



JOURNAL

Başvuru 19.07.2026 Received | Kabul 27.08.2026 Accepted

E-ISSN: 3108-5296 | <https://www.paradigmajournal.com>

Cilt 2, Sayı 3 (2026), ss. 184-199

Doi., 10.29228/paradigma.96816

Atıf Bilgisi / Reference Information

Alikulova, M. (2026). Çevre eğitiminin okul öncesi dönem öğrencileri üzerindeki etkilerine kuramsal bir bakış. *Paradigma Sosyal Bilimler Dergisi*, 2(3), 184-199, <https://doi.org/10.29228/paradigma.96816>

Çevre Eğitiminin Okul Öncesi Dönem Öğrencileri Üzerindeki Etkilerine Kuramsal Bir Bakış

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Özet

Bu çalışmanın amacı, okul öncesi dönemde yürütülen çevre eğitiminin çocukların çevresel farkındalık, tutum, bilgi, davranış, doğayla bağ kurma, bilişsel gelişim ve sosyal-duygusal gelişimleri üzerindeki etkilerini kuramsal ve ampirik bulgular birlikte değerlendirilerek ortaya koymaktır. Çalışma, yapılandırılmış kuramsal derleme ve kanıt sentezi yaklaşımıyla hazırlanmıştır. Erken çocukluk çevre eğitimi alanındaki temel kuramsal metinlerin yanı sıra, 1995–2026 döneminde yayımlanan sistematik derlemeler, deneysel ve yarı deneysel araştırmalar, karma yöntem çalışmaları ve nitel araştırmalar incelenmiştir. Özellikle okul öncesi yaş grubunu doğrudan ele alan ve çevresel farkındalık, çevresel tutum, çevresel davranış, ekolojik okuryazarlık, doğayla ilişki ve sürdürülebilir yaşam becerileri gibi çıktıları raporlayan çalışmalar değerlendirmeye alınmıştır. Bulgular, çevre eğitiminin etkisinin tek bir bilişsel kazanımla sınırlı olmadığını; çocukların çevresel kavramları anlamlandırma biçimlerinden canlılara yönelik duyarlılıklarına, geri dönüşüm ve tüketim davranışlarından problem çözme, iş birliği ve sorumluluk almaya kadar uzanan çok boyutlu bir gelişim alanı oluşturduğunu göstermektedir. Ardoin ve Bowers'ın (2020) 66 ampirik çalışmayı kapsayan sistematik derlemesinde araştırmaların %82'sinin ağırlıklı olarak olumlu sonuçlar bildirmesi; çalışmaların %76'sında çevresel okuryazarlık, %38'inde bilişsel, %38'inde sosyal-duygusal ve %21'inde fiziksel gelişim çıktılarının raporlanması, alanın genel eğilimini açık biçimde ortaya koymaktadır. Türkiye'de 360 okul öncesi çocukla yürütülen ekolojik okuryazarlık uygulamasında çevresel tutum toplam puanının 51,26'dan 65,88'e, çevresel farkındalık puanının 23,07'den 27,87'ye yükselmesi de bu eğilimle uyumludur (Sayın et al., 2022). Çalışmada yayımlanmış istatistiklerden ikincil olarak hesaplanan standartlaştırılmış değişim büyüklükleri, söz konusu örnekte çevresel tutum için $d \approx 2,60$, çevresel farkındalık için $d \approx 1,03$ düzeyindedir; ancak kontrol grubu bulunmaması nedeniyle bu değerler nedensel etki tahmini olarak değil, örneklem içi değişimin büyüklüğü olarak yorumlanmıştır.

Anahtar Kelimeler: çevre eğitimi, okul öncesi eğitim, çevresel farkındalık, çevresel tutum, ekolojik okuryazarlık



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A Theoretical Overview of the Effects of Environmental Education on Preschool Children

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Abstract

The purpose of this study is to examine the effects of environmental education in the preschool period on children's environmental awareness, attitudes, knowledge, behavior, connectedness to nature, cognitive development, and social-emotional development by integrating theoretical perspectives with empirical evidence. The study was designed as a structured theoretical review and evidence synthesis. Foundational theoretical texts in early childhood environmental education were examined together with systematic reviews, experimental and quasi-experimental studies, mixed-methods studies, and qualitative research published between 1995 and 2026. Priority was given to studies directly involving preschool-aged children and reporting outcomes related to environmental awareness, environmental attitudes, ecological literacy, pro-environmental behavior, nature connectedness, and sustainability-related competencies. The findings indicate that the effects of environmental education are not limited to the acquisition of factual knowledge. Rather, environmental education is associated with a multidimensional developmental pattern extending from children's understanding of environmental concepts to care for living beings, recycling and consumption practices, problem solving, cooperation, and responsibility. In the systematic review of 66 empirical studies conducted by Ardoin and Bowers (2020), 82% of the studies reported mainly positive findings; environmental literacy outcomes were reported in 76% of the studies, cognitive outcomes in 38%, social-emotional outcomes in 38%, and physical development outcomes in 21%. Evidence from Türkiye is consistent with this pattern. In a study involving 360 preschool children, mean environmental attitude scores increased from 51.26 to 65.88 and environmental awareness scores from 23.07 to 27.87 following an ecological literacy program (Sayın et al., 2022). Secondary standardized change estimates calculated from the published statistics were approximately $d_z=2.60$ for environmental attitudes and $d_z=1.03$ for environmental awareness; because the study used a single-group pretest-posttest design, these estimates are interpreted as within-sample change rather than causal effects.

Keywords: Environmental education, preschool education, environmental awareness, environmental attitude, ecological literacy

Introduction

The relationship between environmental problems and childhood cannot be understood solely in terms of ecological risks that may emerge in the future. Children already live within processes such as air pollution, rising temperatures, water scarcity, waste generation, biodiversity loss, and the pressure of urbanization on natural areas. Environmental education in early childhood should therefore be regarded not as a means of transmitting the problems of the adult world to children, but as a pedagogical field that enables them to notice the environment in which they live, make sense of their relationships with living beings, and understand the consequences of their everyday choices in developmentally appropriate ways. UNESCO's approach to strengthening sustainability in early childhood education likewise emphasizes that environmental learning should not be postponed to later stages of schooling (UNESCO, 2024). From this perspective, environmental education in preschool ceases to be a separate "theme" and instead becomes a way of educationally structuring the child's relationship with the living environment.

The early childhood years are particularly important for the formation of environmental attitudes. Children's evaluations of the environment are not merely repetitions of what adults tell them; direct experience, family practices, everyday school routines, peer interactions, and contact with natural settings jointly shape these evaluations. In developing an environmental attitude scale for preschool children, Musser and Diamond (1999) showed that children's environmental attitudes were associated not with verbal ability but with the extent of their participation in environmentally related activities at home. This finding suggests that early environmental education may remain limited when it relies solely on information transmission and that attitude development requires behavior, participation, and repeated experience.

One of the theoretical foundations of environmental education in the preschool period is the view that children actively construct knowledge. From a constructivist perspective, children develop environmental concepts not primarily through ready-made definitions but by observing, classifying, comparing, establishing cause-and-effect relationships, and assigning meaning to their own experiences. Accordingly, concepts such as soil, water, plants, animals, energy, waste, and seasons should be represented in preschool education not through abstract explanations, but through experiences such as touching, observing, growing, caring, measuring, transforming, and discussing. In Ogelman's (2012) soil education project conducted with 180 children aged 5–6, the experimental group's soil-related knowledge scores increased significantly compared with those of the control group, demonstrating that concrete and contextual learning can support the development of environmental concepts.

A second major theoretical strand in early childhood environmental education is the sociocultural learning approach. Environmental meanings do not emerge in the child's mind in isolation; teachers' questions, shared play with peers, repeated family practices, and the environmental values embedded in social life all constitute contexts for learning. Environmental education should therefore be understood not as a process in which children are taught a "list of correct behaviors," but as a social learning process through which the capacity to think and act together is developed. Davis (2009) and Elliott and Davis (2009), who have examined education for sustainability in early childhood, argue that sustainability in preschool institutions should not remain

at the level of affection for nature; it should be supported by opportunities for children to participate, make decisions, and influence everyday practices.

Biophilia, nature connectedness, and place-based learning approaches also provide an important framework for understanding children's relationships with nature. Regular contact with natural environments generates knowledge about living beings while also allowing children to form emotional bonds with particular places. Giusti, Barthel, and Marcus (2014) demonstrated that preschool children's repeated routines in nature were associated with affinity with the biosphere and a sense of belonging to nature. Elliot, Ten Eycke, Chan, and Müller's (2014) study of a nature kindergarten similarly showed that sustained outdoor experience can provide an important pedagogical context for nature relatedness and environmental responsibility. The effects of environmental education therefore cannot be evaluated solely by asking "how many environmental concepts were learned?"; it is also necessary to examine how children perceive nature, how they relate to living beings, and how they position themselves in relation to the more-than-human world.

The value dimension is also important in the development of environmental attitudes. Preschool children may initially provide nature-centered responses to environmental questions, yet closer examination of their justifications may reveal evaluations that prioritize human benefit. In a qualitative study with 40 preschool children, Kahriman-Öztürk, Olgan, and Tuncer (2012) found that children could initially make ecocentric choices regarding many environmental issues, while some of the reasons they gave for those choices were grounded in anthropocentric considerations. This suggests that normative statements such as "we should protect nature" are insufficient in preschool environmental education; children also need concrete experiences through which they can understand the interdependence between humans and nature.

A sustainability perspective further broadens the scope of environmental education. Sustainability links environmental protection with issues such as consumption, equity, resource sharing, social responsibility, and the living conditions of future generations. In discussing the contribution of early childhood education to sustainable societies, Pramling Samuelsson and Kaga (2008) emphasize that young children are not merely individuals who need protection, but social actors capable of constructing meaning and participating. Ärlemalm-Hagsér (2013), in a study of Swedish preschools, found that although discourses of respect and care for nature were strong, children's opportunities for genuine participation and agency remained limited in some practices. This critique highlights the importance of transforming environmental education from a sequence of activities prepared for children into a learning process conducted with children.

Developmental appropriateness in preschool environmental education requires content to be organized in accordance with children's cognitive and emotional capacities. When issues such as climate change, species extinction, or pollution are presented at a scale likely to provoke anxiety, they may produce a sense of helplessness rather than learning. By contrast, local, observable, and actionable environmental issues can provide children with both meaning and a sense of competence. Reducing a classroom's paper consumption, caring for a plant in the schoolyard, sorting waste, or monitoring water use enables macro-level environmental problems to be connected with everyday life. The principles of excellence developed by the NAAEE for early childhood environmental education programs likewise identify developmental appropriateness, play, inquiry, outdoor experience, family participation, and the holistic quality of the learning environment as core characteristics (NAAEE, 2016).

Research evaluating the effects of environmental education has increased markedly over the past two decades. In Ardoin and Bowers's (2020) systematic review covering 1995–2018, 64% of the 66 studies that met the inclusion criteria were published between 2013 and 2018 alone, indicating the rapid recent expansion of the field. In the same review, 55% of the studies were classified as predominantly qualitative, 26% as quantitative, and the remainder as mixed-methods. This diversity demonstrates that early childhood environmental education is too complex to be assessed through a single methodological lens. Changes in children's environmental knowledge may be examined through standardized tests, whereas their meanings and interpretations of nature may become more visible through drawings, interviews, observation notes, and play behavior.

Research on preschool environmental education in Türkiye shows a similar diversity. Game-based environmental activities (Akbayrak & Kuru Turaşı, 2017), creative drama (Aydın & Aykaç, 2016), multimedia-supported programs (Buldur & Ömeroğlu, 2021), picture-book-based programs (Polat & Deretarla Gül, 2023), ecological literacy interventions (Sayın et al., 2022), environmental awareness programs (Uçar Çabuk & İsal, 2023), 3R practices integrated with science process skills (Güvenir & Türkmen, 2024), and sustainable environmental education programs (Çomak et al., 2025) have examined environmental outcomes through different pedagogical pathways. A systematic review published in 2026 on nature-based preschool research in Türkiye found that 34 studies focused particularly on environmental attitudes, awareness, perceptions of nature, and social skills and generally reported positive outcomes (Arı Ersan & Şeker, 2026).

Nevertheless, the positive findings in the field require cautious interpretation. Methodological limitations such as small samples, convenience sampling, short-term interventions, limited reliability of measurement tools, absence of control groups, and researchers simultaneously serving as program implementers are common in early childhood environmental education studies. For example, an increase observed in a single-group pretest-posttest design may reflect the program, but it may also be associated with maturation, testing effects, or concurrent classroom experiences. Accordingly, the broad claim that “environmental education is effective” should be accompanied by clarification of what type of environmental education is effective, for how long, for which age group, on which outcomes, and under what research design.

Responding to this need, the present study aims to evaluate the effects of preschool environmental education not only in terms of environmental literacy but also across cognitive, social-emotional, behavioral, and nature-related dimensions. The central question is what types of change preschool environmental education has been associated with in children and under which pedagogical conditions these changes emerge most consistently. To this end, international systematic reviews were considered alongside experimental, quasi-experimental, and qualitative studies from Türkiye, and the quantitative meaning of selected findings was further examined through limited secondary effect-size calculations based on published statistics.

Method

This study is a structured theoretical review that integrates theoretical approaches and empirical findings in the field of preschool environmental education. Its purpose is not to generate data from a new participant group, but to bring together existing scientific evidence according to systematic criteria in order to explain the effects of environmental education on preschool children. The methodological approach therefore follows a search and selection logic that is more transparent than a traditional narrative review, while adopting a more flexible form of evidence synthesis than a

quantitative meta-analysis. Because the studies reviewed were markedly heterogeneous in research design, sample characteristics, intervention duration, and measurement instruments, a common meta-analytic effect size was not calculated across all studies. Instead, reported sample characteristics and outcomes were compared and interpreted comparatively.

The source-selection process used the keywords early childhood environmental education, preschool environmental education, environmental education in preschool, ecological literacy, environmental awareness, environmental attitude, nature-based preschool, sustainability education in early childhood, recycling education, and pro-environmental attitudes. To identify foundational studies and current evidence, publications indexed in Google Scholar, ERIC records, PubMed/PMC, DergiPark, and article pages of academic publishers were included in the search framework. The theoretical foundation of the study drew on key works addressing the relationship between early childhood and sustainability, including Davis (2009), Elliott and Davis (2009), Ärlemalm-Hagsér (2013), NAAEE (2016), and Pramling Samuelsson and Kaga (2008).

Four primary criteria were used to select empirical evidence: the study had to directly include preschool or early-childhood age groups; report an identifiable intervention or experience related to environmental education, nature-based education, ecological literacy, or sustainability education; present an outcome such as environmental awareness, attitude, knowledge, behavior, nature connectedness, cognitive development, social-emotional development, or a closely related construct; and provide sufficiently clear methodological and results information to allow interpretation. Adult samples without direct relevance to children, studies based solely on teacher opinions that did not report child outcomes, and publications with insufficient methodological or outcome information were excluded from the core evidence set. International reports explaining the theoretical and programmatic framework of environmental education were nevertheless used for discussion purposes.

In synthesizing the evidence, study design, sample size, age group, intervention or implementation type, duration, principal outcome measured, and direction of the reported result were coded first. For quantitative studies, published statistics such as means, standard deviations, *t* values, *p* values, and sample sizes were considered; for qualitative studies, explicitly reported themes and patterns were used. Ardoin and Bowers's (2020) systematic review of 66 studies served as higher-level evidence describing the general distribution of the field and its outcome categories. Interpretations of evidence from Türkiye were developed particularly through studies such as Sayın et al. (2022), Uçar Çabuk and İşal (2023), Güvenir and Türkmen (2024), Polat and Deretarla Gül (2023), Buldur and Ömeroğlu (2021), and Yılmaz, Yılmaz Bolat, and Gölcük (2020).

Secondary calculations based on published statistics relied only on values explicitly reported in the original articles. For related measurements in single-group pretest-posttest designs, the standardized within-sample change magnitude was calculated using the published paired-samples *t* value and sample size with the formula $dz = t/\sqrt{n}$. For posttest comparisons between independent groups, an approximate Cohen's *d* was calculated using $d = t/\sqrt{(1/n_1 + 1/n_2)}$. These calculations do not constitute reanalysis of the raw data from the original studies; rather, they are secondary standardizations intended to facilitate interpretation of published test statistics. Particularly in designs without a control group, calculated *dz* values were interpreted not as causal "program effects" but as the magnitude of change observed within the sample.

From an ethical standpoint, the study did not involve the collection of new participant data, personal data, or any intervention; therefore, no data-collection process requiring ethics committee approval was conducted. Numerical results were restricted to values reported in the relevant publications, and unreported statistics were not estimated. This approach is particularly important for maintaining scientific accuracy in research involving preschool children, because overstating findings derived from small samples or uncontrolled designs may lead to misleading conclusions about early childhood education practices.

Findings

The first and most evident conclusion from the reviewed evidence is that preschool environmental education generally shows a positive direction in the domain of environmental literacy. In Ardoin and Bowers's (2020) systematic review of 66 empirical studies, 50 studies (76%) reported outcomes related to the development of environmental literacy. In the same review, 54 studies (82%) reported predominantly positive outcomes, 11 (17%) reported a combination of positive and null effects, and only one study reported solely nonsignificant/null findings. Although this distribution indicates that early childhood environmental education is a generally promising field of research, the predominance of positive publications also requires consideration of possible publication bias. Nevertheless, the replication of findings across different countries, program types, and measurement tools suggests that the effects of environmental education on children's ways of thinking about the environment are not merely context-specific.

When the pedagogical structure of the programs is examined, direct contact with nature emerges as a central feature. Of the 66 studies in Ardoin and Bowers's (2020) sample, 54 (83%) included spending time outdoors in natural or nature-rich settings. Forty-one programs (66%) consisted of applications integrated into the regular school program and sustained throughout an academic year; 12 (19%) were one-time interventions, and 9 (15%) lasted between one and eight weeks. This distribution suggests that positive outcomes are supported not only by short-term activities but especially by repeated experiences in nature. Prominent implementation categories in the review included time spent in nature, play and movement, knowledge and skill development, social interaction, creative arts, time for reflection and observation, taking action, family connections, and personal connection.

From the perspective of cognitive development, the influence of environmental education extends beyond learning environmental concepts. In Ardoin and Bowers's (2020) review, 25 studies (38%) reported cognitive developmental outcomes, including cognitive functions, academic content learning, and creativity. Because natural settings provide preschool children with variable, multisensory, and problem-rich learning environments, they can embed skills such as observation, comparison, classification, prediction, and inference within everyday experience. In Ogelman's (2012) soil education project, a comparison of 90 children in the experimental group and 90 in the control group showed a significant increase in soil-related knowledge scores in favor of the experimental group, providing a concrete example of the contribution of topic-focused environmental education to conceptual learning. Similarly, programs integrating picture books, drama, and science-process activities can move environmental concepts beyond abstract explanation and connect them with children's existing cognitive schemas.

Evidence concerning social-emotional development likewise demonstrates that environmental education is not merely a form of science or factual instruction. In Ardoin and Bowers's (2020)

review, 25 studies (38%) reported social and emotional developmental outcomes extending to social skills, self-regulation, autonomy, and cooperation within groups. Open-ended play in natural environments gives children opportunities to establish shared goals, distribute roles, and adapt collectively to changing environmental conditions. Findings from Hammarsten et al. (2019) in a forest-garden context show that children's experiences of using their senses, observing, learning together, and developing a sense of community are intertwined with ecological literacy. In this respect, environmental education can be conceptualized as a pedagogical context that produces environmental and developmental outcomes together rather than treating them as separate domains.

Recent research has examined more directly the effects of empathy with nature and emotional connection on environmental attitudes. In their first study with 138 preschool children, Li et al. (2024) reported that empathy with nature positively predicted pro-environmental attitudes beyond the explanatory contribution of empathy toward people. In the quasi-experimental second phase of the same research, 46 children were assigned to intervention and active-control groups; following an instructional session designed to stimulate empathy with nature, the intervention group displayed higher pro-environmental attitudes. This finding indicates that environmental education can be strengthened through activities based not only on teaching rules but also on understanding the perspectives of living beings, providing care, and developing emotional relationships with nature.

One of the largest-sample findings from Türkiye comes from the ecological literacy education study conducted by Sayın et al. (2022) with 360 preschool children from 24 schools. Children's total environmental attitude score was reported as 51.26 (SD = 4.23) before the intervention and 65.88 (SD = 3.76) afterward. This increase corresponds to an approximately 28.5% change in the mean score, with a paired-samples t-test result of $t(359) = 49.421$, $p < .001$. A secondary calculation based on the published t value yielded $d \approx 2.60$. Significant increases were also reported in the subdimensions of environmental attitude: consumption, $t(359) = 19.207$; environmental protection, $t(359) = 25.665$; recycling-reuse, $t(359) = 34.652$; and lifestyle habits, $t(359) = 29.618$. These values indicate substantial within-sample change; however, because the study used a single-group pretest-posttest design, attributing the entire change to the intervention would not be methodologically justified.

In the same study, the total environmental awareness score increased from 23.07 (SD = 3.45) to 27.87 (SD = 3.11), corresponding to an approximately 20.8% increase in the mean. For total awareness, $t(359) = 19.558$, $p < .001$, and the secondary estimate of d was approximately 1.03. Mean scores increased from 8.60 to 10.37 in the protection of living beings dimension, from 8.66 to 10.00 in the consumption dimension, and from 5.82 to 7.49 in the environmental pollution dimension. The corresponding t values were 15.383, 7.677, and 16.352, respectively. These findings indicate that environmental education is associated not merely with a general awareness of the concept of "environment," but also with change in more specific behavioral domains such as protecting living beings, consumption, and pollution (Sayın et al., 2022).

Experimental evidence involving control groups provides stronger comparative leverage than single-group studies. In the study conducted by Uçar Çabuk and İşal (2023) with 41 children, 21 were in the experimental group and 20 in the control group. Pretest means were 0.81 for the experimental group and 0.75 for the control group, with no significant baseline difference ($p = .117$). At posttest, the experimental-group mean was 0.92 and the control-group mean was 0.82, and the between-group difference was significant, $t = 3.107$, $p = .004$. An approximate independent-groups effect-size calculation based on the published t value yielded $d \approx 0.97$. However, the control group also increased from 0.75 to 0.82, and this change was reported as significant. This pattern suggests that

environmental awareness can develop within the standard preschool curriculum as well and that the contribution of a specialized environmental education program should be interpreted as an additional increase beyond ongoing development.

Table 1. Reported results and secondary calculations from selected quantitative studies

Study	Sample / design	Primary outcome	Reported result	Secondary interpretation
Sayın et al. (2022)	N = 360; single-group pretest-posttest	Environmental attitude	51.26 → 65.88; $t(359) = 49.421$; $p < .001$	28.5% increase; $dz \approx 2.60$
Sayın et al. (2022)	N = 360; single-group pretest-posttest	Environmental awareness	23.07 → 27.87; $t(359) = 19.558$; $p < .001$	20.8% increase; $dz \approx 1.03$
Uçar Çabuk & İşal (2023)	Experimental n = 21; control n = 20	Environmental awareness	Posttest: 0.92 vs. 0.82; $t = 3.107$; $p = .004$	Approx. $d \approx 0.97$
Ogelman (2012)	Experimental n = 90; control n = 90	Soil knowledge	Significant increase in favor of the experimental group	Controlled design; positive direction
Güvenir & Türkmen (2024)	N = 38; quasi-experimental	Attitude and awareness	Experimental-group posttest means significantly higher than control group	Integration of 3R + science process skills

In the quasi-experimental study conducted by Güvenir and Türkmen (2024) with 38 children, posttest scores for environmental attitudes and awareness were significantly higher in the experimental group than in the control group following an intensive program integrating basic science process skills with the reduce-reuse-recycle (3R) approach. Although the sample size was limited, the study is important for demonstrating the integration of environmental education with science process skills. In such integrated programs, the child experiences environmental behavior not as an adult instruction but as part of a process of generating solutions to an observed problem. Sorting waste, discussing possibilities for reusing a material, or observing the consequences of a particular consumption behavior can support scientific thinking and environmental responsibility within the same activity.

The quality of instructional materials is another variable that influences the outcomes of environmental education. The picture-book-based environmental education program of Polat and Deretarla Gül (2023) examined preschool children's environmental attitudes and views using both

quantitative and qualitative data and reported that the program supported children's meaning-making about the environment. Hsiao and Shih (2015) likewise demonstrated the contribution of picture books to teaching environmental concepts to preschool children. An important feature of picture books is that they make environmental processes that children may find difficult to experience directly accessible through narrative, characters, and visual representation. Their effectiveness, however, depends not merely on reading the content but on connecting it with post-reading questions and answers, dramatization, nature observation, and action-oriented activities.

Game-based practices are particularly compatible with the developmental characteristics of the preschool period. Akbayrak and Kuru Turaşlı (2017) reported that game-based environmental activities improved children's environmental awareness in themes such as respect for living beings, recycling, and environmental cleanliness. Play transforms environmental behavior from an abstract moral rule into an experience in which the child takes an active role. A "recycling center" game may enable children to sort waste by type; a garden game may require them to plan water use; and dramatic play based on animal care may prompt discussion of the needs of living beings. The common feature of these activities is that environmental learning is linked to a problem or role that is meaningful to the child.

The behavioral dimension of environmental education is more difficult to measure than gains in attitudes and awareness. Although children may use positive statements about protecting the environment, the extent to which these statements translate into everyday behavior cannot be determined with certainty without observation and long-term follow-up. The findings of Musser and Diamond (1999) are important in this regard: the association between children's environmental attitudes and participation in environmentally related activities at home indicates that behavior is embedded in social routines. Accordingly, a recycling behavior learned in preschool may have limited persistence if it receives no reinforcement at home; by contrast, when family and school support the same behavioral pattern, children can experience environmental responsibility as a sustained life practice.

The relationship between environmental education and physical development becomes particularly evident in nature-based and outdoor-oriented programs. In Ardoin and Bowers's (2020) review, 14 studies (21%) reported physical development outcomes. Activities such as walking, climbing, balancing, carrying, digging, and moving across different surfaces in natural settings integrate environmental learning with gross motor development within the same experience. This finding indicates that planning environmental education as "desk-based environmental information" is inconsistent with the developmental logic of early childhood. Children's bodily participation in the environment allows them to make sense of environmental phenomena through sensory and spatial experience.

Although the evidence concerning language and literacy is more limited in quantity, it is noteworthy. Six studies in Ardoin and Bowers's (2020) review reported language and literacy outcomes. Environment-themed stories, nature journals, children's verbal descriptions of their observations, contextual use of new concepts, and shared discussions provide opportunities to support language development. Kurt Gökçeli's (2022) program integrating environmental education with language activities likewise combined environmental content with early language learning in order to enhance environmental awareness among children aged 48–66 months. This approach demonstrates that environmental education can be distributed across art, language, play, science, and movement activities within the preschool curriculum without requiring a separate lesson period.

Program duration and continuity appear important in explaining the magnitude of outcomes. In the discussion by Sayın et al. (2022), the absence of a significant effect on environmental attitudes in the short-term environmental education program of Yılmaz, Yılmaz Bolat, and Gölcük (2020) was interpreted in relation to the possible role of intervention duration. The fact that two-thirds of the programs in Ardoin and Bowers's (2020) review extended across an entire academic year likewise supports an emphasis on continuity. Environmental attitudes and behavior require repetition, modeling, and everyday practice to a greater extent than knowledge acquired in a single session. Thus, short-term projects may generate awareness, but enduring habits require longer-term structures supported by the institution's physical environment, teacher behavior, and family participation.

Qualitative studies reveal an important tension that quantitative scores may not capture. While learning to protect the environment, children may sometimes develop human-centered justifications, believing that nature should be protected "because it is useful to people." The findings of Kahrman-Öztürk et al. (2012) clearly demonstrate this distinction. Similarly, Ärlemalm-Hagsér (2013) noted that children's genuine participation in decision-making processes can remain limited even in preschool practices characterized by strong sustainability discourse. The success of environmental education should therefore be evaluated not only through higher attitude scores, but also through the extent to which children understand the human-nature relationship as complex and reciprocal and can explain the meaning of their own actions.

A systematic review published in Türkiye in 2026 found that most nature-based preschool studies supported environmental awareness, social development, and positive attitudes toward nature, while methodologically relying largely on qualitative designs, scales, and interviews (Arı Ersan & Şeker, 2026). In the same year, Kartal's (2026) qualitative study examining an eight-week environmental education program with 25 children in Ankara reported improvements in children's understanding of the importance of environmental protection, recycling, and environmental participation. These recent studies indicate that preschool environmental education in Türkiye is increasingly addressing not only environmental knowledge but also behavioral and participatory dimensions.

When the overall pattern of evidence is considered, five principal mechanisms emerge as explanations for the effects of environmental education: direct experience, repetition and continuity, social participation, emotional connection, and action-oriented learning. Direct experience makes environmental concepts concrete; repetition and continuity facilitate the transformation of behavior into routine; social participation enables children to learn from peer and adult models; emotional connection supports the internalization of environmental values; and action-oriented learning gives children a sense that they can have an effect on environmental problems. The findings suggest that environmental education produces more limited outcomes when it relies on only one of these mechanisms, and stronger outcomes when several are integrated within the same program.

Discussion and Conclusions

The evidence synthesized in this study indicates that a substantial, though methodologically variable, body of literature supports the contribution of preschool environmental education to children's environmental awareness and attitudes. The fact that 82% of the studies in Ardoin and Bowers's (2020) systematic review reported predominantly positive findings is one of the strongest indicators summarizing the overall direction of the field. This proportion, however, should not be interpreted as meaning that "programs are definitively effective in 82% of cases," because the

reviewed studies differed in research design, measurement instruments, and intervention duration. A more accurate interpretation is that positive outcomes predominate in early childhood environmental education research and recur particularly in environmental literacy, cognitive development, and social-emotional development.

Experimental findings from Türkiye largely align with this international pattern. The substantial within-sample changes in both environmental attitudes and awareness reported by Sayın et al. (2022) in a sample of 360 children, Ogelman's (2012) controlled study on soil knowledge, and the control-group experimental findings of Uçar Çabuk and İşal (2023) demonstrate that preschool environmental education can produce measurable outcomes. Conversely, the finding by Yılmaz et al. (2020) of no significant effect on environmental attitudes reminds us that not every program yields the same result. Such differences may be explained by variables including intervention duration, the meaningfulness of the content for children, program intensity, the sensitivity of the measurement instrument, and the quality of the implementation setting.

One of the most important distinctions at this point concerns program duration. One-off environmental activities may attract children's attention and curiosity, but changes in attitudes and behavior generally require repeated experience. The fact that 66% of the programs in Ardoin and Bowers's (2020) sample continued throughout the academic year points to continuity as a feature of effective early childhood environmental education. A child who participates in a recycling activity on one day but spends the remainder of the school year in an environment heavily dependent on single-use materials is not in the same pedagogical situation as a child in an institution where waste sorting, conservation, and care are embedded in daily routines. The integration of sustainability education into institutional culture is therefore a quality indicator independent of program content itself.

A second important point is the effect of direct experience with nature. It is not incidental that 83% of the international studies reviewed included outdoor experiences in natural or nature-rich environments (Ardoin & Bowers, 2020). The nature-kindergarten findings of Elliot et al. (2014), Giusti et al.'s (2014) work on nature routines, and Hammarsten et al.'s (2019) forest-garden study show that environmental learning becomes more relational through contact with nature. When a child experiences a tree not merely as an "organism that produces oxygen," but as a living presence under whose shade they play, whose seasonal changes they observe, whose leaves they collect, and whose care they share, environmental knowledge and emotional connection develop within the same process.

Third, the findings show that the affective dimension of environmental education is as important as its cognitive dimension. Li et al. (2024) demonstrated that empathy with nature significantly predicts pro-environmental attitudes, showing that environmental values cannot be explained solely by the amount of knowledge acquired. This result becomes even more meaningful when considered together with Kahrman-Öztürk et al.'s (2012) distinction between ecocentric and anthropocentric justifications. A child may learn environmental protection as a "good behavior" rewarded by adults; however, understanding the intrinsic value of living beings and the interdependence between humans and nature requires a different level of pedagogical depth. Accordingly, emotions such as empathy, care, curiosity, and wonder are legitimate pedagogical learning outcomes in preschool environmental education.

Fourth, family participation appears critical to the persistence of outcomes. Musser and Diamond's (1999) demonstration of an association between environmental attitudes and participation

in environmental activities at home suggests that school alone is insufficient. Family routines such as sorting waste, paying attention to water and energy use, spending time outdoors, or participating in plant and animal care can translate environmental concepts learned at school into behavior. Positive results from project-based programs that include family participation also support this view (Erol & Gülay Ogelman, 2021). Family involvement, however, should not be designed merely as homework; families' living conditions, access to natural areas, and socioeconomic differences should also be considered.

Fifth, preschool environmental education needs to be reconsidered in terms of children's participation. When sustainability education is designed simply as the transmission of adult-defined correct behaviors to children, children may comply with environmental rules without experiencing reflection and decision-making about how those rules are formed. Ärlemalm-Hagsér's (2013) findings show that children's agency and participation in decision-making can remain limited even in institutions where discourses of respect for the environment are strong. Allowing children to decide which plants to grow in the schoolyard, discuss the classroom's waste problem, or develop their own proposals for water conservation can transform environmental behavior from compliance with an external rule into an experience of democratic participation.

Some differences among studies arise from measurement instruments. The use of self-report scales with preschool children is developmentally constrained. Although Musser and Diamond's (1999) CATES-PV made an important contribution to the measurement of preschool environmental attitudes, pictorial response options, structured interviews, behavioral observations, and play-based assessments may often provide more meaningful data for this age group. Evans et al. (2007) assessed children's environmental attitudes and behaviors through gamified tasks. Such measurement approaches are valuable because they can generate data independently of children's literacy skills. Future research would provide more reliable evaluation by combining quantitative and qualitative evidence rather than relying on a single scale score.

The high d_z values calculated from the findings of Sayın et al. (2022) also necessitate discussion of measurement and design. Values of $d_z \approx 2.60$ for attitudes and $d_z \approx 1.03$ for awareness indicate very large within-sample changes. The absence of a control group, however, prevents these values from being interpreted as the pure causal effect of the program. By contrast, the approximate $d \approx 0.97$ calculated for the posttest between-group difference in Uçar Çabuk and İşal's (2023) controlled study provides a stronger comparative signal, although the sample of only 41 children implies that the confidence interval may be wide. This comparison highlights the importance of reporting effect sizes and using larger controlled samples in preschool environmental education research.

The current direction of the literature in Türkiye is toward integrating environmental education with diverse pedagogical tools. Play, drama, picture books, science process skills, multimedia, project-based approaches, and ecological literacy have been used as effective tools across different studies. Although this diversity is valuable, directly comparative designs are needed to answer the question, "Which method is more effective?" Existing studies generally compare one program with standard practice, while research testing different environmental education pedagogies under equivalent sample conditions remains limited. Future comparisons of picture-book-based, nature-based, play-based, and digitally supported approaches in relation to long-term behavioral outcomes would provide greater explanatory value for the field.

Integrating environmental education into the preschool curriculum also redefines the teacher's role. Rather than merely transmitting environmental information, the teacher becomes a facilitator who poses questions that sustain children's curiosity, allows time for observation, creates opportunities to work with natural materials, and connects everyday environmental issues with classroom life. The NAAEE (2016) guidelines therefore address not only content accuracy but also child-centered pedagogy, play and exploration, safe outdoor environments, family participation, and assessment processes as interconnected components of high-quality early childhood environmental education. Program quality should be evaluated less by the number of activities than by how these elements are connected.

Finally, environmental education should not be designed in a way that places responsibility for resolving the ecological crisis created by adult generations onto children. Davis's (2015) sustainability perspective in early childhood avoids romanticizing children as "little environmentalists who will save the future" and instead views them as individuals capable of meaningful participation in today's educational community. The purpose of environmental learning is not to generate fear, but to help children understand the environment in which they live and develop competence in small-scale areas they can influence. Large-scale issues such as the climate crisis should therefore be approached in preschool through care, solidarity, careful use of resources, and local action rather than through catastrophic discourse.

In conclusion, the accumulated theoretical and empirical evidence on preschool environmental education indicates that the early childhood years are an appropriate period for establishing the foundations of environmental literacy. This appropriateness does not derive from children being "empty vessels," but from the fact that they are at a stage of life in which they intensely observe their surroundings, experience curiosity, construct meaning through play, and develop behavioral patterns through everyday interactions. Effective environmental education takes these developmental characteristics into account and connects environmental concepts with direct experience, play, movement, caregiving, questioning, and shared decision-making.

A common pattern across the studies reviewed is that environmental education can support cognitive, social-emotional, physical, and linguistic development in addition to producing positive outcomes in environmental awareness and attitudes. Ardoin and Bowers's (2020) systematic review of 66 studies clearly demonstrates this multidimensional structure. Evidence from Türkiye generally points in the same direction in relation to ecological literacy, environmental awareness, recycling, sustainable consumption, and environmental attitudes. Nevertheless, the reliability of research findings depends not only on program quality but also on the strength of the research design. Large changes observed in uncontrolled pretest-posttest studies may be important, but they should not be interpreted as causal effects.

In terms of practice, preschool institutions are advised not to limit environmental education to a few special days or project weeks each year. Environmental learning should be distributed across daily routines, and children should be enabled to participate in decisions concerning the classroom's and school's use of water, energy, waste, and materials. Nature walks, schoolyard activities, plant cultivation, observation of local species, and play with natural materials should be used regularly. Picture books, drama, art, and science activities should be considered tools that support children in making sense of these direct experiences.

A principal recommendation for teachers is that pre-service and in-service education should explicitly address the fact that environmental education consists of more than environmental knowledge. Teachers should be supported not only in the scientific content of environmental concepts but also in child participation, open-ended questioning, organizing nature-based play, risk management, addressing environmental anxiety in developmentally appropriate ways, and structuring family participation. Because teachers' own environmental behaviors provide powerful models for children, institutional school practices should be consistent with the messages conveyed in the classroom.

For families, environmental education should be supported through sustainable and accessible everyday practices at home. Rather than expecting the same level of nature activity or materials from every family, low-cost practices such as conserving water, reducing unnecessary consumption, reusing materials, conducting brief outdoor observations, and caring for plants at home can be recommended. Family participation can make behaviors learned at school meaningful and repetitive in the home environment. Because families differ in environmental knowledge and living conditions, however, participation should be approached supportively rather than judgmentally.

From a research perspective, larger randomized studies or strong quasi-experimental designs, long-term follow-up measurements, and multiple data sources are needed. Reporting effect sizes and confidence intervals would help move interpretation beyond reliance on p values alone. In addition to measures of environmental awareness and attitudes, mixed-methods designs should include indicators of actual behavior, family observations, teacher observations, and children's own explanations. Program implementation fidelity should also be reported clearly, including the frequency and duration of activities and the teacher competencies under which they were implemented.

Future studies should also consider socioeconomic and spatial inequalities. Access to natural areas is not equal for all children; those living in urban centers, attending institutions with small play areas, or coming from families with limited economic resources may have less access to nature-based programs. Preschool environmental education policies should therefore be designed so that high-quality nature experience does not remain a privilege of certain private institutions. Improving school grounds, establishing collaborations with neighborhood parks, and developing nature programs supported by local governments may help reduce such inequalities.

Success in environmental education should be evaluated within a broader framework than the number of correct answers children provide about the environment. A child's ability to explain why a living being should not be harmed, propose a way to reuse a material, notice and modify water consumption, observe nature with curiosity, and make shared environmental decisions with peers all represent different manifestations of environmental learning. Assessment instruments should therefore encompass cognitive, affective, and behavioral dimensions together.

Taken as a whole, preschool environmental education appears strongest in educational environments where children have regular contact with nature, play and movement are preserved, learning extends across multiple developmental domains, children participate in decision-making, and consistent environmental practices are maintained across family and school life. Before claiming to prepare individuals who will solve future environmental problems, the aim of environmental education in early childhood should be to support children who can notice the environment in which

they live, remain curious, care for living things, establish cause-and-effect relationships, and assume responsibility at a level appropriate to their capacities.

Additional Information

Conflict of Interest Statement: The authors declare that there is no conflict of interest regarding this study.

Funding Statement: This study received no financial or institutional support from any organization or institution.

Ethics Approval Statement: Ethics committee approval was not required for this study.

Author Contribution Statement: All authors contributed equally to the study.

Artificial Intelligence Statement: No artificial intelligence tools were used in the preparation or conduct of this study.

Kaynakça

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