Exploring 3rd Graders' Informal Science Learning Experiences in the Schoolyard: A Qualitative Study

- Um estudo sobre as experiências de aprendizagem científica informal de estudantes do 3º ano no pátio escolar: uma abordagem qualitativa
- Un estudio sobre las experiencias de aprendizaje científico informal de estudiantes de tercer grado en el patio escolar: un enfoque cualitativo

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Abstract

This qualitative study examined the informal science learning experiences of 29 third-grade students in a schoolyard environment. Data were collected through semi-structured interviews and a questionnaire on students' views of living things and the environment. Findings indicate that engagement in schoolyard activities enhanced students' understanding of environmental concepts, including living and non-living organisms, biodiversity, forest ecosystems, recycling, and interactions between organisms and their environment. Students' environmental awareness improved within a short period, and their concrete reasoning abilities facilitated meaningful connections with observable phenomena, reflecting developmental learning processes. The results also highlight that experiential engagement encouraged active inquiry, curiosity, and reflection, aligning with principles of experiential learning. However, misconceptions persisted regarding abstract ecological concepts such as the food web, microscopic organisms, soil, water, and flowers, suggesting the need for developmentally appropriate scaffolding in informal science contexts. These results highlight the educational potential of schoolyards as outdoor learning

Research Article

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environments, reinforcing experiential, inquiry-based approaches and fostering sustainable environmental attitudes in primary education.

Keywords

informal learning; schoolyard; primary school students; living things and environment

Resumo

Este estudo qualitativo examinou as experiências de aprendizagem científica informal de 29 alunos do terceiro ano em um ambiente de pátio escolar. Os dados foram coletados por meio de entrevistas semiestruturadas e um questionário sobre as percepções dos alunos acerca dos seres vivos e do meio ambiente. Os achados indicam que a participação em atividades no pátio escolar aprimorou a compreensão dos conceitos ambientais pelos alunos, incluindo organismos vivos e não vivos, biodiversidade, ecossistemas florestais, reciclagem e interações entre organismos e seu ambiente. A consciência ambiental dos alunos melhorou em um curto período, e suas habilidades de raciocínio concreto facilitaram conexões significativas com fenômenos observáveis, refletindo processos de aprendizagem em desenvolvimento. Os resultados também destacam que o envolvimento experiencial incentivou a investigação ativa, a curiosidade e a reflexão, alinhando-se aos princípios da aprendizagem experiencial. No entanto, persistiram equívocos sobre conceitos ecológicos abstratos, como a cadeia alimentar, organismos microscópicos, solo, água e plantas, sugerindo a necessidade de suporte apropriado ao desenvolvimento em contextos informais de ciência. Esses resultados destacam o potencial educativo dos pátios escolares como ambientes de aprendizagem ao ar livre, reforçando abordagens experiencial e investigativa e promovendo atitudes ambientais sustentáveis na educação primária.

Palavras-chave

aprendizagem informal; pátio escolar; alunos do ensino fundamental; seres vivos e meio ambiente

Resumen

Este estudio cualitativo examinó las experiencias de aprendizaje informal en ciencias de 29 estudiantes de tercer grado en un entorno de patio escolar. Los datos se recopilaron mediante entrevistas semiestructuradas y un cuestionario sobre las percepciones de los estudiantes acerca de los seres vivos y el medio ambiente. Los hallazgos indican que la participación en actividades en el patio escolar mejoró la comprensión de los conceptos ambientales, incluidos los organismos vivos y no vivos, la biodiversidad, los ecosistemas forestales, el reciclaje y las interacciones entre los organismos y su entorno. La conciencia ambiental de los estudiantes mejoró en un corto período, y sus habilidades de razonamiento concreto facilitaron conexiones significativas con fenómenos observables, reflejando procesos de aprendizaje en desarrollo. Los resultados también destacan que la participación experiencial fomentó la indagación activa, la curiosidad y la reflexión, alineándose con los principios del aprendizaje experiencial. Sin embargo, persistieron conceptos erróneos sobre conceptos ecológicos abstractos, como la cadena alimentaria, los organismos microscópicos, el suelo, el agua y las plantas, lo que sugiere la necesidad de andamiaje apropiado al desarrollo en contextos informales de ciencia. Estos resultados resaltan el potencial educativo de los patios escolares como entornos de aprendizaje al aire libre, reforzando enfoques experienciales y basados en la indagación y fomentando actitudes ambientales sostenibles en la educación primaria.

Palabras clave

aprendizaje informal; patio escolar; estudiantes de primaria; seres vivos y medio ambiente

Introduction

Global environmental challenges, including biodiversity loss, deforestation, air, water, and soil pollution, depletion of natural resources, and hazardous waste resulting from climate change, pose serious threats to the health, productivity, and survival of all living organisms. These human-induced problems endanger life on Earth. Therefore, fostering children's awareness of the environment and environmental issues is essential for developing sustainable solutions in the coming decades. Recent studies have emphasized the crucial role of informal science learning in bridging formal and informal contexts and promoting long-term environmental literacy (Bevan *et al.*, 2020).

Kim and Dopico (2016) highlighted that environmental education is inherently interdisciplinary and argued that leveraging informal science learning experiences can significantly contribute to addressing environmental challenges. More than a century ago, John Dewey, in *The School and Society*, demonstrated that students who recognize themselves as part of an informal learning environment beyond the classroom become active, curious, and motivated learners. Similarly, White (2014) reported that outdoor informal learning provides children with opportunities to investigate, wonder, and innovate while engaging multiple senses. Consistent with this, nature-based environmental education has been shown to enhance children's environmental knowledge and connectedness to nature (Otto & Pensini, 2017). Consequently, well-designed schoolyards, as readily accessible informal learning environments, can foster meaningful learning experiences and increase students' motivation and engagement.

Why Schoolyards?

In many countries, children spend most of their time at home in urban settings, often disconnected from nature. Outside of school, their activities largely revolve around screens such as televisions, tablets, and computers, or indoor recreational facilities. In developing countries, such as Turkey, where science centers, museums, and natural parks are limited, children often have few opportunities to experience nature directly (Bastı *et al.*, 2011). For many children, schoolyards are the closest environment to real-life natural experiences. Research has shown that schoolyards can serve as effective sites for ecological learning, providing authentic engagement with living systems (Raved & Yarden, 2021).

Schoolyards offer students hands-on experiences with living and non-living things, supporting exploration of concepts such as biodiversity, ecological balance, life cycles, food webs, and recycling (Johnson, 2000). Well-designed schoolyards also promote cooperation, ownership, belonging, respect, and responsibility. In such environments, students engage in creative problem-solving for both open-ended and structured tasks, contributing to sustainable environmental education (Maloof, 2006). Furthermore, field-based outdoor learning experiences have been shown to increase primary students' interest and engagement in biology (Vergara Estupiñán & Corredor Aristizábal, 2019).

However, studies indicate that schoolyards are often underutilized as learning environments in many countries (Dyment & Bell, 2008). This underscores the need to design schoolyards in ways that meet students' developmental and educational needs, positioning them as accessible, high-impact sites for informal science learning.

Significance of the study

The present study is significant in terms of students' developmental level, informal learning, schoolyard experiences, and cultural context. One of the most effective strategies for fostering environmental awareness is to strengthen students' connections with nature. The stronger the human–nature relationship, the more promising the future of our planet (Özgün & Özgün, 2018). Research indicates that individuals with a strong connection to nature exhibit lower levels of anxiety and engage in more environmentally responsible behaviors compared to those with weaker connections (Çakır *et al.*, 2015).

Additionally, previous studies suggest that the foundation for environmental awareness is established between the ages of 7 and 15 (Atasoy, 2005), and cognitive sensitivity toward environmental issues develops around ages 9 and 10 (Eroğlu, 2009). According to Piaget, third-grade students are in the concrete operational stage, which aligns with the age at which cognitive sensitivity toward the environment is emerging. Therefore, conducting this study with 10-year-old students is particularly meaningful.

Another critical aspect of this research is the cross-cultural relevance of raising environmental awareness. Moreover, informal learning experiences have been shown to positively impact challenges common among children worldwide, such as obesity, attention deficits, and hyperactivity (Louv, 2012). Informal learning is often implemented in settings such as nature camps (Yardımcı, 2009), science centers and museums (Bozdoğan, 2007; Rennie & Williams, 2002; Doğan *et al.*, 2011), zoos (Collins *et al.*, 2020), and forest schools (Coates & Pimlott-Wilson, 2019).

This study is unique in that it investigates informal science learning experiences conducted directly in the schoolyard, an accessible environment where all students and teachers can participate freely. Furthermore, the study is significant for assessing students' perceptions of living organisms and the natural environment, enhancing environmental awareness, improving the effectiveness of science education, and promoting the utilization of schoolyards as informal learning environments within science instruction (Vergara Estupiñán & Corredor Aristizábal, 2019).

Research Question

This study adopts a qualitative approach to explore third-grade students' experiences with informal science learning in the schoolyard, focusing on the development of concepts such as characteristics of living and non-living organisms, biodiversity, Food webs, microscopic organisms, habitats, recycling, forest importance, and interactions between living beings and the environment. The central research question is as follows: How do informal science learning experiences in the

schoolyard contribute to third-grade students' conceptual understanding and awareness of living organisms and the environment?

Methodology

Effective science education emphasizes small-group, hands-on learning experiences (Dewey, 2011). Accordingly, this study employs a qualitative research design to investigate the process of informal science learning in the schoolyard for third-grade students (approximately 9 years old). The research was conducted with a single group, using pre- and post-test measures, to ensure that all students could participate in this engaging and instructive activity while controlling for teacher-related variables.

Sampling

The participants of this study consisted of 29 third-grade students (11 male, 18 female), aged approximately 9–10 years, enrolled in a state primary school with an average socioeconomic background in a city in the Western Black Sea Region of Turkey. Initially, the study included 32 students; however, three students were unable to participate in the post-test for various reasons, resulting in a final sample of 29 students.

Data collection procedure

The study was conducted in an authentic context within the schoolyard. Prior to implementation, websites, books, and activities employed in forest schools in the United Kingdom were reviewed and selected in accordance with the third-grade Science Curriculum. These activities were subsequently adapted based on the recommendations of three experts in science education.

The intervention was conducted with seven student groups, each consisting of 4–5 students, over a four-week period under the guidance of classroom teachers, four in-service teachers, and the researchers. The schedule and activities implemented are presented in Table 1.

Table 1.

Treatment applied during the informal science learning process in the schoolyard

Week	Activities
Week 1	Examining soil structure; creating compost with paper, cardboard, eggshells, coffee and tea waste brought from home, and leaves and wood chips collected from the yard; identifying dinosaur fossils and exploring dinosaur images with 3D glasses.
Week 2	Observing local bird species; constructing bird nests using natural materials (grass, leaves, shrubs, stones, wool, cotton, feathers, sticks, moss, mud); creating thermoses with various materials for bird eggs. Thermos production with various materials (cotton, foil, sponge, cotton, etc.) for bird eggs,
Week 3	Observing small creatures such as insects, worms, grasshoppers, butterflies, and ants; conducting walks to collect litter; constructing a Food web using ropes to represent producers, herbivores, carnivores, and decomposers.
Week 4	Planting and maintaining plants; holding a family picnic; observing apple browning; drawing pictures of natural environments.

Note. Activities were conducted with groups of 4–5 students over four weeks under the guidance of classroom teachers, in-service teachers, and researchers.

Data Collection Instruments

Students' conceptual development regarding living organisms and the environment through informal science learning in the schoolyard was examined using the Views on Living Things and Environment Questionnaire, developed by the researchers (Table 1). The questionnaire comprised 11 open-ended items. Its clarity and comprehensibility were evaluated by three Turkish teachers, and minor revisions were made based on their recommendations. Pilot

interviews were conducted with four third-grade students from the target school, resulting in minor adjustments. An additional question was included in the post-test to capture students' reflections on their informal science learning experiences in the schoolyard. Internal validity was supported through students' approval, while external validity was strengthened by presenting direct student quotations in the findings section.

Data collection procedure

Data were collected via semi-structured interviews conducted as pre- and post-tests before and after the intervention by the first author. Students were given sufficient time to respond to each question, with interviews lasting approximately 25–30 minutes per student. Prior to implementation, parents were informed about the research process, and interviews were recorded with their consent. Students' identities and the school's name were kept confidential.

Ensuring validity in qualitative research requires that the researcher observes phenomena as objectively as possible. In this study, external validity (transferability) and internal validity (credibility) were ensured through multiple strategies. To strengthen internal validity, no time constraints were imposed during the interviews, allowing students to express their perspectives freely. External validity was supported by providing detailed information regarding the study's population, sampling strategy, design, participants, data collection instruments and procedures, data analysis, and interpretation of findings.

Data analysis

Students' responses to the Views on Living Things and Environment Questionnaire were transcribed from audio recordings. Each student was assigned a pseudonym to ensure confidentiality. All data were imported into NVivo 12 Plus and analyzed using a content analysis approach. Following Corbin and Strauss (2007), the researchers identified codes, grouped them into themes, and interpreted the findings. Codes and themes, along with their frequencies, are presented in tables and figures.

As noted by Yıldırım and Şimşek (2011), the researcher's reflections are valuable in qualitative research due to their close engagement with the phenomenon. Therefore, concepts and their interrelationships were interpreted. To minimize the risk of misinterpretation, an iterative process of multiple readings of transcripts was employed (Cohen *et al.*, 2011). Responses were compared using models and tables to enhance clarity. For example, when students were asked, "What would happen if there were no rabbits in the area where the creatures in the picture live?" their responses included:

- "If there were no rabbits, there would be more grass because the rabbit eats grass." (Y.A)

- "If there were no rabbits, the animals that feed on rabbits would starve, but they could feed on other animals." (Z.E)

From these responses, the codes "grass multiplication" (Y.A) and "starvation" (Z.E) were generated. These codes were then grouped into sub-themes, such as "predator hunger and prey population increase", which contributed to the main theme "nutritional relationships". This process was systematically applied to all questionnaire items, ensuring consistency and rigor in the analysis.

Findings

The pre- and post-test data from the Views on Living Things and Environment Questionnaire were analyzed using NVivo 12 Plus, and sample coding models are presented in Figures 1 and 2. However, for clarity, the findings are presented in this section in table format rather than as models.

Classification of living and non-living beings

The coding models derived from students' responses to the first questionnaire item, *"Would you classify the pictures as living or non-living? Can you explain how you made this classification (i.e., which criteria did you use)?"*, are illustrated in Figures 1 and 2.

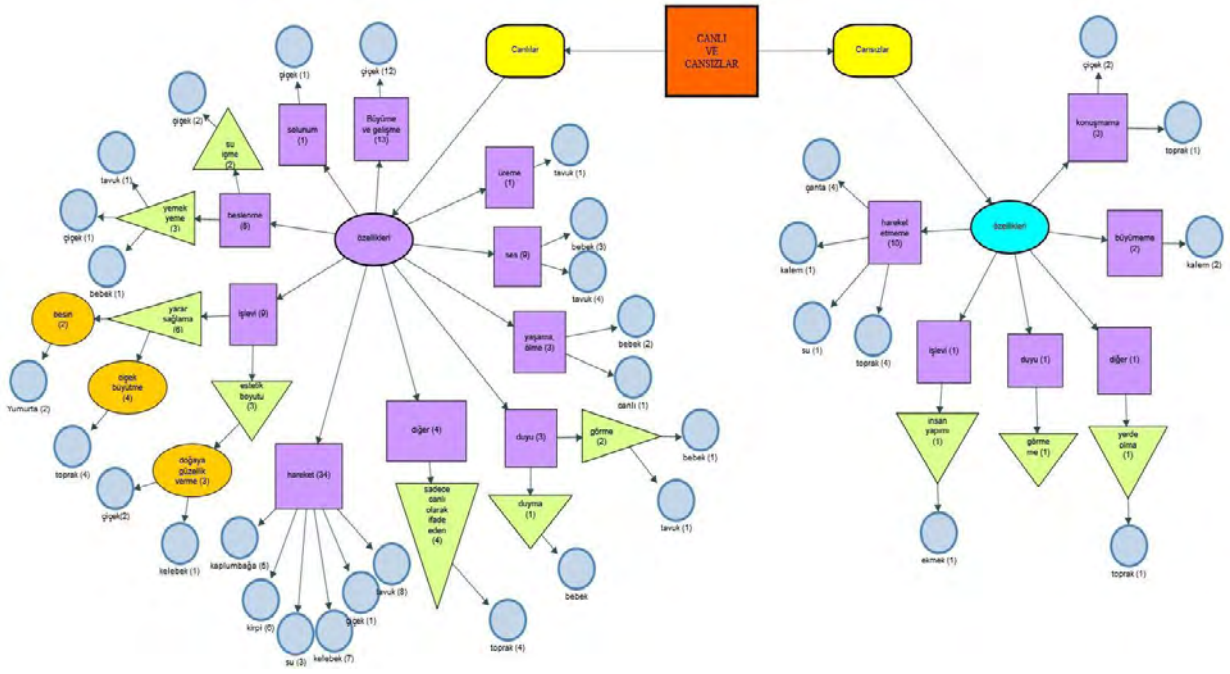

Figure 1.
Pre-test response coding model and frequency of students' classifications for the first questionnaire item

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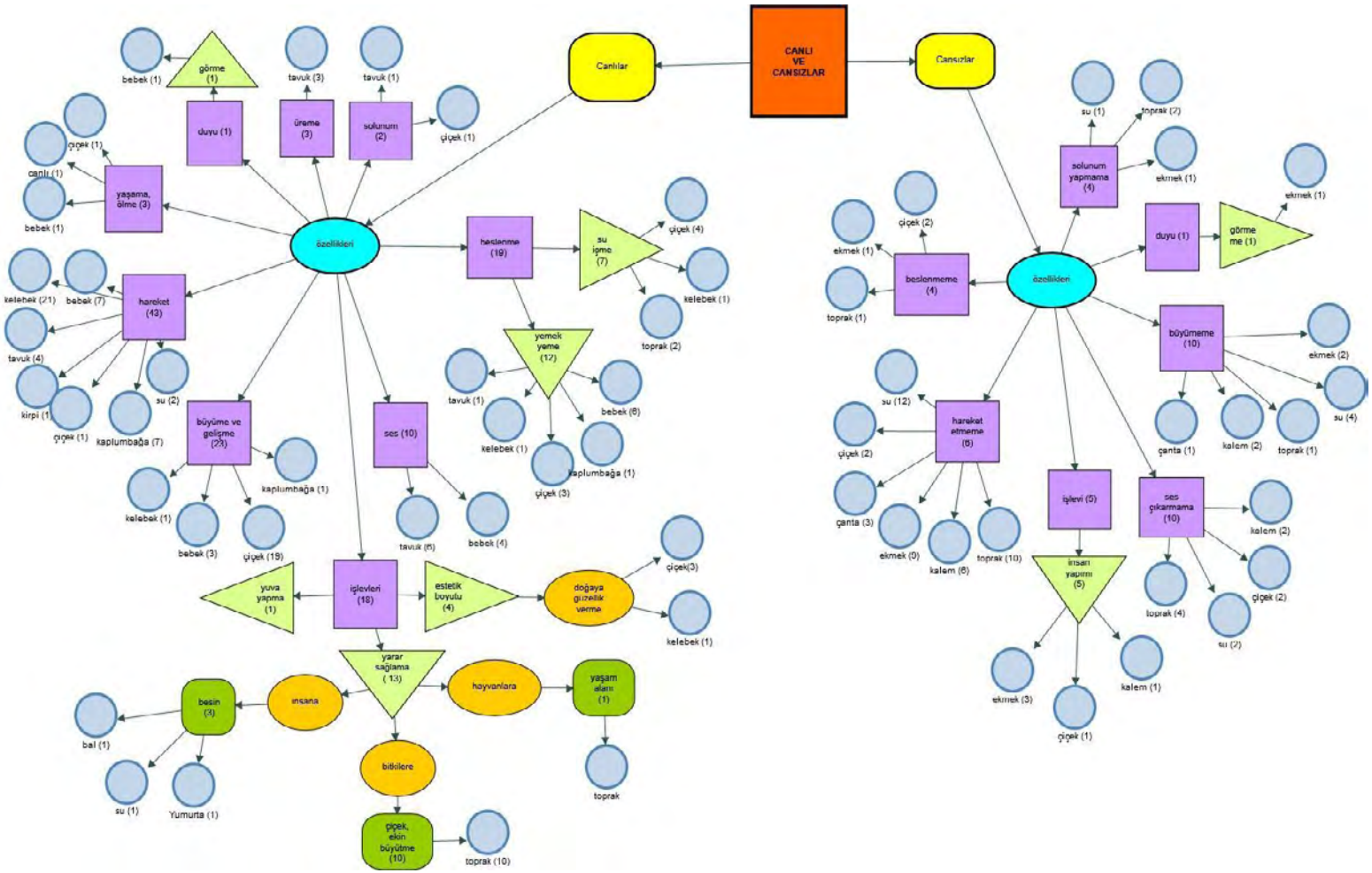

Figure 2.

Post-test coding and frequency model of students' answers to question 1

Pre- and post-test results showed that students correctly classified items in the pictures as living or non-living, including examples such as chicken, baby, butterfly, hedgehog, turtle, bag, bread, and pencil. Notably, while eight students classified soil as living and 20 as non-living in the pre-test, the number of students classifying soil as living increased to 12 in the post-test. For water, three students classified it as living and 26 as non-living in both pre- and post-tests.

Students based their classifications on common characteristics of living beings, such as nutrition, growth, development, movement, reproduction, and breathing (e.g., chicken = living; bag = non-living). In the pre-test, nine students used only one characteristic to classify living beings; in the post-test, this number decreased to one, indicating a positive effect of the activities.

Another significant finding was that 14 students in the pre-test classified living beings using two characteristics (e.g., growth and movement or nutrition and movement). In the post-test, 22 students used three or more characteristics (e.g., nutrition, growth, development, movement, breathing), demonstrating notable conceptual development. Selected student responses illustrate this progression:

- *"Among living beings; flowers grow, chickens can move, hedgehogs walk. Pencils do not move; they are non-living."* (H.Ö.)
- *"Turtles can move; they feed on leaves. Bread cannot move, pencil cannot do anything. We can move it."* (A.Y.)

Statements from students reporting three or more characteristics are presented below:

- *"I did the grouping according to moving, eating, growing. For example, the soil is non-living because it cannot move."* (T.G.)
- *"Living beings move, they breathe, they eat, but non-living things cannot move, they cannot speak, they cannot breathe. We plant the flower and grow it. The soil cannot breathe. The chicken moves and eats food."* (Z.M.E.)

Overall, students correctly classified 11 of the 14 items as living or non-living in both pre- and post-tests. In the pre-test, students (N = 14) used at most two characteristics together for classifying living beings, whereas in the post-test, 22 students applied three or more characteristics, which is a salient finding. Some students classified the chicken as living based on "laying eggs" because they were not yet familiar with "reproduction" as a characteristic of life.

Another important finding was that the misconception regarding "flower" decreased from three students in the pre-test to one student in the post-test. A summary of these findings is presented in Table 2.

Table 2.

Pre- and post-test coding framework and frequency of students' classifications for the first questionnaire item

Question 1.	Frequency		Sample	
	Pre-test	Post-test	Pre-test	Post-Test
Characteristics of Living Beings*				
Movement	34	43	Chicken, butterfly, turtle, hedgehog, flower, water	Chicken, butterfly, turtle, hedgehog, flower, water, baby
Growth&Development	13	23	Flower	Butterfly, baby, flower, turtle
Sound	9	10	Baby, chicken	Baby, chicken
Ecosystem services	9	18		
Providing benefits * * *	6	14		
*Food****	2	3	Egg	Honey, water, egg
Growing flowers	4	10	Soil	Soil
Habitat for animals	-	1		Soil
Aesthetic dimension	3	4		
Giving beauty to the nature	3	4	Flower, butterfly	Flower, butterfly
Nesting	-	1		
Nutrition	5	19		
Drinking water	2	7	Flower	Flower, butterfly, soil
Eating	3	12	Chicken, flower, baby	Chicken, flower, baby, butterfly, turtle
Sense	3	1		
Hearing	1	-	Baby	
Vision	2	1	Baby, chicken	Baby
Life and death	3	3	Baby, living	Baby, living, flower
Breathing	1	2	Flower	Flower, chicken
Reproduction	1	3	Chicken	Chicken
Other	4	-		
Those who describe only as living	4	-	Soil	
Characteristics of Non-Living Beings*				
Inability to move	10	6	Bag, pencil, water, soil	Bag, pencil, water, soil, bread, flower
Inability to speak	3	-	Flower, soil	
Ecosystem services	1	5		
Hadmade	1	5	Bread	Bread, flower, pencil
Inability to grow	2	10	Pencil	Pencil, bag, soil, water, bread
Sense	1	1		
Inability to see	1	1		Bread
Other	1	-		

Question 1.	Frequency		Sample	
	Pre-test	Post-test	Pre-test	Post-Test
Being on ground	1	-	Soil	
Inability to eat	-	4		Flower, bread, soil
Inability to produce sound	-	10		Soil, water, flower, pencil
Inability to respire	-	4		Water, soil, bread

Theme; * (bold and uppercase), sub-theme; * * (bold), sub-theme; * * * (underlined), sub-theme; * * * * (italic)

Table 3.

Pre-test and post-test coding and frequency of the 2nd question for student responses

Question 2	Frequency		Sample	
	Pre-test	Post-test	Pre-test	Post-Test
Living Beings in the Forest *				
Importance of Living Beings * *				
Unimportant Living Beings * * *	6	3		
*Ecosystem services** * * *	5	3		
For people * * * * *	5	3		
-Non-beneficial	3	1	hedgehog, bear, fox	mouse
-Intimidation	2	-	lion	
-Causing harm	-	2		Spider
Habitat	1	1		
-Stepping on	1	1	grass	
For other animals	-	1		
- Non-beneficial	-	1		wolf, bear
All Living Things Matter	23	26		
Ecosystem Services	16	21		
Emotional expression	1	3		
-having a family	1	-		
-friend	-	1		cat
-joy	-	1		
-cute	-	1		hedgehog
Entertainment	-	2		
-playing	-	1		cat
-travel	-	1		horse
Aesthetic dimension	2	3		
-ornament of the nature	-	1		
-nice odor	-	1		flower
-adding beauty to nature	2	1	squirrel	butterfly
Providing benefits	13	17		
-Benefits for nature	2	4		
-balance of the nature *******	1	2		
+Food web	1	2		

Question 2	Frequency		Sample	
	Pre-test	Post-test	Pre-test	Post-Test
-providing oxygen	1	-	trees	
-benefits for plants	-	1		
+growing of flower	-	1		worm
-ventilating the soil	-	1		worm
-The benefits of animals for each other	-	1		
Benefits for humans	8	8		
-navigation	1	-	ant	
-Food web	-	1		
-protection	-	1		dog
-meeting the needs	4	4		
+food	4	4	chicken, cow, bee	chicken
+bag, shoes	1	-	snake	
-prevention of natural disaster	-	1		flood
-fresh air	-	1		tree
-helping	2	-	horse, donkey	
-Chain benefits	3	4		
-living and aesthetic	1	-		
-benefits for nature and aesthetic value	1	-		
-benefits for humans and aesthetic value	1	-		
-aesthetics-benefits for humans-living	-	1		
-benefits for humans and the nature	-	2		
-emotion-aesthetics-benefits for humans	-	1		
Living	7	5		

Theme; * *(bold and uppercase), sub-theme;* ** *(bold), sub-theme;* *** *(underlined), sub-theme;* ***** *(italic), sub-theme;* ***** *(bold and italic), sub-theme;* ****** *(dash and italic), sub-theme;* ********(+)*

Grouping of living beings in the forest and their importance levels

Table 3 presents a comparative summary of pre- and post-test findings, derived from coding students' responses to the second questionnaire item, which included questions such as: *"Which creatures do you think live in the forest? Are any of these living beings unimportant? How do you determine the importance or unimportance of living beings?"*

Analysis of the pre- and post-test data on the grouping and perceived importance of forest-dwelling organisms revealed that students provided more examples of vertebrate animals, such as chickens and cows, than plants (pre-test: 4 examples; post-test: 7 examples).

Another notable finding was that students classified all living beings as important in both pre- and post-tests, based on criteria including benefits to humans or nature, being alive, enhancing the beauty of nature, and emotional

significance. Among these criteria, the theme most frequently cited by students in both tests (pre-test: 9 students; post-test: 12 students) was benefits to humans. Example statements illustrating this theme include:

- "Shoes and bags are made of snakes-kin. Bees make us honey." (S.G.)
- "I don't think there are any unimportant living beings. All animals have benefits for us. For example, because the cat eats the mouse, the mouse cannot eat the food in the field. In other words, all living beings have benefits for humans." (B.K.)

Post-test results indicated a diversification in students' reasoning for the importance of living beings compared to the pre-test. New themes emerged, such as interdependence among animals and entertainment value, reflecting a more nuanced understanding of ecological relationships.

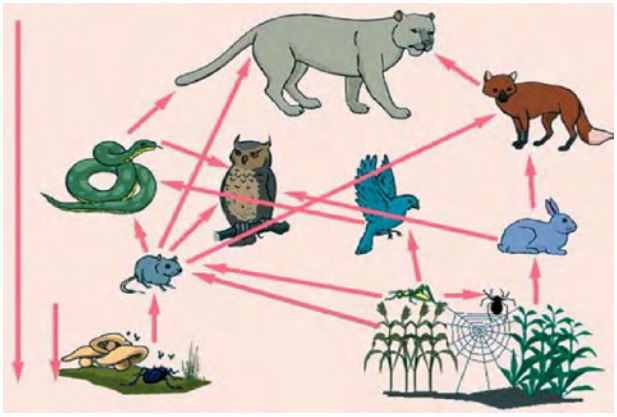

Figure 3.
Food web illustration presented to students.

Source: *https://evindz.weebly.com/besin-zinciri.html*

The image above was shown to the students without any prior explanation. They were then asked the following questions:

a. "Can you describe what is happening in this picture (Image 1)?"
b. "What do you think would happen if there were no rabbits in the area where these creatures live?"
c. "If you were to add humans to the picture, where would you place them? Can you explain your reasoning?"
d. "Do non-living components, such as soil, air, or water, influence the organisms in this picture? If so, what type of effect do they have?"

A comparative summary of students' responses to these questions is presented in Table 4.

Table 4.

Pre-test and post-test coding and frequency of the 3rd question for student responses

Question 3.	Frequency	
	Pre-test	Post-Test
Opinions on the Food Web in the Picture *		
Things described in the picture **		
It describes animals in nature ***	29	16
*Appearances****	5	-
Characteristics	4	-
Size	2	-
Power	1	-
Beauty	1	-
Actions	1	-
Interrelationship	19	16
Eating each other	15	12
Dependance	1	-
Necessity	1	1
Utility	1	-
Fight	1	-
Damage	-	3
It describes the Food web	3	14
Placement of human in the picture		
In terms of nutritional source	9	22
Plant-fed	3	2
- Placing it next to the grass * * * * * *	2	-
- Placing it on the right side of the mushroom	1	-
- On the right of the rabbit	-	2
Animal-fed	5	10
- Placing it between the rabbit and fox	1	1
- Placing it next to the rabbit	4	5
- On the snake	-	2
- On the right of the mouse.	-	2
Mushroom-fed	3	10
- Placing it next to the mushroom	2	8
- Placing it on the snake	1	-
- Placing it between the rabbit and bird	-	1
- Placing it under the mouse	-	1
Emotionally	10	2
Loving the rabbit	5	2
- Placing it next to the plant	1	1
- Placing it next to the rabbit	4	1
Next to the creature they love	5	-
- Placing it next to the mushroom	2	-
- Placing it next to the bird	1	-
- Placing it on the snake	1	-

Question 3.	Frequency	
	Pre-test	Post-Test
- Placing it on the fox	1	-
Humans are not animals	1	-
- Placing it under the picture	1	-
Aesthetic value	-	2
Being cute	-	1
- Placing it next to the rabbit	-	1
Beauty	-	1
- Placing it next to the mushroom	-	1
In terms of damage	9	10
Endamaging of human	1	4
- Placing it on the snake	1	1
- Next to the rabbit	-	2
- On the right of the mushroom	-	1
Humans harmed	2	1
- Placing it next to the snake	2	1
Harmlessness	6	5
- Placing it next to the rabbit	3	3
- Placing it next to the mushroom * * * * * *	3	1
- Placing it between the rabbit and bird	-	1
Changes when rabbits are removed from the picture * *	29	32
Emotionally* * * *	7	-
*Fear*****	1	-
Lack of love	3	-
Staying alone	1	-
Rabbit's friend* * * * * *	1	-
Getting sad	2	-
Humans	2	-
Animals	1	-
Aesthetic value	4	3
The beauty of nature is damaged	4	3
The balance of nature is damaged	-	1
Food web is damaged	-	9
Nothing makes difference	2	-
Failure to recognize the rabbit	2	-
Nutritional Relationship	14	19
Those who feed on rabbits go hungry	9	11
Bear, mouse, fox, spider, owl, snake		
Those who feed on rabbits feed on other living beings	1	3
The wolf feeds on the mouse	1	1
The fox feeds on the spider	-	1
The snake feeds on bird	-	1
The living beings the rabbit feeds on multiply	4	4
Carrots, spiders, herbs, plants		

Question 3.		Frequency	
		Pre-test	Post-Test
Whoever eats the living being that feeds on the rabbit goes hungry		-	1
Rabbit, fox, tiger			
The effect of non-living beings on those in the picture			
Effect of water		24	29
Water is important		2	-
Hurting animals now and then		1	-
Source of nutrient		6	14
Animals		6	14
Source of life		14	15
Animals		5	7
Living beings		9	6
Humans		-	2
Cleanliness		1	-
Birds' washing-up		1	-
Effect of soil		25	30
Source of nutrient		4	1
Animals		4	1
Source of life	Plant, animal, living	3	7
Habitat	Plant, animal, living	12	20
Mushroom		-	1
The ground stepped on		-	2
Where ants are hiding		1	-
Soil is essential		4	-
No effect		1	-
Effect of air		21	22
Air is essential		4	2
Breathing	Animal	7	15
Living		-	7
Source of life	Animal, living	9	5
Flying	Bird	1	-

Theme; * (bold and uppercase), sub-theme; * * (bold), sub-theme; * * * (underlined), sub-theme; * * * * (italic), sub-theme; * * * * * (bold and italic), sub-theme; * * * * * * (-)

Students' Understanding of the Food web, Forest Benefits, Waste, and Apple Decomposition

Regarding the question, *"Can you tell us what is happening in this picture (Image 1)?"*, pre-test responses revealed that almost all students lacked understanding of the Food web concept. Only three students used the term "Food web," and among these, two provided statements such as, *"They follow each other; I understand that they need each other; they frighten and poison,"* indicating misinterpretation of the concept. Most students (N = 15) described the phenomena in the picture

as animals eating one another, highlighting insufficient prior knowledge.

In the post-test, the number of students using the term "Food web" increased significantly (N = 14), and they provided detailed explanations of the interactions between organisms depicted in the picture.

For the question, *"What would happen if there were no rabbits…?"*, pre-test responses indicated that students mainly focused on predators starving, as well as emotional and aesthetic concerns such as loss of natural beauty, inability to enjoy observing rabbits, and sadness for humans or animals. Two students who initially stated, *"Nothing would make a difference if there were no rabbits,"* corrected their misconceptions in the post-test, responding instead, *"Those who eat these rabbits will go hungry"* and *"The fox will go hungry if there is no rabbit."*

Data regarding the placement of humans in the picture (Table 4) showed that students predominantly positioned humans near mushrooms, rabbits, and plants. While students primarily considered food sources (pre-test: 9; post-test: 22) and potential damage (pre-test: 9; post-test: 10), they were less inclined to include emotional considerations in the post-test (pre-test: 10; post-test: 2).

When examining students' understanding of the influence of non-living components (soil, air, water) on organisms (Table 4), responses predominantly included themes such as "source of food," "source of life," and "habitat."

Table 5.

Pre-test and post-test coding and frequency of the 4th question for student responses

Question 4	Frequencies	
	Pre-test	Post-Test
Benefits of Forests *		
I do not know	1	-
Benefit For Plants	2	6
Habitat***	2	2
*Living space****		
Growth	4	4
It grows plants		
Benefits For Animals	3	
Source of food	1	-
Food		
Habitat	2	2
Living space		
Benefits For Human	51	53
Communication	1	-
Postal bird	1	-
Getting to know the nature	3	2
Getting to know plants	2	-
Getting to know animals	1	2
Source of oxygen	13	15
Clean environment	2	2

Entertainment	12	11
Hunting	1	-
Fishing	3	2
Swinging in hammock	1	-
Having picnic	7	6
Travelling	-	1
Collecting flowers	-	1
Playing games	-	1
Aesthetic and Emotional benefit	7	3
Aesthetic value of nature	4	1
Loving animals	1	1
Nice odor	2	-
The beauty of butterflies	-	1
Source for needs	13	14
Heating	2	1
Wood*****	2	1
Education materials	5	3
Paper	1	1
Desk + board	2	-
Notebook + pencil	2	2
Source of food	6	10
Mushroom	1	1
Water	1	1
Food	2	-
Fruit	2	5
Honey	-	1
Plants	-	2

Theme; * (bold and uppercase), sub-theme; ** (bold), sub-theme; *** (underlined), sub-theme; **** (italic), sub-theme; ***** (bold and italic)

A comparative summary of this question is presented in Table 5.

Benefits of Forests

Responses to the questions, *"What causes forest fires?"* and *"What can we do to protect forests?"*, indicated that pre-test participants primarily recognized forest benefits for humans. Students identified resources such as food, notebooks, pencils, paper, and firewood (13 students) and recreational uses such as picnics, observing plants and animals, and fishing (12 students). They also noted oxygen production as a forest benefit (13 students). Only five students mentioned forests as habitats for animals and plants. Post-test data showed that students continued to emphasize human benefits, with oxygen production highlighted by 15 students. Additionally, eight students in the pre-test mentioned forests' protective role against natural disasters such as floods, landslides, and avalanches. Most students attributed forest fires to activities like picnics and campfires.

Wastes and recycling

The ninth questionnaire item asked, *"What waste causes pollution here? Can this waste be recovered? What are the benefits of recycling?"* Pre- and post-test data indicated increased student awareness of recycling and its benefits (Table 6).

Table 6.

Pre-test and post-test coding and frequency of the 5th question for student responses

Question 5 (Waste and Recycling)	Frequency	
	Pre-test	Post-Test
Forest Pollution*		
Wastes causing pollution and recycling* *		
Recyclability of waste * * *		
*Non-recyclable****	1	-
Recyclable	28	29
Reusing after cleaning*****	3	-
-Examples for waste * * * * * *		
-Domestic waste	3	-
+Plastic	3	-
bottle	2	-
bag	1	-
Recovered Materials	25	29
-Examples for waste		
-Domestic waste		
+Plastic	34	45
bottle	11	17
bag	14	18
box	9	10
+Diaper	2	1
+Paper	11	11
+Packages	4	5
+Kitchen waste	10	9
+Glass bottle	8	5
+Reused materials	7	2
+Metal	-	4
-Special Waste:	3	4
+Battery	3	4
-Park and garden waste	-	1
+Stone	-	1
Benefits of recycling		
I do not know	1	-
Benefits for nature	8	5
Clean environment	1	1
Protecting trees	7	4
Benefits for human	23	27
Recycling	1	1
Reusing	17	25
Saving	5	-
-general opinion	4	-
-money	1	-
-fresh air	-	1

Theme; * (bold and uppercase), sub-theme; ** (bold), sub-theme; *** (underlined), sub-theme; ***** (italic), sub-theme; ***** (bold and italic), sub-theme; ****** (dash and italic), sub-theme; ********(+)

Apple Decomposition

Coding of students' responses to the question, *"How do you explain that an apple falling from a tree gradually rots and disappears over time if it is left on the ground?"*, is summarized in Table 7. In both pre- and post-tests, most students (pre-test: 15; post-test: 14) attributed decomposition to small animals. Only three students in the post-test identified bacteria or invisible agents as causes of decay, reflecting Piaget's view that third-grade students are in the concrete operational stage, where abstract biological processes are less accessible.

Table 7.

Pre-test and post-test coding and frequency of the 6th question for student responses

Question 6.	Frequency		Sample	
	Pre-Test	Post-Test	Pre-test	Post-Test
Reasons for Apple's Rotting*				
Animals**				
Feeding***	15	14	Bug	Ant
			Mushroom (mold)	Worm (Maggot)
			Groundhog	Spider
			Ant	Fly
			Worm (Maggot)	
Sun	7	2		
Heat	7	2		
Air pollution	1	2		
Oxygen	1	-		
Lack of water	4	3		
Soil	3	4		
I do not know	2	-		
Vitamin deficiency	-	1		
Invisible Agents	-	2		
Bacteria	-	1		

Theme; * (bold and uppercase), sub-theme; **(bold), sub-theme; ***(underlined)

Students' Perceptions of Informal Science Learning in the Schoolyard

When asked about their experiences during the informal science learning activities, all students expressed positive affective responses, including statements such as, *"I was very happy," "I was excited," "I liked contributing to nature,"* and *"I liked learning more about the environment."* Furthermore, when asked whether they wished to return to the classroom during cold weather, most students (16) reported that they had fun and found the activities enjoyable.

Discussion and Conclusion

In Turkey and many developing countries, children often have limited direct interaction with nature due to insufficient green spaces in schools and the predominantly theoretical approach to environmental education (Atasoy, 2015). The findings of this study underscore the potential of schoolyards as authentic informal learning environments that foster students' engagement with the natural world.

Overall, the results indicate that informal science learning experiences in the schoolyard substantially enhanced 3rd-grade students' understanding of living and non-living entities, biodiversity, forest ecosystems, recycling, and the interactions between organisms and their environment. These outcomes are consistent with previous research demonstrating that hands-on, outdoor activities positively influence students' environmental awareness and attitudes (Bowker & Tearle, 2007; Fisman, 2005; Bogner, 1998).

Students' ability to distinguish living from non-living entities improved post-intervention, with greater use of multiple characteristics of living beings such as movement, growth, nutrition, and breathing. Nonetheless, misconceptions regarding soil, flowers, and water persisted, reflecting the conceptual challenges inherent in abstract ecological constructs and the developmental limitations of children in the concrete operational stage (Piaget). These results highlight the importance of pre-assessment and targeted interventions to address resistant misconceptions effectively.

Post-test findings revealed that students increasingly recognized the ecological and utilitarian significance of forest-dwelling organisms, including their contributions to ecosystem services and human well-being. Similarly, students' understanding of Food web dynamics improved, as evidenced by a notable increase in correct post-test responses. However, comprehension of complex ecological relationships and microscopic organisms remained limited, consistent with developmental expectations (Lederman, 2007). These findings align with previous studies emphasizing the difficulty of teaching abstract ecological concepts to young learners (Yardımcı, 2009; Strommen, 1995; Çil, 2015).

Students also demonstrated enhanced awareness of the multifaceted benefits of forests, including resources, recreation, oxygen production, and protection against natural hazards. They correctly identified human activities as primary causes of forest fires and proposed preventive measures, suggesting that schoolyard-based learning can foster both cognitive understanding and practical environmental stewardship. From a theoretical perspective, these findings corroborate Vygotsky's (1978) view that teachers can scaffold learning within the zone of proximal development, maximizing opportunities for cognitive, social, and affective growth through outdoor, experiential activities. Despite cold weather and limited clothing, students actively engaged in the learning process, underscoring the motivational potential of well-designed schoolyard experiences (Kuo *et al.*, 2019).

Furthermore, early engagement with nature can promote long-term pro-environmental behaviors (Chawla & Cushing, 2007), while culturally and nationally diverse contexts may influence how students perceive and interact with natural environments (Malone & Tranter, 2003). These considerations highlight the broader applicability and potential limitations of schoolyard-based informal learning programs.

The study is limited by its small sample size and focus on a single school in Turkey, which may constrain the generalizability of the

results. Future research could investigate informal science learning in schoolyards across diverse cultural and national contexts to compare students' environmental awareness globally.

In conclusion, schoolyard-based informal science learning offers a powerful avenue for enhancing primary students' understanding of living and non-living entities, ecological relationships, and environmental awareness. While these experiences positively impact concrete concepts, abstract ecological phenomena such as population regulation, microscopic organisms, and complex Food web interactions require continued instructional support tailored to developmental readiness. These findings reinforce the critical role of experiential, place-based learning in early science education and the need for intentional design of schoolyard learning environments.

Declarations

Conflict of Interest

The authors declare that there is no conflict of interest regarding the conduct and publication of this study.

Author Statement

This study is part of the first author's master's thesis.

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