Fraijo-Sing (2020) indicated that preschool children included more animals than the plants in their drawings. However, in the study of Flowers et al. (2015), insects were the most frequently drawn living figures. However, in the current study, the animals were generally drawn as birds. In this respect, the findings were similar to those reported in the studies by Çalış-Şaşı and Balcı (2021), Günindi (2012) and (Kalvaitis & Monhardt, 2012). Accordingly, children and their mothers included similar living components in their drawings.

In terms of abiotic visual codes, the sun and cloud were the most frequently drawn visual figures by children and their mothers. In this respect, it was consistent with

other studies in the literature (Bulut-Öngen & Örsay, 2024; Kalvaitis & Monhardt, 2012). Additionally, children more frequently included the sea as an abiotic element, whereas mothers more often depicted rivers, which contrasts with previous studies. The frequency of including of these figures was lower in other studies (Çalış-Şaşı & Balcı, 2021; Ahi & Kahriman-Pamuk, 2021; Köşker, 2019; Günindi, 2012). This was followed by a rainbow in children's drawings, and its frequency was lower in previous studies compared to that of the sun and cloud (Kalvaitis & Monhardt, 2012; Çalış- Şaşı & Balcı, 2021). However, in the current study, mothers included mountains more frequently, which was a drawn more frequently than rainbows in other studies (Kalvaitis & Monhardt, 2012).

When the codes in the drawings of children and mothers were examined, the most frequently represented figure in the built category was "house with garden". This finding is consistent with previous research (Çalış-Şaşı & Balcı, 2021; Fraijo-Sing et al., 2020; Günindi, 2012; Köşker, 2019). The second most frequently drawn built environment element among children was the playground. This finding is consistent with the study of Ahi (2016) and Flowers et al. (2015), but in other studies, playgrounds were either rarely represented or entirely not included, which may contrast with the idea of including children reflect their own experiences and observations in their mental models (Flowers et al. 2015). Thus, in the present study, the frequent depiction of house and playgrounds can be interpreted as a reflection of children's time spent in house and parks, which indicates that their mental models were directly influenced by environmental experience. As it was supported, while mental models form the basis of individuals' behavior in processes such as reasoning and decision-making, they benefit from the individual's personal life, thoughts, perceptions, and experiences (Jones et al., 2011). Accordingly, children often spend time in parks in their daily lives, and this experience was reflected in their thoughts, which were frequently observed in their drawings. In addition, mothers most frequently drew cars, followed by roads, whereas children tended to draw apartments first, followed by cars. In other studies, cars and roads were also included, but they were not frequently drawn figures, which is not commonly reported in previous studies (Çalış- Şaşı & Balcı, 2021; Ahi et al., 2017; Köşker, 2019). Alerby (2000) explained the way children in the younger age group think in terms of their

immediate realities and experiences, while they gradually develop global views as they grow older. Accordingly, while younger children tend to focus on the experiences in their daily lives “here and now”, older age groups can also think in terms of what may happen in the future (Alerby, 2000). In the present study, while children focused on components and events in their immediate environment, mothers adopted a broader and more abstract perspective.

In conclusion, in the drawings of children and mothers, it was observed that children mostly drew from the living category, while mothers mostly drew from the built category. Also, in the drawings of children and mothers, there were often places with flowers, trees, and grass, as well as structures such as playgrounds and residential areas. This showed that children and mothers represented the environment more through figures they frequently encountered in their environment and that these representations were generally based on passive observations. In addition, children focused on water-related activities through abiotic components, such activities require active participation and direct interaction. In support of these findings, nature sports have also been found to positively affect environmental attitudes (Çetinkaya, 2015). In contrast, although protection behaviors on environmental issues included in the drawings, a generally low trend was observed in the scores obtained from the DAET-R scale, indicating that children and mothers generally spend time in parks and areas around their homes as the environment, and a relationship based on exploration or deep interaction was not established. It indicated the effect of the nature of the activities on mental model development. This emphasized that Louv (2006) refers to spending time outdoors not only as being in physical outdoor spaces but also as free and exploratory nature experiences (e.g., climbing trees, and walking in the forest). Similarly, participation in appreciation-based nature activities (hiking, viewing the scenery, camping, bird watching) has a partial mediating effect between environmental attitudes and green consumption behaviors (Thapa, 2010). Children and mothers frequently included flowers, trees, and grass, but it was found that their interaction was limited, and they were not exploratory. Accordingly, participating in environmental activities may not affect environmental attitudes alone; rather, the type of environmental activities participated in was also important.

5.2. What Are the Environmental Mental Model Scores Of 48–66-Month-Old Children and Their Mothers As Measured By The DAET-R, And Are There Significant Differences Between Their Mean Scores And Demographic Variables?

The first research question involved discussing the findings obtained from the quantitative data analysis. This section examined the total and subdimension (Human, Living, Abiotic, and Built) scores obtained by children and their mothers on the DAET-R scale and assessed these findings in comparison with the existing literature. Following that, the scores obtained by children and their mothers on the DAET-R scale according to their demographic variables were discussed. For children, the demographic variables included gender and participation in environmental activities with their mothers. For mothers, the demographic variables included educational status and frequency of individual participation in environmental activities. Each variable was examined in the context of its effect on the development of environmental mental models.

When the scores obtained by children and mothers on the DAET-R scale were examined based on subdimensions (Human, Living, Abiotic, Built), the results for the Human dimension were examined first. In this context, the scores of both children and their mothers related to the human dimension were compared and discussed in relation to the existing literature. Mothers included human components in their drawings less frequently when it was compared to children. According to descriptive statistics, the children's mean score in this sub-dimension was significantly higher than the mothers' score ($M_c = .85$ and $M_m = .71$, respectively). The result was also supported by the distribution of the scores that more than half of the mothers and nearly half of the children did not include human figures in their drawings and they received score of 0. This result indicates that mothers were less likely than children to represent human factors in their environmental mental models through their drawings. Moreover, approximately one in three children and one in four mothers received 2 points by showing the human figure interacting with another environmental factor in their drawings, but there was no causality in these interactions. On the other hand, while no child received the highest score of 3, only a

small number of mothers reached this level (2.8%). This highest score focuses on the effects of human behaviors on the environmental system, along with the cause-and-effect relationship. Accordingly, while children drew more interactive drawings than their mothers, they could not associate these mental models with systems interaction. The findings were also consistent with previous research. Studies in the literature revealed that both children and adults include human figures in their environmental drawings to a limited extent (Ahi, 2015; Flowers et al., 2015; Moseley et al., 2010). In studies conducted in older groups, it was found that half of the participants' mental models did not include the human factor in their environmental representations (Cavas, 2011; Desjean-Perrotta, 2013; Moseley et al., 2010; Wuellner et al., 2017; Liu & Lin, 2015). This finding was also supported by that primary school children's mental models and they included human figures without associating them with other factors, by reflecting a mental model that humans were not part of the environment (Cavas, 2011; Çalış-Şaşı & Balcı, 2021; Desjean-Perrotta, 2013; Moseley et al., 2020) and in the preschool age group (Ahi, 2015; Ahi & Kahriman-Pamuk, 2021; Fraijo-Sing et al., 2020). Accordingly, it was found that children's mental models rarely included human figures, whereas greater emphasis was put on living and abiotic components (Ahi & Kahriman-Parmuk, 2021; Desjean-Perrotta, 2013; Fraijo-Sing et al., 2020; Moula et al., 2021).

In the living sub-dimension, the mothers' mean score was significantly higher than the children's mean scores ($M_c = 1.11$ and $M_m = 1.39$, respectively). Approximately half of the participants from both groups received a score of 1, indicating that they included the living figures as unconnected without showing any interactions of other factors. However, the mean score and the percentage of participants who received a score of 3 were higher among mothers, which indicates that their mental models of living factors were more relational and reflected interactions with other components through causal relationships. In other words, these findings indicated that mothers included living components in their drawings more frequently and in a more relational manner compared to children. Similar results have been reported in previous studies where only a quite small percentage of participants depicted living factors from a systems-based perspective (Liu & Lin, 2015; Moseley et al., 2010, 2020). The results indicate that while some mothers comprehend the interactions

among living and environmental factors, children often depict living things in a more superficial way, focusing on a factor present without considering their relationship to other factors. Therefore, the mean and percentage of high scores are consistently increased among mothers.

The findings of the current study are generally consistent with those of previous studies conducted with preschool and primary school students. In terms of preschool group that half of the children included living figures in their drawings (Ahi, 2015; Moula et al., 2021). While one-fourth of the children did not include the living figures. Similarly, Çalış-Şaşı and Balcı (2021) found that the inclusion of living elements increased with age; however, many students still depicted these living factors in a basic and unrelated way. Interestingly, Flowers et al. (2015) found that approximately three out of four children aged 6–12 included living elements in their drawings. In contrast, Shepardson et al. (2007) reported that fewer than half of fourth- and twelfth grade, and approximately two out of three preservice teachers (Cavas, 2011; Moseley et al., 2010; Desjean-Perrotta, 2013; Liu & Lin, 2015) included living elements in their environmental models. These findings suggest that participants pay more attention to living components than children but have difficulty incorporating them into systemic, interconnected mental models of the environment.

In the abiotic sub-dimension, both children and mothers ($M_c = 1.01$ and $M_m = 1.05$, respectively) received similar scores and no statistical difference was found. Nearly one-fourth of the mothers and close to one-fifth of the children's mental models did not include any abiotic components through their drawings. However, more than half of the children and half of the mothers included abiotic factors without interacting with other factors. This indicates that children included abiotic components such as sun, water, and air in their drawings in a more decorative way without the interrelation of other factors. Higher scores, which require associations between factors, were drawn by one-fourth of the mothers in a relational context with other factors. However, system-level representations were quite limited in both groups. These results were consistent with the literature. For example, in previous studies, the rate of children not including abiotic elements in their drawings varies between different groups. In Ahi's (2015) study with preschool children in a public school,

approximately one in every five children and approximately one in every twenty children attending forest schools did not include abiotic elements (Ahi & Kahriman-Pamuk, 2021). In primary school age groups, the rate of not including abiotic elements varies from one in every six to seven children (Çalış-Şaşı & Balcı, 2021) when it was one in every three children (Desjean-Perrotta, 2013) and one in every two children (Flowers et al., 2015).

In studies conducted with undergraduate students and teacher candidates, the percentage of not drawing any abiotic components was reported one-third of the participants (Moseley et al., 2010; Cavas, 2011; Ahi et al., 2017) and one-fifth of them (Liu & Lin, 2015). While those who only drew the abiotic components without any relation with others were more than half and nearly three-quarters respectively, the interrelated and system-based drawing percentages were quite low. In this respect, the relational drawing percentage of mothers in the current study was higher compared to adult samples in other studies. This suggests that in the current study, mothers tend to depict the environment in a more interconnected and contextualized manner when compared to previous studies. According to the results, children included abiotic components more than mothers, but these drawings were unrelated or decorative. In contrast, mothers had higher percentages of relational drawings, which helps explain why scores of 1 (factor present) were more prevalent among children, whereas scores of 2 (factors interacting) were more common among mothers.

In terms of built sub-dimension, the mother's mean scores ($M_c = .96$ and $M_m = 1.36$, respectively) were higher than the children's mean scores and this difference was statistically significant. Nearly one in three children and nearly one in six mothers did not include any built environment components in their drawings, suggesting that children were almost twice as likely as mothers not to include these elements in their drawings. Additionally, quite a small portion of children and mothers produced system-level representations. In terms of literature, one in three of preschool (Ahi, 2015; Ahi & Kahriman-Pamuk, 2021) and one in three (Desjean-Perrotta, 2013; Flowers et al., 2015) and one in four of primary school children (Kalvaitis &

Monhardt, 2011) did not include any built environment components. Also, the majority of them represented these components only at the factor present level.

In adult samples, the rate of those who did not draw built components varies between nearly one in four (Moseley et al., 2010) and half of them (Cavas, 2011; Liu & Lin, 2015).

In terms of the total mean score of the mothers was significantly higher than the total score of the children ($M_c = 3.92$ and $M_m = 4.50$, respectively). Moreover, when the drawings of children and mothers in the quantitative study were examined, the majority of the participants depicted the environment without interacting with other factors. In contrast, a lower rate, one in three children and nearly half of the mothers drew the environment in interaction with another factor. Accordingly, both children and mothers tended to represent the environment without being in a relationship or isolated by other factors. However, only four mothers scored between 9-12, which shows representations of the environment as a holistic approach. However, this may also suggest that majority of the environmental mental models were unrelated and one-sided. When other studies were examined, it was found that a large majority of the children in his study on preschool children (Ahi, 2015; Ahi & Kahriman- Pamuk, 2021; Sak, 2023), and primary school children (Desjean-Perrotta, 2013) and college students (Wuellner et al., 2017) created unrelated drawings in the pre-test phase of the study. These percentages were higher than those in the present study, and one in five of the children drew a relational model by scoring 5-8 points. In comparison, Ahi et al. (2017) found that more than half of teacher candidates and two out of three undergraduate students (Liu & Lin, 2015) created unrelated models by indicating the factor as present without demonstrating meaningful connections between them. This rate is slightly higher than the mothers in the current study. In the studies, less than half of the participants produced relational models, and only a limited number of individuals demonstrated a systems approach; these results were closely similar to the mothers in the present study and consistent with the literature (Ahi et al., 2017; Moseley et al., 2010). These results reveal that the environmental mental models of children and mothers are largely unrelated, one-dimensional, and require systemic integration.

When these results were discussed with the previous research, Shepardson et al. (2007) argued that environmental education and educational materials were insufficient to promote scientific environmental mental models. In addition, it was stated that students were rarely given enough opportunities to engage in meaningful discussions and make sense of the concept of the environment through lessons, which resulted in the formation of superficial mental models. (Liu & Lin, 2015). To develop more advanced mental models about the environment, it was emphasized that educational settings should provide learners with enriched experiences related to environmental systems (Çalış-Şaşı & Balcı, 2021). For example, in the study of Ahi (2015) regarding the development of human model components for the environment, more than half of the children did not include a human figure before the intervention but the education was effective in promoting children to include human figures in their drawings. Similarly, Wuellner et al. (2017) compared university students' mental models about the environment with the drawings at the beginning and end of the semester; while almost half of the students did not include the human figure in their environmental drawings at the beginning of the semester, this percentage increased significantly after the environmental education.

Another possible explanation is that, in some studies, the absence of human components in mental models of the environment was associated with individuals perceiving the environment as a natural entity, largely independent of human influence and intervention (Moseley et al., 2010; Desjean-Perrotta, 2013; Payne, 2014; Liu & Lin, 2015; Ahi et al., 2017). However, previous studies have emphasized that students with more comprehensive and holistic mental models establish a stronger bond with the environment and have a greater sense of responsibility towards it (Liu & Lin, 2015). Also, the age difference has been identified as an important factor in the studies. Bruni and Schultz (2010) found that the implicit connection established by children aged 10–12 with nature was higher than that of university students and environmental activists. Similarly, Loughland, Reid, and Petocz (2002) emphasized that perceiving the environment merely as an object hinders individuals from developing a sense of environmental responsibility, often leading to a lack of engagement in environmentally related actions. This finding suggests that when children perceive themselves as part of the environment,

their connection to it strengthens. Additionally, interest in the environment may have decreased over time, as shown by the decline in this connection with age. Similarly, in the current study, children's more frequent use of human figures in their drawings indicates a potentially stronger relationship with the environment compared to their mothers. In contrast, mothers' less frequent inclusion of human figures suggests that their connection with nature might have weakened due to factors such as increased screen time, greater exposure to built environments, and changes in daily life practices (Bruni & Schultz, 2010).

Another possible explanation for the limited human figure stated by Moseley et al. (2010) was the inadequacy of teacher education programs in developing a conceptual environmental model that includes human, living, abiotic, and built factors holistically. Similarly, Shepardson et al. (2007) argued that environmental education has been restructured with an approach based on revealing students' personal experiences with the environment and critically questioning these experiences, rather than focusing only on predefined topics. As a result, children and mothers included the human figure without relating it to other environmental factors. It was stated that the holistic and systems approach included in the definition of NAEE (2004) would not be fully understood by individuals, and this was explained by inadequate programming in the education system (Shepardson et al., 2007; Çalış-Şaşı & Balci, 2021).

When the drawings were examined in general, children often depicted the environment by associating it with nature through living and abiotic components without including human components (Moula, Walshe & Lee, 2021; Ahi & Kahrman-Pamuk, 2021; Moseley). The reasons for these results can be listed as follows. Studies revealed that children's environmental perceptions were largely shaped by plants and animals they frequently observe in their daily lives (Fraijo-Sing et al., 2020; Özsoy, 2012). Common components such as trees, flowers, birds, mountains, fruits, etc., in their drawings, reflect these direct experiences (Fraijo-Sing et al., 2020). In addition, it was stated that interest in animals can be a starting point in the development of their awareness of the environment (Flowers et al., 2015). These results indicate that children associate the concept of environment with

familiar living objects they can perceive and recognize in their immediate surroundings. As Fraijo-Sing et al. (2020) also indicated, while children often include familiar living components in their drawings, they sometimes use symbols that are not found in their direct surroundings. This situation can be explained by the effect of indirect experiences obtained from the media or various materials (Shepardson, 2005). In addition, the inclusion of facial expressions on the figures can show that they may establish an emotional connection with nature (Fraijo-Sing et al., 2020), which was mainly observed in the current study.

The frequent representation of both living and abiotic components may also be related to how children conceptualize the environment. Shepardson (2007) mentioned that middle and high school students often realize the environment as a system consisting of living and non-living components, even though they took environmental science education, the effects of this education on students' conceptualization of the environment were limited. It was attributed to the prototypical environmental perception in books, for example, forests, mountains, and rivers. According to Shepardson (2007), textbooks and curriculum programs generally adopt an ecosystem perspective, or a view of the environment reduced to pollution, but this hinders the development of a conceptual and system-based environmental model. It was consistent with the results of the current study that children and mothers often produced unrelated models. It was also found that although preschool children drew objects such as trees, children, flowers, and birds that they observed in the environment, they had difficulty expressing the ecological relationships between these objects (Taşkın & Şahin, 2008). This may be related to both the developmental stage of the children and their limited environmental experiences. The presence of similar patterns in the primary school students indicates that a lack of direct observations or experiential learning may also restrict the development of deeper environmental understanding (Çalış-Şaşı & Balcı, 2021).

The tendency of young children depicts the components they observe and experience in their drawings can be explained through Piaget's theory of cognitive development, particularly the preoperational stage. During this period, children develop symbolic thinking that enables them to think about objects and events (Bredekamp & Joseph

2013). However, they also exhibit egocentric thinking and believe that their own perspectives and conceptualizations are correct and valid to everyone, which limits their ability to understand broader or alternative viewpoints. Since abstract thinking has not developed, they struggle to think of the multi-level aspects of ideas but tend to focus on a single dimension. Also, children in this stage engage in intuitive thinking; they focus on a single dimension and have difficulty establishing two-way relationships, focusing on the objects they see and experience in their environment (Müller, Eycke & Baker, pp.143). In addition, as mentioned before, children have drawn the objects they observe in their close environment and living and abiotic components are the most common daily life components that children encounter. Accordingly, Bronfenbrenner's ecological systems theory indicates that children are primarily affected by their social interactions and experiences (Bredekamp & Joseph 2013). The microsystem includes the children's school, family, and daycare centers, which are these daily experiences called "proximal processes" and are the most important feature affecting their development (Bredekamp & Joseph 2013). From this perspective, the daily conversations children have with their parents, teachers, and peers, the areas they play in, and the objects they encounter in their home-school environment all contribute to their environmental understanding and are directly reflected in their drawings. Therefore, children's frequent inclusion of concrete, familiar environmental components in their drawings can be interpreted as a result of both their cognitive development stage and the influence of their ecological context. As an example, Ahi and Kahrman-Pamuk (2021) studied preschool children attending forest schools. The findings revealed that children in forest schools, who had more direct and frequent experiences with environment, primarily included biotic and abiotic components in their drawings and exhibited more positive attitudes and protective behaviors towards the environment. These results emphasize the importance of the microsystem context defined in Bronfenbrenner's ecological systems theory. The diversity and quality of children's direct learning environments, especially their opportunities for hands-on experiences with environment, significantly shape their environmental awareness and attitudes, which would contribute to differences in educational systems and children's microsystem interactions.

In addition, the tendency to depict their immediate environment can be explained by Bruner's "modes of representation" model. According to this model, during the mental representation process of mental representation, the children organize the mental images obtained from visual or other sensory experiences and process a stage called the "iconic mode of representation" (Bruner, 1977, pp. 11–12). As the children gain experience with these mental images, they do not need physical objects themselves, but instead use their iconic representations (Bruner, 1977, pp. 34–35). Accordingly, children frequently include concrete environmental components such as "living" (e.g., tree, bird, flower) and "abiotic" (e.g., sun, water, cloud) in their drawings may be related to their frequent experience of these components visually and recall these experiences more easily through iconic representations.

In addition, these results can be interpreted through the mental model theory. Mental models are the fundamental cognitive structures that shape how individuals perceive the world and how they respond to the environment (Langan & Fox, 2001). These models begin to develop from birth through interaction with the environment (Krcmar & Hight, 2007) and become more complex as it is affected by the individual's prior knowledge, reasoning skills, and social observations (Nersessian, 2002). However, in the present study, although children had iconic representations in their minds of environmental components, these mental models were expressed unrelatedly. It may suggest that both children and mothers have a limited understanding of modeling the environment within a holistic and multi-dimensional system. This may indicate that environmental mental models are not fully integrated with the mental models, but they can be developed and shaped accordingly through education and experience (Krcmar & Hight, 2007). As Desjean-Perrotta, Moseley, and Cantu (2008) also stated, there is a clear lack of understanding even among teachers about how environmental components interact within a system. This finding suggests that adults' environmental experiences often remain at a one-dimensional level, which consists of the presence of the objects. Indeed, Ausubel et al. (1978) emphasized that teachers should identify individuals' faulty or incomplete mental models and contribute to the development of these models. However, Shepardson et al. (2007) argue that while individuals' environmental literacy should be developed, mental models should not conflict with scientific models. Therefore, it is important

to support not only children's but also parents' environmental thinking styles and to structure their mental models.

Finally, the finding that mothers included built environment components more than children can be attributed to their definitions of the environment developing with education (Moseley et al., 2010). In addition, the quality of environmental experiences can also affect these representations. Shepardson et al. (2007) revealed that individuals' understanding of the environment differs according to the type of environment they live in; individuals who spend more time in the built environment tend to define such components as the environment. In this context, the inclusion of built environment components encountered in daily life, such as home, school, classroom, and car in drawings, was directly related to the individual's environmental experiences (Moseley et al., 2010).

In conclusion, according to the findings obtained from the quantitative study data, when evaluated in the context of mental model theory, it can be concluded that both children's and their mothers' understanding of the environment is shaped by observations and experiences in daily life but was not sufficiently integrated and supported by scientific foundations in terms of system and relation. Studies in the literature (Blanche Desjean-Perrotta et al., 2008; Alerby, 2000; Shepardson et al., 2007) also emphasize that environmental knowledge and awareness often remain superficial, not only in children but also in adults, and that systems thinking is not fully developed. Therefore, this study indicates that the environmental mental models of both children and parents should be developed in line with scientific knowledge and system-based approaches.

Additionally, this study examined how gender differences among preschool children affect their environmental mental models. In terms of gender differences in the current study, girls scored higher than boys in built, abiotic sub-dimensions, and total score sub-dimensions, and this difference was found to be statistically significant. This result showed that girls' mental models of the environment may be more integrated and comprehensive than boys'. However, this result contradicted some previous studies conducted with the DAET-R scale. When these results were

compared with the literature, no statistically significant difference was found between girls and boys in the studies conducted by Ahi et al. (2017) and Çalış-Şaşı and Balcı (2021). Similarly, when this scale was applied to university students, it was revealed that students' mental models did not differ significantly according to gender; however, gender was a determinant of environmental effect and behavioral intention (Liu and Lin, 2015). Although it differs from the literature in this respect, when other environmental studies are examined in general, it was observed that girls are more prominent in environmental issues. For example, it was demonstrated in various studies that female students were more sensitive in their behaviors regarding environmental issues compared to male students (Çelik & Doğru, 2019; Yılmaz & Andersen, 2004), had higher implicit commitment to nature (Schultz & Tabanico, 2007), and had more developed levels of identification with nature (Bruni & Schultz, 2010).

At the attitude level, it was revealed in many studies that girls have more positive attitudes toward the environment (Gökçe et al., 2007; Tikka et al., 2000; Leppänen et al., 2012). In particular, in the study of Tikka et al. (2000), it was found that female undergraduate students developed more positive attitudes towards the environment; however, male students had higher levels of environmental knowledge. Similarly, the findings of Boeve-de Pauw et al. (2011) showed that female students have more environmentalist views than male students. Explanations regarding the reasons for these attitudinal differences have been largely associated with gender roles and socialization processes. For example, Collado, Evans & Sorrel (2017), revealed that girls were more influenced by social agents (especially family and friends) in their attitudes and behaviors towards the environment than boys. These findings indicated that gender may play an important role in attitudes, behaviors, and mental representations towards the environment. However, traditionalist approaches had attempted to explain this difference with gender roles (Davidson & Freudenburg, 1996; Gilligan, 1982; Zelenzky et al., 2002). Accordingly, social environments teach individuals how to behave in a traditionally masculine and feminine manner, which may lead to differing levels of environmental concerns (Strapko, MacIlroy & Smith, 2016). Similarly, Davidson and Freudenburg (1996) stated that women perceive environmental risks more seriously than men and that this difference may be related

to social roles such as women being held responsible for children and the home environment, caregiving, and domestic responsibilities, and a lower perception of control over environmental threats. However, Xiao & McCright (2012) stated in their findings that social roles (e.g., full-time work, parenting, housework) were not effective in explaining this difference and that gender differences mostly stem from individuals' socialization experiences. Similarly, Strapko et al. (2016) stated that gender differences in environmental concerns may be explained more significantly not only by being female or male but also by the individual value orientations attributed to these genders. Accordingly, Xiao and McCright (2012) stated that women are more successful in perceiving environmental risks, which increases the level of anxiety, and that there may be an indirect relationship between gender and anxiety. Females are also more sensitive to environmental health problems (Davidson & Freudenburg, 1996; Xiao & McCright, 2012). Accordingly, it was found that the "ethic of care" value orientation was positively related to environmental concerns in both females and males (Xiao & McCright, 2012). This approach also overlaps with the understanding of care ethics put forward by Gilligan (1982). Gilligan (1982) stated that females form their ethical decisions based on strengthening relational ties, empathy, compassion, and responsibility, which may cause them to develop a more sensitive attitude toward environmental issues. In this context, the fact that girls have higher environmental awareness scores may be associated with their being directed towards care-oriented values (ethics of care) from an early age.

This difference is not only based on a biological basis but also on socially learned value systems. In addition, according to gendered risk perception theory, girls may tend to score higher in environmental awareness tests because they can perceive environmental threats as more dangerous and more direct risks to themselves (Davidson & Freudenburg, 1996; Xiao & McCright, 2012). The result that girls obtained higher scores may be explained by social roles, learned behaviors, or individual behaviors attributed to gender. In conclusion, the findings of this study have shown that gender may influence environmental mental models at explicit and implicit levels, and this effect may be based on biological foundations and social and cultural learning processes.

In terms of children's and their mothers' DAET-R scores based on participation in environmental activities, the current study examined the effect of the frequency of children's and mothers' participation in environmental activities on environmental mental models. According to the results, it was observed that children who participated in environmental activities with their mothers had higher abiotic and total scores. Also, there was a statistically significant difference in the mother's independent participation in the environmental activities in the total scores. These results were supported by the literature showing that socialization plays an important role in children's transition from knowledge to active participation (Veselinovska & Osogovska, 2012). Indeed, children preferred activities that involved spending time in nature, such as arranging green areas (72.9%), over activities that could be conducted at school, but children stated that they wanted to participate in environmental activities with their friends (Veselinovska & Osogovska, 2012). In this context, environmental activities carried out by children with their mothers can be seen as an important socialization tool in the development of environmental mental models when evaluated in terms of social learning processes. In addition, a significant difference was observed in the total scores of mothers who participated in environmental activities individually. These findings were supported by the literature; mental models are structures derived and influenced by individuals' expectations, beliefs, and previous experiences, and are also transmitted through cultural and social mechanisms (Holtrop et al., 2021). Similarly, Nersessian (2002) detailed that the quality, functioning, and originality of the mental models used by individuals were related to the individual's reasoning skills and prior knowledge; these structures develop with new learning. It was emphasized that environmental education should not be based solely on the transfer of information but should allow individuals to learn by directly experiencing the environment they live in (Moseley et al., 2010; Shepardson et al., 2007). Therefore, environmental education processes may be built based on the local environment, personal experiences, and past experiences. Ballantyne (2001) observed positive changes in the environmental behaviors of children who actively learned and put into practice environmental issues, and it was also indicated that these children participated in conversations and discussions about the environment. This supports the fact that personal experiences and individual mental models play a critical role in the formation of environmental

mental model. Similarly, Baur and Haase (2015) provided environmental education that included active participation in one group of children, and environmental education based only on knowledge in the other group. In the group that actively participated it observed an improvement in waste separation behaviors was observed. In contrast, although there was an increase in the level of knowledge in the group that only received education, this was not reflected in behavioral change. These findings emphasize the importance of active participation in environmental issues. In addition, Tabanico and Shultz (2010) emphasized in their studies that connections with nature increase with experience. In this study, it was found that people who spent more time in nature had higher implicit connections with nature. In addition, even spending a day in a natural park strengthened these connections (Tabanico & Shultz, 2010). However, for this connection to strengthen, the time spent, and its frequency must also increase (Cheng & Monroe, 2012; Tabanico & Shultz, 2010). Children's direct experiences in nature have also been effective in the level of ecological awareness (Howlett & Turner, 2023). In studies conducted on adults, the frequency of exposure to nature changes the individual's definitions and perceptions of nature (DeVille et al., 2021). As Louv (2006) also stated, today's children live deprived of nature. However, spending time freely in nature allows children to better understand the environment. On the other hand, Bruni and Schultz (2010) reached a finding that contradicts this view. In their study, it was found that children spending time outside did not affect their implicit connectedness with nature. Indeed, in the present study, the significant differences observed in the DAET-R scores of the participants who stated that they participated in environmental activities were limited.

However, Ahi and Kahrman-Pamuk (2021) revealed in their study that children who received education in nature schools drew more living-focused pictures, and it was supported by the first-hand daily experiences that the children had directly with nature. However, in the study by Köşker (2019), approximately one-third of the children expressed nature as "distant areas", but 89% of the children stated that they liked being in nature, and these included fun activities. Similar results were also found by Wals (1994), who defined nature as fun areas; accordingly, it included activities such as picnic areas, camping, holiday resorts, and listening to and

watching animals. In addition, as given in the demographic information form, almost all of the children participating in the study lived in the city center. According to Howlett and Turner (2023), in order to enhance the environmental contribution of urban centers, instead of merely increasing green areas, these areas should be arranged to provide interactive experiences for individuals. Accordingly, children spend time passively in green areas, which may suggest these experiences may not be sufficient for fostering environmental awareness. Howlett and Turner (2023) found that children were unable to provide detailed information about plants, which indicated a superficial level of knowledge that is consistent with the findings of the present study.

In conclusion, this study demonstrated that environmentally based experiences were important in the development of environmental mental models, but passive participation may be insufficient in this process, which generally coincides with the low scores and non-integrating figures obtained from the DAET-R scale. In contrast, educational environments in which individuals actively engage and were based on discovery and integrated with socialization processes may be provided.

In terms of mother's environmental mental models scores by education level, the current study, the effect of mothers' education levels (undergraduate degree or above, associate's degree or below) on environmental mental models was examined, and it was found that there was a significant difference in DAET-R scores of mothers with higher education levels. Thus, mothers with an undergraduate degree or above had higher scores in abiotic, built sub-dimensions, and total scores compared to the group with an associate degree or below, and this difference was statistically significant. These results suggested that mothers with higher education levels may have more environmentally related and developed mental models. However, in existing DAET-R studies, generally, grade levels or duration of education were examined, rather than the education level itself. In the study by Ahi et al. (2017), the DAET-R scores were analyzed as grade difference rather than education level, and statistically significant differences were observed. However, this difference was not found in the study by Liu and Lin (2015), which also focused on grade differences. Shepardson (2007) also examined it based on grade levels and did not find

differences between grades and stated that the child defined the environment with living and abiotic components. As a result, the DAET-R scale has been used to examine the level of education of the participants in the literature to a limited extent, but the present study revealed significant differences in the environmental mental models of mothers depending on their education level. This finding corresponds to the studies in the literature that reveal the positive effect of the level of education on environmental attitudes and behaviors (Torgler & García-Valiñas, 2007; Leppänen et al., 2012). In particular, in the study of Leppänen et al. (2012), it was found that mothers with a university education exhibited more positive environmental attitudes, and this was supported by the more developed mental models in the current study.

Moreover, numerous studies have highlighted the significant role of educational levels in shaping environmentally responsible behaviors. It has been reported that the willingness to pay for the protection of wetlands in the surrounding area (Blomquist & Whitehead, 1998), environmental measures (Engel & Pötschke, 1998), and environmentally friendly transportation practices (Veisten et al., 2004) increases with the level of education of individuals. It has been also revealed that individuals with higher education levels contribute more to the use of renewable energy and environmental awareness (Özçiçek & Ağpak, 2017; Özbay & Duyar, 2022). Similarly, Tang, Abosedra, and Naghavi (2020) emphasize that effective environmental policies can only be implemented sustainably in societies with higher education levels. De Silva and Pownall (2014) found that individuals' preferences between environmental sustainability and social and financial well-being increase with the development of the level of education. Accordingly, higher education graduates may make more environmentally friendly choices. In particular, education is of great importance in the processes of assessing climate change risks, combating these risks, and adapting to new environmental conditions (Czarnek et al., 2021; Lutz et al., 2014). Indeed, Czarnek et al. (2021) found that highly educated individuals showed more support for environmental policies. Meyer (2015) revealed that the duration of education, even an additional year, directly increases the environmental behavior of the individual. Jowett et al. (2014) supported the importance of the increase in the level of education and showed that the changes in the environmental

attitudes of university students significantly improved during the higher education process. This finding was also supported by the study of Çalış-Şaşı and Balcı (2021). In the study conducted using the DAET-R scale, the environmental mental models of 3rd and 4th graders were compared, and found that the older age group scored higher in total scores. Israel & Levinson (2004) reported that as the level of education increases, environmental sensitivity and tendencies towards protecting the environment also increase. It was stated that the level of education significantly affects environmental concern in all measurement approaches, and it was emphasized that this effect was also valid at the international level (Klineberg, McKeever & Rothenbach, 1998; Xiao, Dunlap & Hong, 2013). As a result, it has been stated in the literature that there were significant differences between the level of education and various variables such as environmental attitude, behavior, sensitivity, and anxiety. The present study contributes to the literature by revealing significant differences in mothers' environmental mental models based on education level.

5.2.1 The Relationship between Children's and Mothers' Environmental Mental Models Based on DAET-R Scores

According to the results of the current study, a significant and positive relationship was found between the total scores of children and mothers on the DAET-R scale and the living sub-dimension. The results indicated that there was a low but statistically significant relationship between the living and total scores of children and mothers in terms of environmental mental models.

However, the findings regarding the Human sub-dimension revealed that children mostly drew themselves while mothers mostly drew their children. The low correlation coefficient found in this sub-dimension indicates that the effect of human components on the intergenerational transmission of environmental mental models may be limited. In addition, mental model differences emerged between children and mothers in the abiotic and built sub-dimensions. It was observed that children preferred visual codes such as sun, cloud, sea, and rainbow, while mothers focused on visual codes such as sun, cloud, river, and mountain. These findings may be due to factors such as individual experiences of the environmental mental models

between generations, differentiation of places of residence, insufficient social interaction, and less time spent in nature. Indeed, in the process of learning environmental values, children should actively internalize these values after learning and acquiring them through the socialization process (family, school, media) (Grønhøj & Thøgersen, 2009; Chawla & Derr, 2012). Accordingly, through joint attention, children learn what others value and notice, and over time, they direct their attention to issues that reflect the shared values of those around them (Chawla & Derr, 2012). Families engage in these behaviors with children as role models for environmentally friendly behaviors, but passive modeling may not be sufficient for the transmission of these behaviors; children are required to participate actively, and the family should reinforce the desired behaviors during the process (Grønhøj & Thøgersen, 2009). Thus, children's perspectives on the environment are developed and shaped by reinforcing their interests and supporting them through socialization. Indeed, the findings that environmental issues are shaped between the child and the mother in the context of intergenerational transmission theory have been supported by the literature. These results demonstrated that the mother's environmental behaviors can be transmitted to children through socialization. In the literature, this conception was associated with intergenerational transmission, which means that the individual's behaviors are affected by early life experiences concerning social interactions between family members (Handy, Katz-Gerro, Greenspan & Vered, 2021).

When the literature was examined, there was also a positive relationship between the children's and parents' environmental issues. Previous research also supports the idea that parents' environmental behaviors can be transmitted to their children through socialization (Leppänen et al., 2012; Liu, Chen & Dang, 2022; Meeusen, 2014). On the other hand, correlational studies have shown that children also affect their parents' environmental literacy and affinity (Liu et al., 2022) and that they transfer environmental knowledge and pro-environmental behaviors to their parents (Kong & Jia, 2023). Accordingly, environmental values and behaviors can be transferred to between generations through socialization within families, and the current study supports this transmission process, even though the correlation was relatively low.

In terms of behavioral transmission, Handy et al. (2021) found correlations between environmental behaviors according to correlation results between children and parents, according to which both generations (18-28 years old young adults and 42-62 years old parents) engaged in activities such as similar electricity and water consumption, purchasing organic food and environmentally friendly food, repairing clothes, donating, participating in outdoor activities. However, there was no similarity in other behaviors such as recycling, obtaining environmental information, and plastic use (Handy et al., 2021). Similarly, in the study conducted with adolescents, similarity was observed between parents and children in purchasing organic and environmentally friendly products, similar to young adults (Grønhøj & Thøgersen, 2009). Compared to attitudes, similarities in behaviors are greater (Grønhøj & Thøgersen, 2009). However, the literature emphasizes that parents have more positive pro-environmental behaviors (Grønhøj & Thøgersen, 2009) and attitudes than children (Leppänen et al., 2012; Meeusen, 2014; Cheng & Monroe, 2012). This result was also supported in the current study, which may be explained by the fact that the younger generation is more distant from nature and the older generation spends more time in the environment (Leppänen et al., 2012). According to Grønhøj and Thøgersen (2009), the parents have gained greater environmental experience and a deeper understanding of the rationale behind pro-environmental behaviors, which can be attributed to their life stage and having deeper knowledge. In contrast, the preschool-aged children in the current study may have more limited environmental experiences. In addition to behaviors, the intergenerational transmission of ecological values was examined in the literature, and a significant relationship was found (Scopelliti, Barni & Rinallo, 2022; Cheng & Monroe, 2012). Similar to the present study, Scopelliti et al. (2022) found a correlation between mothers' environmental values and the recycling and waste reduction behaviors of their young adults (aged 18–30). However, there is a limited study in the early childhood area, although the correlation was low, the findings suggest that mothers may influence the development of children's environmental mental models, which is consistent with the literature.

Studies conducted in younger age groups revealed that environmental behavior is more effectively transmitted across generations during early childhood. Matthies et

al. (2012) showed that parents' recycling habits in children aged 8-10 were also reflected in their children. Accordingly, Collado, et al. (2017), when the age groups of intergenerational transmission were examined, it was found that children in the younger age group (9-13 years old) were more affected by socialization and showed more similarities with their parents in this respect.

In the current study, a relationship was found between the mental models of children and mothers, which may be related to social learning processes and the modeling role of mothers in daily life. In addition to socialization, talking about environmental issues within the family also positively affects this process (Meeusen, 2014). Accordingly, families can transfer these concerns to their children as a result of their communication about environmental concerns (Meeusen, 2014). Similarly, Matthies et al. (2012) examined environmental issues in their study and found that conversations about the environment positively affected children's awareness. However, the transfer of these concerns and attitudes between generations is only moderate in strength (Meeusen, 2014). Despite its significance, limited attention has been given to the intergenerational transmission of environmental understanding during the preschool years. In this context, the present study addresses a critical gap by exploring how environmental mental models are transmitted across generations at an early developmental stage. In fact, this study supports the possibility of this transmission at an early age and shows that children begin to be affected by their parents' environmental behaviors and attitudes while they are still in preschool, and that both may be mental models influenced together, so children may also affect their mothers' mental models. This finding emphasizes the importance of social learning and socialization processes in developing environmental mental models from an early age. Thus, it highlights the importance of prioritizing environmental education and family-centered strategies from an early age.

Similarly, in the studies conducted by Grønhøj and Thøgersen (2009) and Collado, Evans, and Sorrel (2017), significant but low-level correlations were found between the environmental perceptions and attitudes of children and parents, which findings are consistent with those of the present study. According to Meeusen (2014), such low relationships may stem from the limited focus of families on environmental

issues, and children may adopt their parents as role models when they engage in concrete behaviors and consistent environmental behaviors, thereby increasing the visibility and impact of those attitudes. Matthies et al. (2012) stated that the behaviors that children and parents engage in together or the existence of visible processes affect this transfer. As a result, children should communicate with their parents on environmental issues, and parents should be role models for children with concrete behaviors. According to Collado et al. (2017), the reason for this low correlation is that children are not only influenced by their parents but also by their friends. According to Chawla and Derr (2012), children can also be influenced by media and books on environmental issues. Another idea that may affect this transfer is that in a study conducted with primary school children and their parents, it was found that making moral evaluations was effective in the intergenerational transfer of environmentalist behaviors (Giancola et al., 2024). A significant relationship was found between parents and children, especially regarding not harming animals and plants (Giancola et al., 2024). Accordingly, when children think about the moral consequences of harming the environment, they feel more responsible and internalize environmental problems better (Giancola et al., 2024). Similarly, since the children in the current study were at the preschool level, they may have difficulty morally questioning and internalizing environmental behaviors. Thus, as indicated in the literature, mother–child communication around environmental issues should be encouraged, mothers should serve as role models and engage in concrete observations and experiences together in the environment and finally guide children to question morally and realize the consequences of their behaviors.

Moreover, Cheng and Monroe (2012) emphasized the role of empathy in shaping and developing environmental values. According to their findings, children with higher empathy skills for nature often display this behavior through family interactions and their parents' modelling actions. As a result, these children are more likely to spend time outdoors, develop stronger environmental attitudes, and have greater self-efficacy. When these findings are considered together, then, it can be argued that an approach based on multidimensional interactions provides information and fosters moral awareness, empathy, self-efficacy, experiential learning, role modeling, and concrete learning experiences between children and mothers may be most effective.

Finally, a positive significant correlation was found only in the living sub-dimension and total scores in the study, but no correlation was found in the human, abiotic, and built sub-dimensions. This result is consistent with previous research. Collado, Corraliza & Ruiz (2015) also reported no significant correlations. Accordingly, children may not yet have the developmental capacity to model their parents' environmental mental representations effectively because learning occurs through reward, praise, and punishment in traditional education systems (Rogoff et al., 2003). Also, parents may be inadequate in transferring their environmental knowledge and attitudes to children when they do not use these external motivations (Collado et al., 2017).

Overall, these findings indicate that intergenerational transmission of environmental mental models is possible between children and their mothers. Still, the children should have deeper engagement with their mothers and immediate environment, through role modeling, and developmentally appropriate support to foster relational environmental mental models.

5.3. Educational Implications of the Study

The findings of this study offer important implications for shaping environmental education in early childhood. First of all, in both groups, the human sub-dimension was represented the least frequently. However, children receive higher scores than mothers in the human sub-dimension, and it was concluded that human figures are more frequently included in children's mental models than their mothers. This finding is consistent with previous studies (Ahi, 2015; Çalış- Şaşı & Balcı, 2021; Flowers et al., 2015; Moseley et al., 2010). These findings demonstrated that children do not perceive human figures as part of the environment, and at the same time, they also emphasized the shortcomings of the current environmental education. In addition, important processes such as discussion and interpretation are often missing in environmental education courses and are mainly centered around the concept of "nature and natural resources" (Liu & Lin, 2015; Moseley et al., 2010; Ahi & Kahrman-Pamuk, 2021). Another reason that may contribute to the absence of human figures in the drawings is the possible lack of learning environments that

enhance children's environmental experiences (Çalış- Şaşı & Balcı, 2021). Indeed, Shepardson et al. (2007) emphasized that environmental education and learning areas are recommended to be structured to reflect children's experiences with the environment and within a perspective that not only introduces nature but also includes individuals' attitudes and behaviors towards the environment. Indeed, the Tbilisi Declaration (1977) emphasized that environmental education is essential to be accessible to all age groups, with the importance of initiating such education in early childhood. Furthermore, this declaration highlighted that it is crucial to address environmental education not only through natural systems but also through its interaction with human actions and emphasized the transformative effects of daily life practices and activities on the environment. In this manner, it was emphasized that to raise preschoolers as environmentally literate and environmentally ethical individuals, they may be educated to conceptualize the human factor in the environment (Cengizoglu et al., 2022). As a result, environmental programs that are implemented from early childhood may focus not only on protecting nature but also on the mutual relationship between humans and the environment, increasing interaction with the environment through experiences, and providing discussion environments. In addition, it is important to include not only children but also mothers in environmental education processes and encourage them to talk about human and environmental interactions. Therefore, there is a need to create environmental programs in early childhood education to help children understand the interaction between humans and the environment, recognize the role of humans in driving change, and learn how their actions can impact the environment (NAEE, 2019).

Despite the limited inclusion of human figures, mothers and children received the highest scores in the "living" sub-dimension and frequently included related figures such as trees, flowers, and grass in their drawings; these findings are consistent with previous studies (Ahi et al., 2017; Collado et al., 2016; Flowers et al., 2015; Günindi, 2012; Kalvaitis & Monhardt, 2010). The reason for this, as previously discussed, is that the environment is widely perceived through nature and the natural system, and they are frequently observed in everyday life (Fraijo-Sing et al., 2020; Özsor, 2012). In addition, this environmental model may be shaped by prototypical environment

representations from books, which include mountains, rivers, and trees (Shepardson, 2007), and children may have difficulty explaining interrelationships among these components (Taşkın & Şahin, 2008). Also, instead of focusing only on environmental pollution, the priority is required to be given to a system-based approach that investigates the causes of pollution (Shepardson, 2007). In this respect, both teachers and mothers are expected to educate children about the environment not only through depictions of green areas but also by including human influence and other factors, while fostering children's ability to understand the cause-and-effect relationships in the environmental systems.

Another finding of this study was that children and mothers frequently drew houses in the built category, which was consistent with the previous research (Ahi, 2015; Çalış-Şaşı & Balcı, 2021; Günindi, 2012; Köşker, 2019). In addition, children frequently included playgrounds, which were also supported by the literature (Ahi, 2015; Flowers et al., 2015). In terms of mental models' theory, individuals' experiences and personal lives form the foundation of their mental representations (Jones et al., 2011). Accordingly, spending frequent time in the park was reflected in their perceptions and integrated into their mental models.

In addition, frequent depictions of living and abiotic components that they observed around were also reflected in these mental models and were explained with the idea of "here and now" (Alerby, 2000). These findings are also consistent with Piaget's preoperational stage because children have egocentric thoughts and perceptions limited to their environment (Bredenkamp & Joseph, 2013). Accordingly, children may begin to develop more global perspectives as they get older while addressing local figures and problems in their immediate environment (Alerby, 2000). Therefore, programs designed for preschool children incorporate more local figures, issues, and problems.

Another finding of the study was that approximately 70% of children's drawings and approximately 53% of mothers' drawings included unrelated modeling (factor present), and this finding is supported by previous studies (Ahi et al., 2017; Ahi & Kahrıman-Pamuk, 2021; Moseley et al., 2010). These unsystematic mental models

have not been integrated and are often evaluated at a superficial level, and in this respect (Desjean-Perrotta et al. 2008). Therefore, contributions are recommended to be focused on detecting these unrelated models and developing these models scientifically (Ausubel et al., 1978). In this respect, the skills that need to be developed at the preschool to primary education level include a) understanding and exploring environmental issues, investigating environmental problems, b) evaluating the results of problems and trying them again, c) offering and developing alternative solutions, d) having different environmental perspectives along with flexibility and creativity (NAAEE, 2019). Within the microsystem, children's environmental understanding is shaped by their social interactions and everyday experiences, including communication channels, play areas, and objects in their immediate environment (Bredekamp & Joseph 2013). Therefore, these skills are supported within preschool programs, with particular emphasis on fostering parent involvement programs in their development. Such approaches can help children balance their egocentric perspective and grasp the concept of the environment more comprehensively.

Another important finding of the study was that girls received higher scores than boys in built, abiotic, and total scores. Indeed, Collado et al. (2017) emphasized that girls are more influenced by socialization processes. In general, in environmental studies, differences between girls and boys were found and explained based on traditional gender roles.

Indeed, these differences may have been found through these social roles, for example, girls being directed towards care and protection, but these gender roles are essential to be changed in the classroom and family environments. Education programs and teachers are expected to include strategies that balance these different interests and approaches that emerge at an early age. In addition, based on the idea that gender roles develop in the preschool period, mothers and teachers are encouraged to ensure and support the participation of girls and boys in environmental experiences, and they need to be encouraged to participate in these activities together.

Another important finding of the current study was the differences in participation frequency in environmental activities. While a significant difference was observed in the abiotic and total scores of children who participated in environmental activities with their mothers, a significant difference was observed in the total scores of mothers' independent participation in environmental activities. Moreover, the importance of previous and active experiences in the formation of mental models has been stated and can be transferred through socialization (Holtrop et al. 2021). Accordingly, direct interaction and engagement with nature are particularly effective in fostering desired environmental behaviors (Baur & Haase, 2015).

However, with the increase in time spent (Tabanico & Shultz, 2010), the types of activities performed are also important (Thapa, 2010). Programs that incorporate active participation (Thapa, 2010), nature-based sports (Çetinkaya, 2015), unstructured and exploratory play (Louv, 2006), and daily first-hand experiences in outdoor settings (Ahi & Kahriman-Pamuk, 2021) are required to be integrated into early childhood education. These experiences contribute to building a strong connection with nature in the early years, which in turn increases the likelihood of environmentally responsible behavior later in life (Chawla, 2020; Otto & Pensini, 2017). As a result, environmental experiences gained through time spent with the mother in environmental areas or through school-based activities can be transmitted in mother-child interactions, and this transmission is bidirectional. In this respect, while the mother affects the children's mental models, the children also affect the mother's mental models. Thus, it is important to design for both the children and their mothers in terms of environmental issues.

In this respect, teachers are also encouraged to participate in programs that support parents' engagement in environmental education, and they are expected to be guided and encouraged throughout this process. Another key finding of the study is that higher levels of mothers' education are associated with increased scores in the abiotic, built, and total scores. Meyer (2015) found that even a one-year increase in education duration positively affects environmental behaviors, which was also consistent with the current study. This difference emphasizes that mothers with lower levels of education need to be supported in family-based environmental education

programs. Such programs can strengthen environmental knowledge and awareness, benefiting both mothers and children in terms of mental models.

Finally, another important finding of the study was the examination of the relationships between children and mothers on the DAET-R scale. According to the results, a significant and positive relationship was found between the total score and the living sub-dimension. Moreover, there are limited studies in the literature on the transfer of children's and mothers' mental models of the environment, and this study fills the research gap in this respect. This finding is consistent with the theory of intergenerational transmission that children's behaviors are affected by their interactions with family members (Handy et al., 2021). Similar to the current study, low-level correlations were found in studies on environmental perception and attitudes (Grønhøj & Thøgersen, 2009; 2012; Evans and Sorrel, 2017). However, this low correlation is due to reasons such as the mother not being a sufficient role model (Meeusen, 2014), lack of concrete experiences (Matthies et al., 2012), and the influence of peer groups (Collado et al., 2017). According to Scopelliti et al. (2022), the family is the primary socialization agent for learning pro-environmental behaviors. Therefore, the influences coming from the family in early childhood form the basis of children's environmental perspectives and behaviors. In fact, frequent communication and shared ideas about environmental issues support the transfer of these norms and values (Meeusen, 2018; Scopelliti et al., 2022). Accordingly, mothers are expected to model positive environmental behaviors for their children towards the environment in their daily lives, and joint activities towards the environment need to be organized, such as nature walks or waste separation. From this perspective, if a mother's environmental mental model is both interrelated and comprehensive, it is likely to support a more structured and meaningful transmission of environmental understanding to the next generations. Thus, a well-structured mental model helps children to understand environmental issues as part of the wider ecological and social context rather than as separate aspects.

Therefore, it is recommended that environmental education policies provide courses not only for children but also for parents and be structured in a way that would increase the environmental awareness and knowledge levels of mothers in particular,

which will contribute to the more holistic development of children's mental models of the environment.

5.4. Recommendations for Future Research

This study examined the environmental mental models of preschool children and their mothers, focusing on their relationship with each other. However, future studies may focus more specifically on environmental behaviors and explore these aspects in greater detail. When the literature was examined, Handy et al. (2021) and Grønhøj & Thøgersen (2009) examined environmental behaviors between generations and found similarities in purchasing organic food, electricity and its use, and participation in outdoor activities, but not in recycling, environmental information seeking, and plastic use. However, Demirci (2023) found that parents preferred to engage in environmentally meaningful behaviors individually. Possible reasons for this include the child's developmental level may not be sufficient to understand such behaviors, parental belief that engaging in such behaviors with children may take more time, parenting styles, and protective parental tendencies (Demirci, 2023). In this case, future research may inform parents of the reasons why they may need to participate in environmental activities with their children and provide the necessary education, and research may relate environmental behaviors and mental models. Also, in this study, the mental models of children aged 48–66 months were examined. In future studies, children's mental models can be examined by dividing them into specific age groups and discussing age differences in terms of developmental differences. Moreover, this study was conducted on the mental models of the children and their mothers. However, the child-family-school-based approaches could be studied by including the school program and teacher influence. Indeed, Chawla (1998) suggested that integrating natural areas and environmental issues into a children's daily life, which ensures enriched school environments with outdoor experiences, and raising parents and teachers as role models knowledgeable with a strong connection to nature are key aspects of this process. Therefore, children's and parents' environmental mental models can be analyzed together with the environmental education content at school or the teacher's environmental mental models.

Since the majority of the children and mothers participating in the study lived in urban areas, the differences in mental models between children and mothers growing up in urban or rural areas could not be examined. Moreover, the decrease in natural and unplanned green spaces with modern urbanization limits the opportunities and experiences for children in urban areas to interact with nature (Sobko, Jia & Brown, 2018). At the same time, since the majority of children and mothers grew up in apartments, which limited the collection of diverse demographic data related to residential environments, data on these two demographic variables could not be obtained. Moreover, while participants living in the urban areas received higher environmental values, individuals growing up in rural areas felt more moral obligations and exhibited more protective environmental behaviors (Berenguer, Corraliza & Martín, 2005). In this respect, the mental models between children living in urban and rural areas in the preschool period could be investigated in future studies.

In addition, mothers were the primary focus of the study as they are typically the main caregivers. However, previous research has emphasized that peer groups are also effective in developing environmental attitudes and mental models (Samuelsson, 2011; Chawla, 1988). In particular, significant similarities were found between the environmental attitudes of fathers and the attitudes of children (especially girls), but boys had more negative attitudes than both their parents and girls of their peers (Leppänen et al., 2012). In this respect, parental effects could be examined in terms of gender in future studies. In addition, it was found that grandparents also affected the learning processes in leisure activities with grandchildren, together with intergenerational transmission (Alonso Ruiz et al., 2024). In this respect, other socialization agents in the children's close environment, such as fathers, grandparents, siblings, and peer groups, should also be included in future studies.

The current study found that there was a low but significant positive relationship between children and their mothers in terms of environmental mental models. Instead of focusing only on the effect of parents on children, it could also be emphasized that children could also affect parents' environmental awareness and behavior. It is particularly important to investigate how structured environmental education

programs starting from early childhood provide changes in the way children understand the concept of the environment. Accordingly, it was found that environmental activities integrated into the school educational programs can positively affect children's mental models of the concept of "environment" (Alerby, 2000; Loughland et al., 2002; Moseley et al., 2020; Shepardson et al., 2007) and especially in early childhood period (Ahi, 2015; Sak, 2023), and also preschool children's understanding of human-environment relationship (Cengizoğlu et al., 2022).

In this respect, future studies could examine the impact on families when both parents and children receive environmental education. For instance, it has been found that child-centered environmental education can change the level of knowledge of parents and the arrangements at home (Damerell et al., 2013). Parents of children who received education about wetlands had more knowledge and were more conscious about water conservation compared to a control group that did not receive this education (Damerell et al., 2013). In this respect, intervention studies should evaluate outcomes for children and mothers, and their bidirectional results should be included.

The current study focused on children and mothers in Türkiye, but the ways children understand the environment may vary in different cultural and geographical environments, and this may be reflected in their mental models. For example, a comparative study conducted between different countries compared the NEP scores of children in Belgium, Vietnam, and Zimbabwe (Boeve-de Pauw & Van Petegem, 2012). In this study, differences were found in the level of development of the country and concerns about environmental problems, and the highest scores were obtained by Belgian children. In this respect, the mental models of children in different cultures and countries towards the environment could be measured in future studies

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APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARASTIRMA MERKEZİ APPLIED ETHICS RESEARCH CENTER DUMULUPINAR RII VARI 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	 ORTA DOĞU TEKNİK ÜNİVERSİTESİ MIDDLE EAST TECHNICAL UNIVERSITY
Konu: Değerlendirme Sonucu Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK) İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu Sayın Prof. Dr. Refika Olgan Danışmanlığını yürüttüğünüz Ayten Kuirşun'un "<i>Okul Öncesi Annelerinin ve Çocukların Çevreye Yönelik Zihinsel Modelleri Arasındaki İlişkinin İncelenmesi</i>" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek 0005-ODTÜİAEK-2024 protokol numarası ile onaylanmıştır. Bilgilerinize saygılarımla sunarım. Prof. Dr. Ş. Halil TURAN Başkan Prof. Dr. İ. Semih AKÇOMAK Üye Doç. Dr. Şerife SEVİNÇ Üye Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL Üye	18 OCAK 2024 Doç. Dr. Ali Emre Turgut Üye Doç. Dr. Murat Perit ÇAKIR Üye Dr. Öğretim Üyesi Müge GÜNDÜZ Üye

B. TURKISH SUMMARY/ TRKE ZET

1. GİRİŞ

evre kavramı, farklı kurumlar tarafından eřitli řekillerde tanımlanmaktadır. Birleřmiř Milletler evre Programı (UNEP), evreyi su, toprak ve canlılar gibi geler arasındaki iliřkilerle aıklarken; Amerika Birleřik Devletleri evre Koruma Ajansı (EPA, 2018) yapılı evreyi kapsayan dıřsal etmenlerin etkileřimini vurgulanmıř, ancak sosyal ve ekonomik boyutlara yer vermemektedir. Kuzey Amerika evre Eđitimi Derneđi (NAAEE, 2004) ise fiziksel, sosyal ve ekonomik faktrleri bir arada deđerlendirerek evreyi daha btncl bir yaklařımla ele almaktadır. UNICEF (2015, 2021), evresel srdrlebilirliđi tm ocukların temel hakkı olarak grmekte ve evre bilincinin erken yařta kazandırılması gerektiđini savunmaktadır. Uluslararası Dođa Koruma Birliđi (IUCN) ise evreyi bir sistem olarak tanımlamakta ve korunma, eđitim ve politika geliřtirme gibi ok dzeyli sreleri nermektedir. Tm bu tanımlar, evrenin dođal, yapılı ve sosyal bileřenlerinin bir arada dřnlmesi gerektiđini gstermektedir. evre sorunlarının temelinde insan davranıřlarının yer aldıđı belirtilmektedir (Gardner & Stern, 2002; Frantz & Mayer, 2013). Tketim alıřkanlıkları, yařam biimi ve bireysel tercihler evresel etkileri dođrudan řekillendirmektedir (Takala, 1991; Frantz & Mayer, 2014). Bu nedenle evre eđitimi, evresel farkındalıđın ve davranıřların geliřimini destekleyen nemli bir ara olarak kabul edilmektedir. Tiflis Bildirgesi'nde (1977), evre eđitiminin bireylerin evresel sorunları anlayarak sorumluluk geliřtirmesini sađlaması gerektiđi vurgulanmaktadır. Erken ocukluk dnemi, evresel duyarlılıđın temellerinin atıldıđı kritik bir dnem olarak grlmektedir. Amerikan Ulusal Erken ocukluk Eđitimi Derneđi (NAEYC)'e gre, ilk  yařta beyin bađlantıları hızla oluřmakta ve đrenme kapasitesi en yksek dzeydedir (Shonkoff, 2000). Dođa ile erken yařta kurulan bađın ocukların evreye ynelik bilgi ve davranıřlarını etkilediđi belirtilmiřtir (Otto & Pensini, 2017; Dopko vd., 2019). Bu deneyimlerin ocukların duygusal, biliřsel ve motor geliřimlerine katkı sađladıđı, aynı zamanda yařam boyu evre dostu davranıřların oluřmasına zemin hazırladıđı belirtilmektedir.

(Amoly vd., 2014; Evans vd., 2018). Aileler, çocukların çevreyle olan ilişkilerinde belirleyici bir role sahiptir. Wells ve Lekies (2006), erken yaşta edinilen deneyimlerin bireyin yaşam çizgisini etkilediğini ortaya koymuştur. Ancak günümüzde çocukların doğayla bağlarının zayıfladığı ifade edilmektedir (Scott, 2015). Bu nedenle ebeveynlerin çocuklarına doğayla ilgili deneyim kazandırması önemlidir. Sadece bilgi aktarmak yeterli görülmemektedir, bunun yerine, doğayla doğrudan etkileşim içeren deneyimlerin çevresel farkındalığı artırdığı vurgulanmaktadır (Hungerford & Volk, 1990). Ebeveyn-çocuk etkileşimiyle yürütülen çevre etkinliklerinin davranışların aktarımını kolaylaştırdığı görülmektedir (Jia & Yu, 2021). Bazı durumlarda çocukların çevre bilgisi ebeveynlerini de etkileyebilmekte, bu da karşılıklı bir öğrenme sürecine işaret etmektedir (Žukauskienė vd., 2022). Bu aktarım süreci, literatürde kuşaklararası aktarım olarak tanımlanmıştır ve özellikle erken yaşlarda bu etkinin daha güçlü olduğu ifade edilmektedir (Grønhøj & Thøgersen, 2009; Kong & Jia, 2023). Ancak bazı çalışmalar, ebeveyn ve çocuklar arasındaki çevresel bilgi ve davranışlar arasında zayıf ilişkiler bulunduğunu ortaya koymuştur (Evans vd., 2007). Buna karşılık hem ebeveyn hem çocuk yüksek düzeyde bilgi, ilgi ve motivasyon taşıdığına çevre dostu davranışların arttığı belirlenmiştir (Casaló & Escario, 2016). Ayrıca, ebeveyn etkisinin özellikle kız çocukları üzerinde daha belirgin olduğu da vurgulanmaktadır (Collado, 2017). Türkiye özelinde, TÜİK (2023) verileri çocukların %93,2'sinin kentte büyüdüğünü göstermektedir. Bu oran, Tanner'ın (1980) belirttiği %75'e kıyasla oldukça yüksek bir artış göstermektedir. Louv (2010), doğadan uzaklaşmanın “doğa yoksunluğu sendromu”na neden olduğunu ifade edilmiştir ve bunun çocukların fiziksel ve duygusal gelişimi üzerinde olumsuz etkileri olabileceğini belirtmektedir. Bu nedenle, çocukların doğayla olan ilişkilerinin eğitim yoluyla desteklenmesi gerektiği savunulmaktadır (Place, 2016; D'Amore & Chawla, 2017). Bu süreçte çocukların çevreyi nasıl algıladıklarını ortaya koymak için zihinsel modeller kavramı önemli bir çerçeve sunmaktadır. Langan & Fox (2001), zihinsel modelleri bireyin çevresini anlamlandırmasına yardımcı olan bilişsel yapılar olarak tanımlarken; Norman (1988), bu yapıların bireyler arasında aktarılabilirliğini belirtmektedir. Zihinsel modellerin çevreyle etkileşim yoluyla şekillendiği ve zamanla değişebildiği gösterilmiştir (Krcmar & Hight, 2007; Nersessian, 2002). Eğitim yoluyla bireylerin eksik ya da hatalı zihinsel modellerinin değiştirilip

geliştirilebileceği savunulmaktadır (Ausubel vd., 1978). Shepardson vd. (2007), çevre eğitiminin bireylerin zihinsel modellerini bilimsel bilgiyle uyumlu hale getirmesi gerektiğini belirtmektedir. Rickinson (2001), öğretmenlerin çevreye yönelik tutumlarının öğrencilerin davranışları üzerinde etkili olduğunu ifade etmektedir. Bu bulgular, zihinsel modellerin hem eğitim hem sosyal etkileşim yoluyla biçimlenebileceğini ve çevreye karşı tutum ve davranışları doğrudan etkileyebileceğini göstermektedir. Bu bağlamda yürütülen bu çalışmada, 48–66 aylık çocuklar ile annelerinin çevreye yönelik zihinsel modelleri analiz edilmiş; çizim ve sözel açıklamaları üzerinden “Bir Çevre Çiz Test-Rubrik (BÇÇT-R) toplam ve alt boyut skorları değerlendirilmiştir. Katılımcıların cinsiyet, annenin eğitim düzeyi ve çevresel etkinliklere katılım gibi demografik değişkenlerine göre anlamlı fark olup olmadığı incelenmiş; ayrıca çizimlerde yer alan görsel kodlar karşılaştırılmıştır. Tüm bu bulgular, çevresel zihinsel modellerin nasıl şekillendiğine ve kuşaklar arasında nasıl aktarıldığına dair önemli bir çerçeve sunmaktadır.

1.1 Araştırmanın Önemi

Çevre eğitimi, çocukların sağlığını, ekosistem dengesini ve bütünlüğü korumak için büyük bir öneme sahiptir. Bu nedenle hükümetler ve çevreci kurumlar çevrenin korunması için önemli adımlar atmışlardır (Breiting & Mogensen, 1999). Ancak, çevre dostu davranışların teşvik edilmesi ve çevresel tahribatın önlenmesi için bireysel farkındalık ve sorumluluk geliştirilmesi özellikle erken yaşlarda başlamalıdır (Stern, 2008; Sia vd., 1986). UNESCO (1978) da eleştirel düşünmenin erken yaşta desteklenmesini ve çocuklara çevre sorunlarını anlama becerisi kazandırılmasını önermektedir. Her ne kadar çevre eğitimi yaşam boyu devam eden bir süreç olsa da (Ernst & Burcak, 2019), araştırmalar genellikle ilkokul ve ortaokul düzeyine odaklanmaktadır (Sia vd., 1986). Bu durum, erken çocukluk döneminde çevre eğitime yönelik daha fazla sistematik çalışma ihtiyacı olduğunu ortaya koymaktadır (Siraj-Blatchford vd., 2010). Sekiz yaş altındaki çocuklar, öğrenme kapasiteleri nedeniyle gelecekteki çevre gelişiminde etkili bir konumda bulunmaktadır (Ardoin & Bowers, 2020). Bu dönemde çocukların merakı ve içsel motivasyonu, doğayla olan etkileşimlerini desteklemekte; beyinleri çevreden gelen bilgilere daha açık olmaktadır (Tierney & Nelson III, 2009). Bu deneyimler sadece

nörolojik gelişimi değil, aynı zamanda fiziksel, psikolojik ve sosyal gelişimi de şekillendirmektedir. Erken yaşta çevrede etkileşime dayalı etkinlikler hem çocuklara hem de rehberlik eden yetişkinlere deneyimsel öğrenme fırsatı sunmaktadır (L'Ecuyer, 2014). Ancak bu farkındalığa rağmen, daha yaşlı bireylerin bilgi düzeyi daha sınırlı bulunmuştur ancak geri dönüşüm gibi davranışlarda daha aktif oldukları da belirtilmiştir (Johnson vd., 2021). Bu nedenle, erken yaşta verilen çevre eğitiminin sadece bireysel farkındalık değil, toplumsal dönüşüme de katkı sağlaması gerektiği vurgulanmaktadır (Ardoin & Bowers, 2020). Bu kapsamda yürütülen bu çalışmada, çevresel zihinsel modellerin erken yaşta nasıl oluştuğu BÇÇT-R ölçeği ile incelenmiştir. Zihinsel modeller, bireyin deneyimleriyle şekillenen ve karar alma sürecini etkileyen bilişsel yapılar olarak tanımlanmaktadır (Forrester, 1971; Shepardson vd., 2007). Çevre eğitimi alanında zihinsel modellerin çizimler yoluyla ortaya konması, sıklıkla kullanılan bir yöntem haline gelmiştir (Moseley vd., 2010). BÇÇT-R ölçeği, önceki çalışmalarda farklı gruplarda kullanılmış olsa da (Ahi, 2015; Liu & Lin, 2014), ebeveynlerin, özellikle annelerin zihinsel modellerine odaklanan çalışma sayısı sınırlıdır. Bu durum, annelerin çocukların çevresel zihinsel modeller yapısını şekillendirmedeki rolü düşünüldüğünde, önemli bir araştırma boşluğuna işaret etmektedir. Çizimler, bu çalışmada ölçme aracı olarak ve aynı zamanda çocukların insan, canlı, abiyotik ve insan yapımı alt boyutları arasındaki ilişkileri ifade edebildikleri bir iletişim yolu olarak kullanılmıştır (Hall, 2009; Ring, 2006). Erken yaşta sık kullanılan çizimler, çocukların duygu ve sosyal algılarını anlamak için de önemli bir pencere sunmaktadır (Brooks, 2009; Matthews, 2003). Çizimler, çocukların çevresel bilgi, algı ve sorunlara dair kavrayışlarının incelenmesinde etkili bir araç olarak kullanılmaktadır (Barraza, 1999; Ahi, 2015; Sak, 2023). Bu çalışmada da çocuklar ve annelerinin çizimleri analiz edilmiş ve bu zihinsel temsiller arasındaki benzerlikler ve farklılıklar ortaya konması hedeflenmiştir. Bu süreçte ebeveynlerin, özellikle de annelerin rolü kritik bir öneme sahiptir. Bronfenbrenner'in ekolojik sistemler kuramına göre aile, çocuğun ilk mikrosistemi olarak çevresel deneyimlerin ve zihinsel modellerin oluştuğu en temel ortamı temsil etmektedir. Bu nedenle bu çalışmada annelerden hem çevreyi çizmeleri hem de çizimlerini açıklamaları istenmiştir. Önceki çalışmalar, annelerin tutarlı ve destekleyici davranışlarının çocukların gelişimi üzerinde olumlu etkileri olduğunu göstermiştir (Opendak vd., 2020; Ali vd., 2021). Ancak daha önceki çalışmalar genellikle çevresek tutumları

incelemiş; oysa zihinsel modeller, deneyimlere dayalı, içselleştirilmiş yapılar olarak farklılık göstermektedir (Clement, 1993). Bu nedenle, bu çalışma hem annelerin hem çocukların çevreyi zihinsel olarak nasıl temsil ettiklerini incelemekte ve kuşaklararası benzerlikleri ortaya koymayı amaçlamaktadır. Ayrıca bu çalışmada annenin eğitim düzeyi de bir değişken olarak ele alınmıştır. Önceki bulgular, annelerin eğitim düzeyinin çocukların çevreyle bağlantı kurma biçimlerini ve davranışlarını etkilediğini ortaya koymuştur (Evans vd., 2018). Yüksek eğitim düzeyine sahip annelerin daha sürdürülebilir davranışlar sergilediği ve çocukların da buna paralel olarak daha çevreci tutumlar geliştirdiği görülmüştür (Yılmaz vd., 2014; Payne, 2005). Ayrıca, bu çalışma annelerin bireysel ve çocuklarıyla birlikte çevrede yaptıkları etkinliklerin zihinsel modellerle ilişkisini de incelemiştir. Çöp toplama, ağaç dikme, doğada yürüyüş yapma, geri dönüşüm yapma ve ayrıştırma gibi günlük etkinlikler bu kapsamda değerlendirilmiştir (Chawla, 1999; Samuelsson, 2011). Çocukların bu etkinliklerde aktif rol almasının, çevreyle ilgili kalıcı farkındalıklar oluşturduğu vurgulanmaktadır. Aile bireyleri, bu süreçte çocuklar için model oluşturmakta ve birlikte paylaşılan deneyimler kuşaklararası aktarımı güçlendirmektedir (Arnold vd., 2009; Price vd., 2022). Bu çalışma ayrıca kuşaklararası aktarım kuramı çerçevesinde de ele alınmıştır. Çocukların çevreye yönelik tutum ve değerleri aile içinde günlük yaşam etkileşimleri yoluyla öğrendikleri belirtilmektedir (Grønhøj & Thøgersen, 2009). Bu aktarım, sadece davranış düzeyinde değil; duygusal ve bilişsel yapılarla da gerçekleşmektedir (Branje vd., 2020). Nitekim benzer aktarımlar, beslenme alışkanlıkları, eğitim, duygular ve bilişsel beceriler gibi alanlarda da gözlemlenmiştir (Cole vd., 2000; Sullivan vd., 2021). Ancak zihinsel modellere yönelik bu türden bir kuşaklararası aktarım henüz yeterince incelenmemiştir ve annelerin üzerinden bir çalışma yapılmamıştır. Sonuç olarak bu çalışma, 48-66 aylık çocuklar ve annelerinin çizimleri aracılığıyla çevresel zihinsel modellerini BÇÇT-R ölçeği ile analiz etmeyi amaçlamaktadır. Zihinsel modellerin nasıl geliştiği, nasıl aktarıldığı ve hangi değişkenlerle ilişkili olduğu değerlendirilmiştir. Bu kapsamda, çocuğun cinsiyeti, annenin eğitim düzeyi, bireysel ve ortak çevre etkinliklerine katılımı gibi değişkenler dikkate alınmıştır. Ayrıca, çocukların ve annelerin çizimlerdeki görsel kodlar analiz edilmiş ve bu temsiller arasındaki benzerlik ve farklılıklar ortaya konmuştur. Aşağıda araştırma soruları yer almaktadır:

1. 48–66 aylık çocuklar ve annelerinin çevreye dair çizimlerindeki görsel kodlar arasında nasıl benzerlikler ve farklılıklar gözlemlenmektedir?
2. Çocukların ve annelerinin çevresel zihinsel model puanları (toplam ve alt boyut: insan, canlı, abiyotik, insan yapımı) nasıldır ve ortalamalar arasında anlamlı bir fark bulunmakta mıdır?
 - 2.1 Bu zihinsel model puanları çocukların cinsiyeti, annelerin eğitim düzeyi ve çevresel etkinliklere katılım durumu (bireysel ve birlikte) gibi demografik değişkenlere göre farklılık göstermekte midir?
 - 2.2. Çocukların ve annelerinin toplam ve alt boyut puanları arasında anlamlı bir ilişki bulunmakta mıdır?

YÖNTEM

2.1. Araştırmanın Deseni

Bu çalışmada hem nicel hem de nitel verilerin toplanabilmesi amacıyla gömülü korelasyonel desen kullanılmıştır. Bu yaklaşım, nicel yöntemin sınırlılıklarını gidermeyi ve ölçülen değişkenlere ilişkin daha kapsamlı bir anlayış sağlamayı amaçlamıştır. Buna göre çalışmanın nicel kısmı, araştırma sorularına istatistiksel anlamlılık kazandırırken nitel bileşen bu bulguları daha derinlemesine zenginleştirmiştir. Gömülü paralel desen, her iki veri türünün eşzamanlı olarak toplanmasını mümkün kılmıştır ve çocukların ve annelerin çizimlerine ilişkin açıklamaları ile görsel kodları, nicel bulgulara tamamlayıcı ve açıklayıcı kaynaklar olarak kullanılmıştır.

2.2.Örneklem

Bu çalışmanın hedef kitlesini, Güneydoğu Anadolu Bölgesi'ndeki üç bağımsız devlete bağlı okul öncesi eğitim kurumlarından seçilen 48–66 aylık çocuklar ve anneleri oluşturmaktadır. Araştırmada, amaçlı örnekleme yöntemi kullanılmıştır. Bu kapsamda, belirli okullardan katılımcıların seçilmesini içeren ve sınırlı düzeyde rastgelelik barındıran ölçüt örnekleme yöntemi kullanılmıştır. Buna göre, karma yöntemle yürütülen bu çalışmada, çocukların ve annelerinin çevresel zihinsel

modellerini derinlemesine anlamak amacıyla toplam 322 çocuk ve anneleri araştırmaya dahil edilmiştir. Nitel veri toplama sürecinde, benzer temaların tekrar ortaya çıkmasıyla veri doyumuna ulaşılmış ve bu durum çalışmanın güvenilirliğini artırmış ve elde edilen sonuçların geçerliliğini desteklemiştir.

2.3 Veri Toplama Araçları

Bu çalışmada veri toplamak amacıyla “Anne ve Çocuklara Yönelik Demografik Bilgi Formu” ile “Bir Çevre Çiz Test Rubriği” (BÇÇT-R) olmak üzere iki araç kullanılmıştır. Demografik Bilgi Formu, annelerin yaşı, eğitim düzeyi, ikamet ettikleri yer, çevresel sivil toplum kuruluşlarına üyelik durumu ve çevreyle ilgili etkinliklere katılımı gibi bilgileri içermektedir. BÇÇT-R ölçeği, Moseley, Perotta ve Utley (2010) tarafından geliştirilmiş olup, bireylerin çevreye dair önceki deneyimlerini ve inançlarını yansıtan zihinsel modelleri aracılığıyla çevre bilgisi ve okuryazarlığını değerlendirmeyi amaçlamaktadır. Ölçek dört alt boyuttan oluşmaktadır: insan, canlı, abiyotik ve insan yapımı (Her bir alt boyut, 0 ile 3 puan arasında derecelendirilir. İnsan boyutunda, anne, baba, arkadaş, akraba veya satıcı gibi insan figürleri yer almaktadır. Canlı alt boyutu hem bitkileri hem de hayvanları içerir. Abiyotik alt boyut, canlı olmayan unsurların temsilini içerirken, İnsan yapımı boyutu, insan eliyle oluşturulmuş yapıları kapsar. Toplam puan 0 ile 12 arasında değişmekte olup üç seviyeye ayrılmaktadır: 0–4 puan: “Faktör mevcut” düzeyi, çevresel öğeler çizilmiş ancak aralarında etkileşim yoktur. 5–8 puan: “Etkileşimli düzey”, bir ya da daha fazla faktör birbirleriyle etkileşim halindedir. 9–12 puan: “Sistem temelli anlayış”, iki veya daha fazla faktör net şekilde birbirini etkiler, çevresel ilişkiler yansıtılır. Ölçeğin içerik geçerliği ve kodlayıcılar arası güvenilirliği değerlendirilmiştir. Kodlayıcılar arası uyum oranı %81,4 ile %93,2 arasında değişirken; alt boyutlara ilişkin Pearson momentler çarpımı korelasyon katsayıları .73 ile .93, toplam puan için ise .86 ile .92 arasında bulunmuştur. Bu bulgular, BÇÇT-R ölçeğinin güvenilir ve tutarlı bir araç olduğunu göstermektedir. Bu araştırmada, Ahi (2015) tarafından Türkçeye uyarlanan BÇÇT-R ölçeği kullanılarak çocukların ve annelerin çevresel zihinsel modelleri incelenmiştir. BÇÇT-R’nin Türkçe versiyonuna ilişkin güvenilirlik çalışmasında, Pearson korelasyon katsayısı .87 ve kodlayıcılar arası güvenilirlik katsayısı .91 olarak bulunmuştur.

2.4. Veri Toplama Süreci

Anne katılımcılara, okul öncesi öğretmenleri tarafından dağıtılan ve hem çocuklar hem de anneleri için onam (aydınlatılmış rıza) bölümü içeren formlar aracılığıyla çalışma hakkında bilgi verilmiştir. Anneler hem kendilerine hem de çocuklarına ait demografik bilgi formlarını doldurmuş; ayrıca, boş bir sayfaya çevreyi temsil eden bir resim çizmiş ve bu çizimi açıklayan bir metin eklemişlerdir. Çocuklar ise okulda boş bir sınıfa alınarak, çevreye ilişkin temsili modellerini çizmişlerdir ve bu çizimlerde kuru boya ve pastel boya kullanmışlardır ve çizimin hemen ardından çocuklara çizimlerini açıklamaları istenmiş ve araştırmacı oklar yardımıyla çocukların kodlarını not almıştır, ancak ses kaydı almamıştır.

2.5. Veri Analiz Süreci

Öncelikle çocukların ve annelerin çizimlerinden elde edilen nicel veriler betimsel analiz ile incelenmiş; minimum, maksimum, ortalama ve standart sapma gibi istatistiksel değerler analiz edilmiştir. Ardından normallik varsayımları sağlandıktan sonra, çocuklar ve annelerin BÇÇT-R ölçeğindeki alt boyutlar ve toplam puan ortalamaları arasında anlamlı bir fark olup olmadığını belirlemek amacıyla bağımsız örneklem t-testi uygulanmıştır. Buna ek olarak, diğer demografik değişkenler de bağımsız örneklem t-testi kullanılarak analiz edilmiştir. Son olarak, çocuklar ile annelerinin çevresel zihinsel modelleri arasındaki ilişkiyi incelemek üzere Pearson korelasyon testi yapılmıştır. Nitel veri analizinde ise, içerik analizi yöntemi kullanılarak çocukların ve annelerin çizimlerinde yer alan çevresel öğeler belirlenmiş ve bu unsurlar önceden tanımlanmış kategorilere göre kodlanmıştır.

BULGULAR VE TARTIŞMA

Bu çalışmada, çocukların ve annelerinin çevresel zihinsel modelleri, BÇÇT-R kullanılarak incelenmiştir. Hem çocukların hem de annelerin çizimlerinde yer alan çevresel bileşenler; insan, canlı, abiyotik ve insan tarafından inşa edilmiş olmak üzere dört alt boyutta analiz edilmiştir. İnsan alt boyutunda çocukların ortalamaları

annelerden yüksek bulunmuş, çocuklar daha fazla insan figürü çizmiş; ancak her iki grupta da bu figürler genellikle diğer çevresel faktörlerle ilişkisiz kalmıştır. Özellikle sistemsal ilişkiler kuran çizimler oldukça sınırlı düzeyde kalmıştır. Bu durum, önceki çalışmalarla da örtüşmektedir (Ahi, 2015; Flowers vd., 2015; Moseley vd., 2010). Canlı alt boyutunda ise anneler daha yüksek puanlar almış, canlı öğeleri daha sık ve daha ilişkisel biçimde çizmişlerdir. Çocukların ise bu figürleri daha yüzeysel bir şekilde, genellikle başka faktörlerle ilişkilendirmeden resmettiği görülmüştür. Bu bulgular, benzer şekilde daha önce yapılan çalışmalarda da vurgulanmıştır (Moseley vd. 2010, 2020; Liu & Lin, 2015). Abiyotik alt boyutta çocuklar güneş, bulut ve deniz gibi öğelere daha sık yer vermiş; ancak bu öğeler çoğunlukla ilişkisiz ya da süsleme amacıyla kullanılmıştır. Anneler ise bu öğeleri daha bütüncül bir yaklaşımla, çevresel öğelerle ilişkili biçimde resmetmişlerdir. Ahi ve Kahriman-Pamuk (2021), Çalış-Şaşı ve Balcı (2021) gibi çalışmalarda da çocukların abiyotik öğeleri çoğunlukla ilişkisiz çizdikleri görülmüştür. Bu bulgular, Ahi (2015), Desjean-Perrotta (2013), Kalvaitis ve Monhardt (2011) gibi çalışmalarla da örtüşmektedir. Toplam skor açısından değerlendirildiğinde, annelerin çizimlerinde çocuklara göre daha fazla bütünlük ve ilişkisellik gözlemlenmiştir. Ancak hem çocukların hem de annelerin çoğunlukla çevresel öğeleri ayrı ayrı çizdiği, sistemsal bir anlayışın oldukça sınırlı kaldığı görülmektedir. Wuellner vd. (2017), Ahi vd. (2017) ve Liu ve Lin (2015) gibi çalışmalarda da benzer sonuçlara ulaşılmıştır.

Shepardson vd. (2007), öğrencilerin çevreyle ilgili anlamlı tartışmalara yeterince katılamadığını, bunun da yüzeysel zihinsel modellerin oluşmasına neden olduğunu belirtmiştir. Bruni & Schultz (2010), çocukların doğayla daha güçlü bir bağ kurabildiğini, bu bağın yaşla birlikte zayıflayabileceğini vurgulamaktadır. Ayrıca, Fraijo-Sing vd. (2020) ve Flowers vd. (2015) gibi çalışmalarda, çocukların çevreye ilişkin çizimlerinin doğrudan deneyimlerden beslendiği, ama genellikle ilişkisellik taşımadığı görülmüştür. Shepardson (2007) ise eğitim materyallerinin çevreyi çoğunlukla prototipik (orman, dağ vb.) şekilde yansıttığını ve bunun sistem temelli bir çevre anlayışını desteklemediğini belirtmiştir. Bu çalışmada, Piaget'nin bilişsel gelişim kuramı, Bruner'in temsili model kuramı ve Bronfenbrenner'in ekolojik sistem kuramından yararlanılmıştır ve çocukların sosyal çevrelerde çevresel modelleri pekiştirdikleri ve geliştirdikleri vurgulanmıştır. Ayrıca çocukların

gözlemledikleri çevresel öğeleri ikonlaştırarak basit, tek yönlü bir temsil biçimi geliştirdikleri görülmektedir (Bredkamp & Joseph 2013). Sonuç olarak, bu çalışmanın bulguları, çocukların ve annelerinin çevresel zihinsel modellerinin çoğunlukla deneyim ve gözleme dayandığını, ancak çevreyi sistemsel ve bütüncül bir yapı olarak algılamada eksikliklerin bulunduğunu ortaya koymuştur. Bu durum, literatürde de sıkça vurgulanmış ve eğitimin zihinsel model oluşumuna katkısına vurgu yapılmıştır (Desjean-Perrotta vd., 2008; Shepardson vd., 2007; Çalış-Şaşı & Balcı, 2021).

Bu çalışma, okul öncesi çocukların cinsiyet farklılıklarının çevresel zihinsel modelleri üzerindeki etkisini de incelemiştir. Bulgulara göre, kız çocukları inşa edilmiş çevre, abiyotik alt boyutlar ve toplam puanlarda erkek çocuklardan anlamlı düzeyde daha yüksek puanlar almıştır. Bu da kız çocuklarının çevresel zihinsel modellerinin daha bütüncül ve diğer faktörlerle ilişkili olabileceğini göstermektedir. Ancak bu bulgu, Ahi vd. (2017) ve Çalış-Şaşı & Balcı (2021) tarafından yapılan bazı çalışmalardaki BÇÇT-R ölçeği bulgularıyla çelişmektedir. Liu ve Lin (2015), üniversite öğrencileriyle yaptığı çalışmada, zihinsel modellerde cinsiyete bağlı anlamlı bir fark olmadığını, ancak çevresel etki ve davranışsal niyet açısından cinsiyetin belirleyici olduğunu ortaya koymuştur. Bununla birlikte, çevreyle ilgili diğer çalışmalarda kız çocukların çevre konularında daha duyarlı ve ilgili olduğu görülmüştür (Çelik & Doğru, 2019; Yılmaz & Andersen, 2004). Kızlar doğaya daha yüksek düzeyde bağlılık göstermekte (Schultz & Tabanico, 2007) ve doğayla özdeşleşme seviyeleri erkeklerden daha gelişmiş bulunmaktadır (Bruni & Schultz, 2010). Bu tutumsal farklar, sıklıkla toplumsal cinsiyet rolleri ve sosyalleşme süreçleriyle açıklanmıştır. Collado, Evans ve Sorrel (2017), kız çocuklarının çevresel tutum ve davranışlarında sosyal ajanlardan (özellikle aile ve arkadaşlar) daha fazla etkilendiğini belirtmiştir. Davidson ve Freudenburg (1996), Gilligan (1982) ve Zelenzky vd. (2002) gibi geleneksel yaklaşımlar, kadınların çocuk ve ev sorumluluğu gibi sosyal rolleri nedeniyle çevresel riskleri daha ciddi algıladığını öne sürmüştür. Ancak, Xiao ve McCright (2012) bu farkın sosyal rollere değil, sosyalleşme deneyimlerine dayandığını savunmuştur. Benzer şekilde, Strapko vd. (2016) da çevresel kaygılardaki cinsiyet farklarının yalnızca biyolojik cinsiyete değil, o cinsiyete atfedilen bireysel değer yönelimleriyle de ilişkili olduğunu ileri sürmüştür.

Bunula birlikte, Gilligan'ın (1982) özen etiği yaklaşımı, kadınların karar alma süreçlerinde empati, merhamet ve sorumluluk gibi değerlere öncelik verdiğini ve bu durumun çevresel konularda daha hassas tutum geliştirmelerine yol açtığını ortaya koymuştur. Xiao ve McCright (2012), bu etik yaklaşımın hem kadın hem de erkeklerdeki çevresel kaygılarla pozitif ilişkili olduğunu belirtmiştir. Sonuç olarak, kız çocuklarının daha yüksek çevresel farkındalık puanları almaları, erken yaşlardan itibaren özen odaklı değerlerle yönlendirilmeleriyle, toplumsal öğrenme süreçleriyle ve çevresel tehditleri daha yüksek risk olarak algılamalarıyla açıklanabilir (Davidson & Freudenburg, 1996; Xiao & McCright, 2012). Bu çalışma, cinsiyetin çevresel zihinsel modeller üzerinde hem açık hem örtük düzeyde etkili olabileceğini ve bu etkinin biyolojik temeller kadar sosyal ve kültürel öğrenme süreçlerinden de kaynaklanabileceğini göstermektedir.

Bu çalışmada çocukların ve annelerinin çevresel faaliyetlere katılım sıklığının zihinsel modeller üzerindeki etkisi incelenmiştir. Bulgular, anneleriyle birlikte çevresel faaliyetlere katılan çocukların abiyotik ve toplam puanlarının daha yüksek olduğunu, annelerin bireysel katılım düzeylerinin de toplam puanlara anlamlı şekilde yansıdığını göstermiştir. Bu durum, sosyal öğrenme süreçlerinin çevresel zihinsel model gelişiminde önemli bir rol oynadığını ortaya koymaktadır (Veselinovska & Osogovska, 2012; Holtrop vd., 2021). Çevresel eğitim sadece bilgi aktarımına değil, bireylerin doğrudan deneyim yoluyla öğrenmesine dayanmalıdır (Moseley vd., 2010; Shepardson vd., 2007). Ballantyne (2001) ve Baur ve Haase (2015), aktif katılım içeren programların bilgi edinmenin yanı sıra davranış değişikliği sağladığını ortaya koymuştur. Doğada geçirilen zamanın doğayla kurulan bağı artırdığı (Tabanico & Shultz, 2010; Cheng & Monroe, 2012) ve ekolojik farkındalığı etkilediğini de gösterilmiştir (Howlett & Turner, 2023). Ancak bu bağ her zaman doğrudan gelişmeyebilir, Bruni & Schultz (2010), doğada geçirilen zamanın doğayla bağ kurmayı direkt olarak sağlamadığını ifade etmiştir. Bu çalışmada da çevresel etkinliklere katıldığını belirten çocuklar ve annelerinin BÇÇT-R puanlarında gözlenen farklar sınırlı kalmıştır. Ahi ve Kahriman-Pamuk (2021), doğa okullarında eğitim alan çocukların daha doğa odaklı çizimler yaptığını ortaya koymuştur. Köşker (2019) ve Wals (1994) ise çocukların doğayı genellikle eğlence alanı olarak tanımladıklarını belirtmiştir. Katılımcıların büyük çoğunluğunun şehir merkezinde

yaşadığı dikkate alındığında, kentleşmenin çevresel algıyı nasıl etkilediği önem kazanmaktadır. Howlett ve Turner (2023), yalnızca yeşil alanların sayısının artırılmasının yeterli olmadığını, bu alanların etkileşimli hale getirilmesi gerektiğini vurgulamıştır. Bu bağlamda, çocukların yeşil alanlarda pasif zaman geçirmesi, çevresel farkındalık gelişimi için yetersiz olabilir.

Buna ek olarak, mevcut çalışmada, annelerin eğitim seviyelerine göre çevresel zihinsel modellerinde anlamlı farklar bulunmuştur. Ancak önceki BÇÇT-R araştırmalarında genellikle sınıf düzeylerine odaklanılmış, eğitim seviyesi özelinde sınırlı veri sunulmuştur (Ahi vd., 2017; Liu & Lin, 2015; Shepardson vd., 2007). Bu yönüyle, çalışma literatürdeki boşluğu doldurmayı hedeflemektedir. Elde edilen bulgular, eğitim seviyesinin çevresel tutum ve davranışlar üzerindeki olumlu etkisini destekleyen önceki çalışmalarla örtüşmektedir (Torgler & García-Valiñas, 2007; Leppänen vd., 2012). Özellikle Leppänen vd. (2012), üniversite mezunu annelerin daha olumlu çevre tutumları gösterdiğini belirtmiştir ve bu bulgu mevcut çalışmada da gelişmiş zihinsel modellerle desteklenmiştir. Buna göre daha yüksek eğitim seviyesine sahip annelerin daha gelişmiş ve diğer faktörlerle ilişkili çevresel zihinsel modelleri bulunmaktadır. Benzer şekilde, eğitim seviyesinin çevresel koruma davranışlarını etkilediği de görülmüştür. Yüksek eğitim düzeyine sahip bireylerin, çevreyi koruma adına ödeme istekliliği (Blomquist & Whitehead, 1998), çevresel önlemler (Engel & Pötschke, 1998), çevreci ulaşım tercihleri (Veisten vd., 2004), yenilenebilir enerji kullanımı (Özçiçek & Ağpak, 2017; Özbay & Duyar, 2022) ve genel çevre bilinci gibi alanlarda daha yüksek düzeyde katkı sağladıkları belirtilmiştir. Eğitimin ayrıca iklim değişikliğiyle başa çıkma, risk algısı geliştirme ve sürdürülebilir çevre politikalarının desteklenmesinde kilit rol oynadığı vurgulanmaktadır (Czarnek vd., 2021; Lutz vd., 2014; Tang, Abosedra & Naghavi, 2020). Meyer (2015), eğitim süresindeki her bir ek yılın çevresel davranışları artırdığını göstermiştir. Benzer şekilde, Jowett vd. (2014) ve Çalış-Şaşı ve Balcı (2021) yükseköğretimin çevre tutumlarını olumlu etkilediğini ortaya koymuştur. BÇÇT-R uygulamaları da sınıf düzeyine bağlı olarak daha yüksek puanlar elde edildiğini göstermektedir (Çalış-Şaşı & Balcı, 2021).

Çalışmanın bulgularına göre, çocuklar ve annelerinin arasında BÇÇT-R ölçeğinden elde edilen toplam ve canlı alt boyut puanları arasında pozitif ve anlamlı, ancak

düşük düzeyde bir ilişki bulunmuştur. Bu durum, çevresel zihinsel modellerin nesiller arası aktarımının özellikle canlı unsurlar üzerinden sınırlı da olsa gerçekleştiğini göstermektedir. Buna göre, çevresel değerlerin aktarımında sosyal öğrenme süreci belirleyicidir (Grønhøj & Thøgersen, 2009; Chawla & Derr, 2012). Çocuklar çevresel değerleri yalnızca gözlemle değil, aktif katılım ve aile içi pekiştirme ile içselleştirirler. Nitekim, aile üyeleri arasındaki çevresel davranış benzerliği, sosyalizasyon süreçleriyle ilişkilendirilmiş ve nesiller arası aktarım kuramıyla açıklanmıştır (Handy vd., 2021; Meeusen, 2014; Liu vd., 2022; Kong & Jia, 2023). Ancak korelasyonun düşük olması, bu aktarımın sınırlı düzeyde gerçekleştiğini göstermektedir. Özellikle küçük yaş gruplarında davranışlar daha etkili aktarılmakta; çevresel değerlerin ve tutumların aktarımı ise sınırlı düzeyde kalabilmektedir (Matthies vd., 2012; Collado vd., 2017). Ayrıca çocukların arkadaş çevresi, medya ve kitaplar gibi dış etkenlerle de şekillendikleri bilinmektedir (Chawla & Derr, 2012). Aile içi çevre odaklı sohbetlerin çocuk farkındalığını olumlu etkilediği görülmüştür (Meeusen, 2014; Matthies vd., 2012). Ayrıca ahlaki anlamlandırma ve değerlendirme yetisinin gelişmesi, çocukların çevresel sorumlulukları daha güçlü içselleştirmesine olanak sağlamaktadır (Giancola vd., 2024). Bu nedenle, çevresel eğitimde yalnızca bilgi aktarımı değil; empati, ahlaki farkındalık, öz-yeterlik, modelleme ve deneyime dayalı çok boyutlu bir yaklaşım gereklidir (Cheng & Monroe, 2012; Rogoff vd., 2003). Sonuç olarak, bu çalışma çocukların çevresel zihinsel modellerinin annelerinkine kısmen benzerlik gösterdiğini, ancak bu aktarımın daha etkili olabilmesi için aktif katılım, gözlem ve sosyal pekiştirme ile desteklenmesi gerektiğini ortaya koymuştur. Bu bulgu, erken çocukluk döneminde aile temelli çevre eğitiminin önemini vurgulamakta ve çevresel zihinsel modellerin gelişiminde ebeveynlerin rolünü ön plana çıkarmaktadır.

Çocuklar ve anneler tarafından çizilen çevresel görsellerde en sık kullanılan öğelerin ağaç, çiçek, çim, kuş, kedi, köpek ve elma gibi canlı figürler olduğu görülmüştür. Bu bulgular, daha önceki çalışmalarda da benzer şekilde ortaya konmuştur (Ahi & Kahriman-Pamuk, 2021; Çalış-Şaşı & Balcı, 2021; Günindi, 2012; Kalvaitis & Monhardt, 2012). Hayvan figürleri bitkilere kıyasla daha az çizilse de kuşlar en sık tercih edilen hayvan figürü olmuştur. Abiyotik bileşenlerde ise çocuklar ve anneler en çok güneş ve bulutu çizmiş, çocuklar deniz, anneler ise nehir figürünü daha sık

kullanmıştır (Bulut-Öngen & Örsay, 2024; Kalvaitis & Monhardt, 2012). Gökkuşığı, çocuk çizimlerinde önceki çalışmalardan daha sık görülmüştür.

İnsan yapımı çevre kategorisinde en sık çizilen öge “bahçeli ev” olurken, çocuklar ayrıca oyun parklarını da sıklıkla resmetmişlerdir. Bu durum, çocukların parkta geçirdiği zamanın çevre algılarını doğrudan etkilediğini göstermektedir (Jones et al., 2011). Anneler ise en çok araba ve yol figürleri çizerken, çocuklar daha çok apartman ve araba figürlerine yer vermiştir. Alerby’e (2000) göre küçük yaş grupları “burada ve şimdi “ye odaklanırken, yaşla birlikte daha soyut çevreler çizmeye ve algılamaya başlamaktadırlar. Bu bağlamda, çocuklar daha çok yaşadıkları çevreden, anneler ise daha geniş bir perspektiften çevreyi temsil etmişlerdir. Sonuç olarak hem çocuklar hem de anneler çizimlerinde sıklıkla insanın tasarladığı çevreye odaklanmıştır. Her iki grup da çevreyi pasif gözlemlere dayalı olarak temsil etmiştir ve doğrudan etkileşim ya da keşif odaklı deneyimlere yer vermemiştir. Bu durum, BÇÇT-R puanlarının düşük kalmasını açıklamaktadır. Ayrıca, su ile ilgili öğelerin çocuk çizimlerinde daha sık yer alması, abiyotik alt boyutta anlamlı farklar oluşmasına neden olmuş olabilir. Louv’un (2006) da belirttiği gibi, yalnızca dış mekânda bulunmak değil, doğayla aktif ve özgürce etkileşim kurmak çevresel farkındalığın gelişiminde etkilidir. Dolayısıyla, çevresel etkinliklere katılım kadar, bu etkinliklerin niteliği de çevresel zihinsel modellerin gelişiminde belirleyici olmaktadır (Thapa, 2010; Çetinkaya, 2015).

Gelecek Araştırmalar İçin Öneriler

Bu çalışma, okul öncesi çocuklar ile annelerinin çevresel zihinsel modellerini ve aralarındaki ilişkiyi incelemiştir. Ancak gelecekteki araştırmalarda, çevresel davranışlar daha ayrıntılı şekilde ele alınabilir. Handy vd. (2021) ve Grønhøj & Thøgersen (2009), kuşaklar arası çevresel davranış benzerliklerini; Demirci (2023) ise ebeveynlerin bu tür davranışlara çocuklarıyla birlikte katılmakta isteksiz olabileceklerini göstermiştir. Bu nedenle, gelecekteki araştırmalar ebeveynlerin çocuklarıyla çevresel etkinliklere katılımının önemini vurgulayabilir. Bu çalışmada 48–66 aylık çocukların çevre zihinsel modelleri incelenmiştir ancak gelişimsel farklılıkların etkisini görebilmek adına, yaş gruplarına göre zihinsel modeller

incelenebilir. Ayrıca sadece anne-çocuk ilişkisi ele alınmıştır; ancak okul programı ve öğretmen etkisinin dahil olduğu çocuk-aile-okul temelli yaklaşımlar da değerlendirilebilir. Nitekim, Chawla (1998), doğayla ilişkisi zenginleştirilmiş okul ortamlarının ve doğaya bağlı rol modellerin önemini vurgulamıştır. Ayrıca katılımcıların büyük kısmı şehirde ve apartmanlarda yaşadığından, kentsel ve kırsal yaşam alanlarının etkisi incelenememiştir. Buna karşılık Berenguer, Corraliza & Martín (2005), şehirde yaşayan bireylerin çevresel değerlere daha fazla önem verdiğini vurgularken kırsalda yaşayanların daha fazla ahlaki sorumluluklar hissettiğini belirtmiştir. Bu bağlamda, şehir ve kırsal karşılaştırmalı çalışmalar yapılabilir. Bu çalışmada odak nokta anneler olmuştur. Ancak babalar, kardeşler, akranlar ve büyükanne-büyükbaba gibi diğer sosyal aktörlerin de çevresel tutum ve modeller üzerindeki etkisi değerlendirilebilir (Samuelsson, 2011; Leppänen vd., 2012; Alonso Ruiz vd., 2024). Ayrıca, Çocukların sadece ebeveynlerinden etkilenmediği, aynı zamanda onların da ebeveynleri etkileyebileceği de ilerideki çalışmalarda daha fazla vurgulanabilir ve gerekli eğitimler hem çocuklara hem de annelere sağlanabilir. Nitekim Ahi (2015), Sak (2023), Cengizoglu vd. (2022) gibi çalışmalar, erken çocukluk döneminde yapılan çevresel eğitimin çocukların çevre anlayışını olumlu etkilediğini göstermiştir. Buna göre ilerideki çalışmalarda, çocuk ve ebeveynlere birlikte verilen çevre eğitimlerinin etkisi değerlendirilebilir. Örneğin, Damerell vd. (2013), çocuk merkezli çevre eğitiminin ebeveynlerin bilgi düzeyini ve evdeki düzenlemeleri olumlu etkilediğini bulmuştur. Bu tür müdahale çalışmalarında çift yönlü etkiler ölçülmelidir. Son olarak, çalışma Türkiye’de yürütülmüş olup, farklı kültürel ve coğrafi bağlamlarda yapılacak çalışmalar çocukların çevreyi algılayış biçimlerinde çeşitlilik olabileceğini gösterebilir.

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