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## Effects of Ecological Theater on Attitudes and Knowledge Acquisition Levels through Socioscientific Drawings

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**Abstract:** Elevated levels of environmental pollution, depletion of natural areas, and eradication of various forms of life have determined the impact of climate change. This phenomenon is affecting many countries with droughts, floods, wildfires, viruses, and pests, among other challenges. Conservation of the environment relies solely on human beings. Therefore, considering a quantitative approach, our objective was to determine how the ecotheater strategy enables students to enhance their anthropocentric and ecocentric environmental attitudes. We aimed to establish whether gender makes a difference and evaluate the level of understanding of socio-ecological systems achieved by students through their pictorial content in a population of 35 students. The results indicate that after the use of the ecotheater strategy, students significantly adopted ecocentric attitudes. Among the findings, the environmental dimension progressed the most in behavior change by students, reaching its maximum value. Additionally, the drawings allowed an understanding of the interrelationships between humans and living beings, placing them at level 4, reflecting respect for all forms of life and their reciprocal relationship with the environment. Finally, girls exhibited higher ecocentric behaviors than boys. The study suggests designing learning environments with ecotheater and outdoor activities to foster more reflective and situated attitudes of care and preservation of our environment with responsibility and ethics.

**Keywords:** ecocentrism, environmental awareness, drawings and explanations, ecological theater.

## 生态剧场通过社会科学绘画对态度和知识获取水平的影响

**摘要：**环境污染的加剧、自然区域的耗竭以及各种生命形式的消失决定了气候变化的影响。这种现象正在影响许多国家，带来干旱、洪水、野火、病毒和虫害等挑战。保护环境只能靠人类。因此，考虑到定量方法，我们的目标是确定生态剧院策略如何使学生增强他们以人类为中心和以生态为中心的环境态度。我们的目的是确定性别是否会产生影响，并通过35名学生的绘画内容来评估学生对社会生态系统的理解水平。结果表明，使用生态剧场策略后，学生明显采取了生态中心态度。其中，环境维度对学生行为改变的影响最大，达到了最大值。此外，这些图画使人们能够理解人类与生物之间的相互关系，将其置于第四级，反映了对所有生命形式及其与环境的相互关系的尊重。最后，女孩比男孩表现出更高的生态中心行为。该研究建议设计带有生态剧院和户外活动的学习环境，以培养更具反思性和情境性的态

度，以责任和道德的态度关心和保护我们的环境。

**关键词：**生态中心主义、环境意识、绘图和解释、生态戏剧。

## 1. Introduction

In the face of the advancing technology, population growth, and indiscriminate use of natural resources associated with changes in population consumption [1], there is a need to foster environmentally respectful generations by promoting environmental awareness and care in relationships with the beings in their surroundings [1]. Only through this can we achieve environmental literacy [2]. However, environmental effects continue to escalate with increasing pollution levels, natural habitat depletion, pests, and other factors, resulting in the elimination of various forms of life. Therefore, the decision to conserve or destroy remains solely with humans [3]. The manifestations, such as droughts, floods, wildfires, viruses, and pests, pose a constant threat worldwide. Hence, it is crucial to pay attention to the Sustainable Development Goals (SDGs) to address socio-scientific issues [4] and promote well-being.

Therefore, environmental education should be integrated into all subjects taught in schools, as it is usually only incorporated into science lessons [5]. In this sense, it is pertinent to analyze the levels of anthropocentric and ecocentric attitudes of children acquired through ecotheater.

Many experiences indicate that ecotheater as a strategy allows the creation of a bridge between human relationships and the environment. This activity can transform scientific jargon into understandable reasoning, leading to commitments toward other living beings [6]. When strengthened with outdoor activities, it offers a richer learning experience, where students communicate and interact with each other, their surroundings, and objects during dramatic play [7]. This practice can be considered a useful tool for raising awareness and addressing sustainability and environmental issues. A vibrant art form such as theater can provoke social change [8]. When combined with drawings and explanations from students, it is possible to identify the levels of understanding they reach within socioecological systems, representing and expressing them in various ways after a classroom intervention that leads to an environmental consciousness.

Therefore, it is essential to analyze different forms of representation and deepen conceptual transformation regarding the relationships between biotic and abiotic elements [4], where these levels of understanding require thorough follow-up and analysis [9]. Additionally, communicating their worldview and how they explore and make their perceptions visible for

sustainable futures is crucial [10].

In the literature, pictorial tasks have been used to measure environmental awareness, analyzing the levels of knowledge acquisition based on the analysis of drawings and explanations to establish relationships between the human system and biotic and abiotic components [4], [9]. Another study aimed to establish a network of connections between the sea and land, as well as the sustainable exploitation of marine resources, assuming sustainable behaviors [10]. Outdoor activities, such as a school garden, favored an increase in students' attitudes toward the environment [7]. Futuristic drawings also allowed the generation of positive ideas focused on sustainable development to safeguard biodiversity [11].

Within the analyzed gaps, there is still a need to build environmental awareness strategies with an ecocentric perspective through school projects [3]. Promoting various outdoor activities and their impacts on ecocentric attitudes [2], [4], [12]-[13] is crucial. Therefore, students should be encouraged not only to explain but also to learn to act, assuming commitments and cognitive judgments that lead to well-being and relaxation during their learning process [4], [13].

As evident, environmental literacy is an ongoing issue, internalizing students' experiences with the natural environment to adopt new self-care, protection, and respect behaviors toward all forms of life. In the Peruvian context, there are no studies that allow evaluation of the consistency of the curriculum proposal. Environmental awareness is a cross-cutting theme that teachers must incorporate into their plans, reflecting public and educational policies that must be respected by the population. This aspect is not consciously addressed, and there are no strategic alliances allowing its support and evaluation. Therefore, this study aimed to determine the significant differences found in the pre-test and post-tests regarding how children shape their ecocentric and anthropocentric environmental attitudes through theater as an effective teaching resource. This study also aimed to identify the prevalence of attitude changes and which gender emphasizes it more, extrapolating the comprehension levels of socioecological representations made by children through pictorial depictions.

## 2. Literature Review

### 2.1. Environmental Ethics in Educational Practice

This area of study focuses on examining the ethical

relationship between humans and the environment, emphasizing care and preservation and instilling intrinsic values of respect toward all forms of life [3]. Exposure to nature involves connecting with “green” and “blue” spaces, fostering positive engagement in their care and preservation [13]. However, human activities, through various routines, contribute to environmental damage, such as excessive use of plastic wrappers, littering in the streets, indiscriminate water usage, and keeping appliances running throughout the day, among others, which deteriorate environmental quality. Therefore, ethics seeks a reciprocal relationship between humans and the natural environment [3].

Hence, there is a need to develop environmental ethics attitudes that focus on two types: (a) Anthropocentrism, where attitudes revolve around personal benefits and interests [3]. This can be considered a consequence of environmental change in modern society [14]. While we acknowledge the necessity of green spaces in large cities, more cement tiles than green areas are often laid. (b) Ecocentrism refers to the perceived value and protection of all forms of life and their biotic and abiotic ecosystems, enabling environmental sustainability [3]. In this regard, there are experiences where children, engaging in outdoor activities, connect more with nature and develop a greater ecocentric awareness [12]. This leads teachers to promote experiences of care and protection for all living beings, seeking a harmonious balance between nature and humans [15], aiming to promote moral reasoning [12].

In this sense, environmental awareness in individuals opens the door to understanding and caring for the environment, developing students' environmental literacy to preserve natural diversity [16, 17], and enabling them to have high knowledge and skills to face environmental challenges [18]. From this perspective, the fundamental goal of environmental education is to shape citizens' commitment to the natural environment, enabling them to comprehend and internalize their reciprocal relationship and dependence on systems for conservation [19]. The implementation of the school curriculum should emphasize cultivating awareness, attitudes, and value systems toward environmental conservation [16]. In Peru, the state prioritizes five components in the basic education curriculum: climate change education, health education, eco-efficiency education, disaster risk management education, and biodiversity education, to be incorporated into annual programming and learning experiences [20]. However, there are no current studies on their impact.

Therefore, environmental literacy is the desired outcome for raising awareness and sensitivity to environmental issues and fostering respect and concern for the natural environment. This leads to reflection, knowledge acquisition, understanding of natural systems, and their impact on humans, with robust

responses for active participation [2]. To work on environmental awareness in schools, its implementation should be directed toward developing four dimensions: cognitive, affective, conative, and active [4]. The cognitive dimension pertains to the level of knowledge and information about environmental issues; the affective dimension influences feelings and beliefs about environmental issues; the conative dimension represents judgments, feelings, and behavioral patterns for or against the environment that condition behavior; and the active dimension consists of individual and collective facets. The former refers to a set of personal environmental behaviors, such as saving electricity and environmentally friendly consumption (recycling, reducing, and reusing).

## **2.2. Ecotheater, Representations, and Drawings for Environmental Awareness**

Ecotheater serves as a valuable tool for raising awareness and addressing issues related to sustainability and the environment. It effectively reaches people, delivering a clear and concise message for daily practice and avoiding becoming just another forgotten numerical fact [21]. A systematic review found that exposure to green spaces is correlated with cognitive functioning and plays an active role, whereas the opposite leads to cognitive overload, increasing stress, and decreasing well-being [13]. Creating positive attitudes depends on the strategies employed by teachers, and this can be achieved through theatrical representations, turning them into environmental activism that links representations with current environmental issues [22]. Outdoor activities have become an effective strategy that fosters cognitive, affective, and behavioral dimensions [7], leading to sensory and enjoyable experiences and identifying a simple way of life to help people rediscover the natural world [23]-[24].

Therefore, the analyzed studies demonstrate a growing consensus among environmental education researchers who argue that: (1) drawings can provide a wealth of information about children's attitudes and environmental awareness and (2) drawings, in general, can represent a useful strategy for assessing learning outcomes associated with environmental education programs [25]. In this sense, examining drawings allows individuals to internalize their perception of their environment, revealing richness in understanding, perspectives, and feelings in a way that words cannot express, immersing us in the perspectives and relationships between environmental components [9].

In response to these needs, our objectives are as follows: (a) To determine how the ecotheater strategy has allowed students to shape their anthropocentric and ecocentric environmental attitudes during the pre-test and post-test. (b) To establish if gender makes a difference in the shaping of ecocentric and anthropocentric attitudes in children. (c) To evaluate

the level of understanding of socioecological systems achieved by students through their pictorial content.

### 3. Method

The study adopts a quantitative experimental approach with a control group, incorporating pre-tests and post-tests in which the independent variable is manipulated and the effects are assessed in the dependent variable [26]. The effective didactic resource chosen for this purpose is ecotheater [7], which is utilized as a means of communication and teaching. In this outdoor experience, characters known as the “super-friends” were introduced, with dialogues emphasizing their unique qualities across six representations: (i) Lucho the Ant and Lalo the Earthworm, (ii) Abbi the Bee and Kino the Tree, (iii) Paco the Mushroom and Elio the Mycelium, (iv) Our First Encounter with Mugreman, (v) Beto the Hen and Pepe the Octopus, and (vi) the Final Battle against Mugreman. The dramatic theater featured two main characters, Doctor X9, representing the scientist friend of the “super-friends” and the defender of nature, serving as the interlocutor among the characters. Subsequently, a third antagonist character named Mugreman was introduced, representing a type of entity that promotes pollution. Three assistants (teachers of the children) of Dr. X9, namely Dr. IX9, Dr. BX9, and Dr. FX9, also participated. Their role involved supporting the sessions and ensuring the safety of the children. The intervention comprised six sessions that were conducted over a period of three weeks.



Fig. 1 Dr. X9 fighting with Mugreman, Paco the Mushroom, and Elio the Mycelium in the tree in which the plays were staged (Developed by the authors)

The study population consisted of 35 students from the second and third years of primary education attending an alternative private educational institution in the city of Arequipa. The sampling method employed was intentional, as the study chose a school with an open curriculum that allowed for experiential activities in a nearby forest in the Chilina Valley and on the beaches of Mollendo in Arequipa, Peru.

Table 1 Participating second- and third-year students (Developed by the authors)

|        |        | Grade  |       |       |
|--------|--------|--------|-------|-------|
|        |        | Second | Third | Total |
| Gender | Male   | 11     | 6     | 17    |
|        | Female | 10     | 8     | 18    |
| Total  |        | 21     | 14    | 35    |

The activity spanned six class periods, each lasting approximately 1 hour and 40 minutes. The chosen setting for meaningful learning experiences was the forest. The strategy employed was ecotheater, aiming to effectively engage in interaction with the environment to enhance environmental awareness and ecological understanding. This approach resulted in a substantial increase in perception, skills, participation, and overall experience related to nature and the environment.

Before the activity, the necessary permissions were obtained, starting with approval from the educational authorities. In addition, informed consent was sought and obtained from the parents or guardians of the children, and assent was acquired from the students through the storytelling aspect of the theater.

#### 3.1. Procedures

*Phase 1:* In this initial phase, a pedagogical model with an ecocentric focus, centered around the ecotheater, was developed. The design comprised six learning sessions, each lasting approximately 1 hour and 40 minutes. Prior to the commencement of the learning sessions, each student underwent an interview in which they were presented with 12 cards to assess their anthropocentric and ecocentric levels. The ecotheater experience was entirely experiential, taking advantage of the educational institution location, which allowed for a connection to a forest named “The Forest of the Super-friends within less than 10 minutes. The final presentation occurred on the beaches of Mollendo. The ecotheater involved puppetry, portraying Super-friends (animals, insects, plants, and fungi) with their superpowers (unique qualities or characteristics). The scientist named “Dr. X9” was the guide and connecting character while the antagonist character was named “Mugreman,” representing the entity of pollution. The theatrical representations unfolded from November 15 to December 7, 2022. Ecotheater served as a medium to convey thematic messages about environmental issues, exploring the relationship between humans and nature through ecological narratives grounded in socio-scientific problems.

Table 2 Description of the selected learning activities (Developed by the authors)

| Session Name                                 | Socio-scientific knowledge                                                                                                                                                                                                  | Environmental dimension                                                                                                                                                          |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| We meet Lucho the Ant and Lalo the Earthworm | The environmental attitude of environmental protection is promoted. Students learn more about the qualities and characteristics of plants and animals. Together with the fantasy of superpowers of their super-friends, for | <i>Cognitive dimension:</i> The students, faced with the detected problem, provide solutions to the problems.<br><i>Affective dimension:</i> The story promotes empathy with the |
| We learn from Abbi                           |                                                                                                                                                                                                                             |                                                                                                                                                                                  |

|                                                                            |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| the Bee and Kino the Tree                                                  | example: the “strength” of ants or the “nourishing” power of earthworms, the “pollination” of bees or the “air-cleaning” power of trees, the “communication” power of mycelium or the “healing” power of fungi.                                                                                                                            | characters and nature.<br><i>Conative dimension:</i> Through the creation of the antagonistic character Mugreman, who represents pollution, students assume an attitude of protection to their super-friend and the nature. |
| Paco the Fungus and Elio the Mycelium bring us closer to the fungi kingdom |                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                             |
| Our first encounter with Mugreman                                          | The attitudes of life habits and consumption patterns are promoted. In the talk given in classrooms, pollution is related to consumption habits, for example, by making known the number of trees that are cut down for human consumption. And living habits by collecting and sorting garbage from the super friends’ houses: The forest. | <i>Active dimension:</i> Students sort the garbage they find in the forest into paper and cardboard, plastic and metal containers, and glass. They also fight against pollution, as personified by Mugreman.                |
| We enjoy the sea with Beto the Cockerel and Pepe the Octopus               | The environmental attitude of environmental protection and with consumption habits is promoted, for example, by making known the role of the Gallinazo as a “natural cleaner” and that of the octopus with its power of “transformation”.                                                                                                  | The cognitive, affective, and conative dimensions are strengthened. The active dimension is also motivated by the confirmation of Mugreman’s presence.                                                                      |
| Will this be the final battle against Mugreman?                            | Environmental attitudes are promoted: consumption patterns, recycling, reuse, environmental protection and life habits; when confronted with the pollution represented by the character Mugreman.                                                                                                                                          | <i>Active dimension:</i> Students use the phrase “Life yes, dirt no” to confront Mugreman.                                                                                                                                  |

*Phase 2: reflection through the art-drawing session and interviews.*

In the culmination of the sixth learning session, students engaged in a drawing activity to externalize their internalized experiences. This exercise aimed to analyze their disposition and intrinsic values regarding respect for all forms of life and their reciprocal relationship within the environment. The final drawings were created at the seaside. As the students completed their drawings, interviews were conducted to understand the children’s perceptions of their created characters and settings. This facilitated the establishment of students’ levels of environmental knowledge acquisition.

The interviews started with an acknowledgment of the children’s drawings, fostering a comfortable environment for them to articulate ideas about their creations. Subsequently, questions such as “Can you describe your drawing?”, “Why did you draw it that way?”, “What does it mean?”, and “Anything else you’d like to share?” were posed. Considering the children’s attention span, the questions were tailored based on the children’s willingness to respond.

*Phase 3: post-trip attitude assessment interviews.*

In the week following the excursion, each student underwent an interview regarding the configuration of their environmental education attitudes for post-test evaluation.

### 3.2. Techniques and Instruments

In assessing the ecocentric and anthropocentric attitudes of the boys and girls, the “Children’s Attitudes toward the Environment Preschool Version (CATES-PV)” by Musser and Diamond in 1999, translated into Turkish by [12], was used. The scale was adapted for school-age children, specifically those aged 7 to 8 years, corresponding to the second and third grades of primary school. Expert judgment validation was conducted, involving three PhD holders specializing in Environmental Sciences, Educational Psychology, and Primary Education.

The instrument comprises 4 dimensions and 9 sub-dimensions, totaling 12 questions, each with two sub-questions. For example:

“Some children let the water run while brushing their teeth, but others always turn off the tap. Choose, which child do you prefer?” Each question was supported by visual aids in the form of printed images.

Enabling students to make a more informed choice between two actions and explain the rationale behind their selection. Image A represents the question “Why do you like the child who closes the tap when brushing his teeth?”, and image B represents the question “Why do you like the child who does not close the tap while brushing his teeth?” (Figure 2).

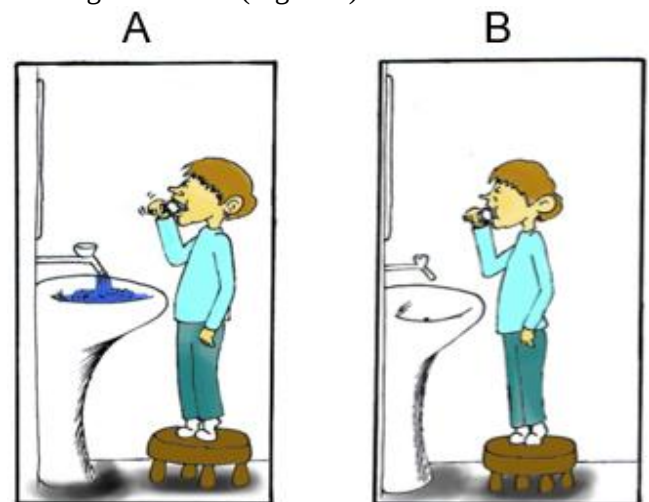


Fig. 2 Comparison of dental hygiene habits (Developed by the authors)

The instrument was administered both before and after the intervention to identify any variations in the environmental attitudes of the boys and girls. Before conducting interviews, the children were asked if they wished to participate in the research, and this inquiry occurred after obtaining informed consent from their parents. The children were encouraged to freely express their thoughts and were reminded that they could withdraw their participation at any time.

Table 3 Environmental attitude instrument measurement (Developed by the authors)

| Reading         |                                                                                                                                               |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Anthropocentric | Maintains anthropocentric environmental behavior, caring for their personal benefit in relation to the existence of others.                   |
| Ecocentric      | Manifests behavioral change of care and protection in daily actions to establish a bond of well-being between the environment and the person. |

To ensure the psychosocial and emotional well-being of the children, interviews were conducted in familiar locations in the presence of researchers and the classroom teacher. Voluntary participation was assured with no form of exclusion, and the data obtained were treated anonymously. The safety and well-being of the children were paramount throughout the research

process.

The 12 cards made it possible to analyze the following topics:

Table 4 Topics used in the instrument (Developed by the authors)

| Dimensions               | Subdimensions                                                     |
|--------------------------|-------------------------------------------------------------------|
| Consumption patterns     | Water consumption<br>Paper consumption<br>Electricity consumption |
| Environmental protection | Plants, insects, and animals<br>Environmental pollution           |
| Recycling – reuse        | Recycling<br>Reuse                                                |
| Living habits            | Playground preferences<br>Residence preferences                   |

For the variable measuring knowledge acquisition levels based on pictorial tasks, the approach proposed by [9] was adopted. At the conclusion of the final session, the children were requested to create drawings and provide explanations of how they perceived the environment and its components. This activity facilitated the classification of drawings. The review process involved both individual and group assessments, analyzing the similarities and differences identified to reach a consensus on the levels represented by each child's drawing.

Table 5 Pictorial levels of socioecological understanding (Levels of understanding of social-ecological systems [9])

| Level 5                                                                                                                                                                                                                                             | Level 4                                                                                                                                                                                                                                                     | Level 3                                                                                                                                                                                                                                                | Level 2                                                                                                                                                                                                                                                     | Level 1                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Systemic understanding of the complexity of the concept.                                                                                                                                                                                            | Understanding relationships in systems                                                                                                                                                                                                                      | Understanding the system components                                                                                                                                                                                                                    | Partial understanding of the systems                                                                                                                                                                                                                        | Presystemic level of understanding                                                                                                                                  |
| Expresses the abstract idea in the drawing, and students describe their ideas in writing, clearly. Students mention all components of social-ecological systems and their impact and ability to make generalizations about the phenomena presented. | An understanding of the relationship in systems includes all components of a social-ecological system. In addition, the drawing includes biological interactions that express relationships with arrows, symbols, and a written description in the drawing. | The geographic location of the entire system is clear. This drawing does not represent the biological interaction between components and excludes critical or abstract references. There is no identification of the relationships between components. | The geographical location of the system is identifiable. There is no biological interaction between the components that use innate knowledge to create systems of representations that represent only a part of the concept of the socio-ecological system. | The drawing is general and does not reflect any location in the participant's geographic space and does not denote the components and relationships of the systems. |

## 4. Results

Following the results obtained in line with our objectives, we will present the results derived from the research, focusing on the following key aspects:

In Table 6, the results indicate a significant impact of the eco-theater strategy on shaping students' environmental attitudes during the pre-test and post-test across different dimensions. In the consumption patterns dimension, there was a considerable decrease in anthropocentric attitudes after the intervention (82.9% pre-test to 57.1% post-test), accompanied by a corresponding increase in ecocentric attitudes (17.1% pre-test to 42.9% post-test). In the environmental protection dimension, the results suggest a complete

transformation, with a shift from 97.1% ecocentric attitudes in the pre-test to 100% in the post-test. Similarly, in the recycling–reusing and lifestyle habits dimensions, there is a marked transition to ecocentric attitudes, moving from 91.4% to 100% in recycling–reusing and from 57.1% to 88.6% in lifestyle habits. These findings support the idea that the eco-theater strategy has triggered a significant shift toward more ecocentric attitudes among students, indicating the positive impact of the intervention on shaping their environmental perspectives.

Table 6 Distribution of dimensions of ecocentric and anthropocentric attitudes (Developed by the authors)

| Dimensions of Ecocentric and Anthropocentric Attitudes | Pre-test |       | Post-test |       |
|--------------------------------------------------------|----------|-------|-----------|-------|
|                                                        | N°       | %     | N°        | %     |
| <b>Consumption patterns</b>                            |          |       |           |       |
| Anthropocentric                                        | 29       | 82.9% | 20        | 57.1% |
| Ecocentric                                             | 6        | 17.1% | 15        | 42.9% |
| Total                                                  | 35       | 100%  | 35        | 100%  |
| <b>Environmental protection</b>                        |          |       |           |       |
| Anthropocentric                                        | 1        | 2.9%  |           |       |
| Ecocentric                                             | 34       | 97.1% | 35        | 100%  |
| Total                                                  | 35       | 100%  | 35        | 100%  |
| <b>Recycling – reusing</b>                             |          |       |           |       |
| Anthropocentric                                        | 3        | 8.6%  |           |       |
| Ecocentric                                             | 32       | 91.4% | 35        | 100%  |
| Total                                                  | 35       | 100%  | 35        | 100%  |
| <b>Life habits</b>                                     |          |       |           |       |
| Anthropocentric                                        | 15       | 42.9% | 4         | 11.4% |
| Ecocentric                                             | 20       | 57.1% | 31        | 88.6% |
| Total                                                  | 35       | 100%  | 35        | 100%  |

Considering Table 7 in the analysis of children's ecocentric and anthropocentric attitudes concerning gender, differentiated patterns are observed in various evaluated dimensions. In the consumption patterns

dimension, it stands out that in the pre-test, anthropocentric attitudes are more prevalent in female children (46%) than in male children (37%), while in the post-test, this difference is reduced (31% female, 26% male). On the other hand, in the environmental protection dimension, a higher presence of ecocentric attitudes is evidenced in female children both in the pre-test (49%) and post-test (51%), whereas in male children, these attitudes remain constant (49%). In the recycling-reusing dimension, a similar trend was observed, where ecocentric attitudes were more pronounced in girls, especially in the post-test (51% female, 49% male). In the lifestyle habits dimension, a decrease in anthropocentric attitudes is perceived in male children in the post-test (9%) compared to the pre-test (26%), whereas in girls, ecocentric attitudes increase significantly (49% post-test, 34% pre-test). These results suggest that, overall, notable differences exist in children's attitudes based on gender, highlighting a greater inclination toward ecocentric perspectives in girls, especially in the dimensions of environmental protection, recycling-reusing, and lifestyle habits.

Table 7 Distribution of dimensions of ecocentric and anthropocentric attitudes by gender

| Dimensions                           |                 | Gender |     |        |     |
|--------------------------------------|-----------------|--------|-----|--------|-----|
|                                      |                 | Male   |     | Female |     |
|                                      |                 | N°     | %   | N°     | %   |
| Consumption patterns (pre-test)      | Anthropocentric | 13     | 37% | 16     | 46% |
|                                      | Ecocentric      | 4      | 11% | 2      | 6%  |
| Consumption patterns (post-test)     | Anthropocentric | 9      | 26% | 11     | 31% |
|                                      | Ecocentric      | 8      | 23% | 7      | 20% |
| Environmental protection (pre-test)  | Anthropocentric | 0      | 0%  | 1      | 3%  |
|                                      | Ecocentric      | 17     | 49% | 17     | 49% |
| Environmental protection (post-test) | Anthropocentric | 0      | 0%  | 0      | 0%  |
|                                      | Ecocentric      | 17     | 49% | 18     | 51% |
| Recycling-reusing (pre-test)         | Anthropocentric | 0      | 0%  | 3      | 9%  |
|                                      | Ecocentric      | 17     | 49% | 15     | 43% |
| Recycling-reusing (post-test)        | Anthropocentric | 0      | 0%  | 0      | 0%  |
|                                      | Ecocentric      | 17     | 49% | 18     | 51% |
| Life habits (pre-test)               | Anthropocentric | 9      | 26% | 6      | 17% |
|                                      | Ecocentric      | 8      | 23% | 12     | 34% |
| Life habits (post-test)              | Anthropocentric | 3      | 9%  | 1      | 3%  |
|                                      | Ecocentric      | 14     | 40% | 17     | 49% |

As observed in Table 8, the results of the assessment of the level of understanding of socioecological systems through pictorial content reveal significant progress among students. The majority of participants reached Level 4 (42.9%), demonstrating a solid understanding of relationships in socioecological systems by including all components and representing biological interactions with arrows, symbols, and written descriptions. Likewise, 37.1% of students achieved Level 5, showing a systemic understanding of the complexity of the concept by expressing abstract ideas and generalizing the presented phenomena. A 20% placed at Level 3, indicating an understanding of system components with a clear geographical location, although without representing biological interaction or including critical or abstract references. Overall, these results suggest

that the assessment strategy based on pictorial content has allowed the identification of significant progress in students' understanding of socioecological systems, highlighting the effectiveness of the methodology in achieving deeper levels of comprehension.

Table 8 Level of understanding of socio-ecological systems achieved by students through their pictorial content (Developed by the authors)

| Pictographic levels | F  | %      |
|---------------------|----|--------|
| Level 3             | 7  | 20.0%  |
| Level 4             | 15 | 42.9%  |
| Level 5             | 13 | 37.1%  |
| Total               | 35 | 100.0% |

The McNemar test will be employed to analyze differences in ecocentric attitudes among children before and after exposure to the ecotheater. This test is

suitable for comparing paired dichotomous variables, such as pre- and post-intervention measurements. The resulting p-value will determine the statistical significance of any change in ecocentric attitudes caused by the eco-theater. A low p-value supports the idea that the intervention had a significant impact,

either supporting or refuting our hypothesis. Before conducting the test, we present a cross-tabulation table detailing pre- and post-intervention frequencies, providing a visual context for comparison (see Table 9 and Figure 3).

Table 9 Crosstabulation of children's attitudes toward the environment (pre-test, post-test) (Developed by the authors)

|          |                  |            | Post-test       |            | Total |
|----------|------------------|------------|-----------------|------------|-------|
|          |                  |            | Anthropocentric | Ecocentric |       |
| Pre-test | Anthropo-centric | Count      | 1               | 17         | 18    |
|          |                  | % of total | 2.9%            | 48.6%      | 51.4% |
|          | Ecocentric       | Count      | 0               | 17         | 17    |
|          |                  | % of total | 0.0%            | 48.6%      | 48.6% |
| Total    |                  | Count      | 1               | 34         | 35    |
|          |                  | % of total | 2.9%            | 97.1%      | 100%  |

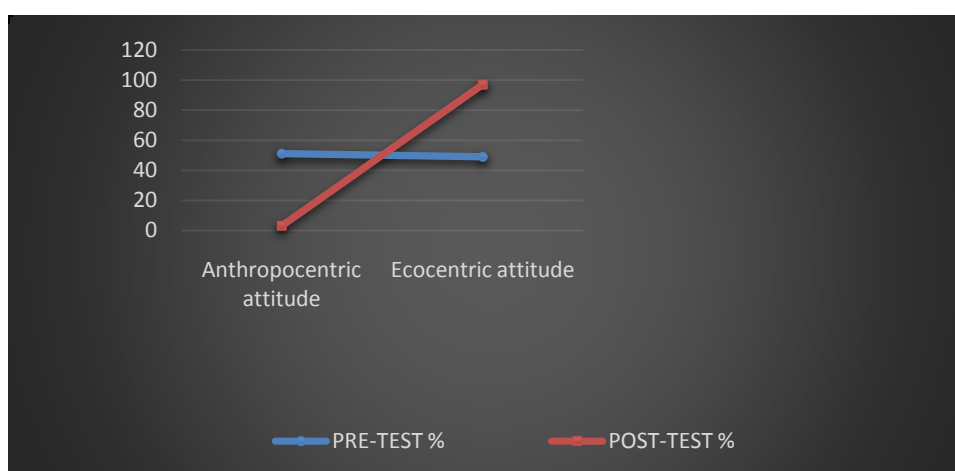


Fig. 3 Line graph of children's attitudes toward the environment (pre-test, post-test) (Developed by the authors)

According to Table 10 and the McNemar test, we obtained a p-value below 0.05. Therefore, we assume that there are modifications between the pre-test and post-test evaluations. This suggests statistically significant evidence to assert that there have been changes in students' environmental attitudes after the implementation of the eco-theater strategy. The probability of the observed difference being due to chance is low.

Table 10 Chi-square and McNemar's tests (Developed by the authors)

|                          | Value | Exact significance (bilateral) |
|--------------------------|-------|--------------------------------|
| McNemar test             | 17    | 0,000 <sup>a</sup>             |
| Valid cases              | 35    |                                |
| a. Binomial distribution |       |                                |

Furthermore, these findings have important implications for educational theory and practice. Confirmation that exposure to ecological theater can change students' attitudes toward the environment supports the utility of arts-based educational interventions to address complex environmental issues. These results also suggest that ecological theater is a promising strategy for integrating environmental education effectively into school curricula.

The students' responses based on pictorial

representations of environmental attitudes demonstrate a shift toward ecocentric attitudes, as shown below (Figure 4).

As can be seen in Figure 4, students identified with codes E35, E26, E31, and E27 indicate the biological characteristics of other living beings and the abiotic component. The drawing by student E26 represents the face of a happy field, with the description stating, "The earth is what gives life to everything..." a powerful phrase summarizing the importance of the earth and its relationship with life, providing the necessary conditions for its development, such as water, oxygen, nutrients, connections, and space. The description concludes with the phrase "Mugreman must know its riches, so that he becomes aware or scared...", referring to pollution; however, despite it is a threat, life is more powerful.

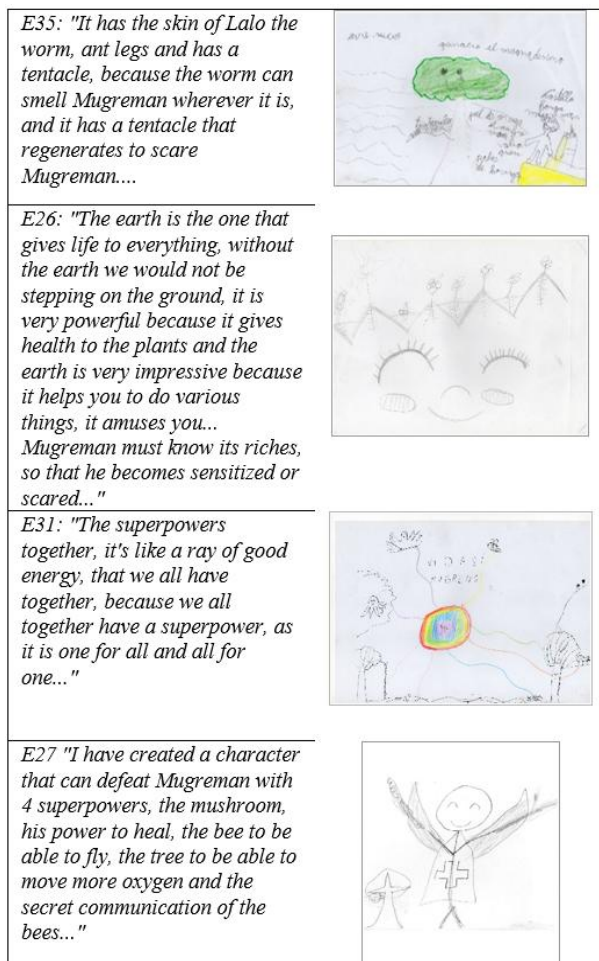


Fig. 4 Student responses and drawings (Developed by the authors)

Additionally, there is an evident capacity for synthesis and integration, using abstract representations with written reflections in the drawings, as seen in the work of student E31, where the phrase "life yes, dirt no" is written as a motto or slogan placed over an amorphous circle of colors representing the energy generated by the union of "superpowers together" of different living beings such as a bird, octopus, bee, tree, caterpillar, fungi, and mycelium. Student E31 uses colloquial language commonly employed by children of his age; the name of his character is "Quinacio el mamadísimo," which means "Quinacio the fortissimo or corpulent", having parts of the tree, caterpillar, ant, and octopus described in the drawing, where it is also noted that "Mugreman valió queso," meaning "Mugreman was or will be defeated." The use of colloquial language demonstrates familiarity with the subject, implying the intention to achieve more effective communication within their circle; for this, a clear understanding of the information and ideas to be conveyed is necessary beforehand. Also, in the drawing by student E27, another character born of his imagination is appreciated, combining "powers" of the fungus, tree, and bee described by him with the intention of defeating pollution. In these latter cases, students even specifically describe the "powers" of their characters, i.e., the biological characteristics of other living beings.

## 5. Discussion

The objective of our study was to determine how the ecotheater strategy has enabled students to shape their anthropocentric and ecocentric environmental attitudes. The results indicate a significant impact of the ecotheater strategy on the configuration of students' environmental attitudes during the pre-test and post-test across different evaluated dimensions. Coincidentally, [27] found in their research that more than three-quarters of students positively valued the role of meadows, forests, and domestic animals in the context of environmental protection. Incorporating drama into environmental education can have positive effects on each stage of environmental behavior [28], suggesting a high and rewarding impact on students if continued.

At the pre-test and post-test levels, our results establish a considerable decrease in anthropocentric attitudes after the intervention and an increase in ecocentric attitudes, emphasizing the dimension of environmental protection in all students, which has been internalized with commitment and responsibility. In contrast to our study, it was found that the consumption dimension achieved the highest level with positive attitudes toward the consumption of water, paper, and electricity.

When evaluating the socioecological systems reached by students through their pictorial content, most students achieved levels of understanding relationships in the systems, followed by a systemic understanding of the complexity of the concept, which is the highest level. In the case of the former, students were able to establish situations through their representations where both species benefit and care for the existence of mutualism, as well as cooperation in the interactions of organisms for mutual benefit through a product or a service. In the case of the latter, from a social perspective and their environment, it seeks mediation in activities carried out by humans responsibly to ensure the sustainability of the planet. We agree with the claims of [25], who argued that drawings and art, in general, can be a useful strategy to assess learning outcomes associated with environmental education programs. Additionally, facilitating nature-based activities proves to be a promising approach, given its potential to promote human health, well-being, and environmental protection [29].

Our findings first support the idea that the ecotheater strategy has led to a significant shift toward more ecocentric attitudes among students, indicating the positive impact of the intervention on shaping their environmental perspectives. Second, the dimensions of environmental protection, recycling-reuse, and lifestyle habits achieved a high value in the post-test, becoming more internalized topics for students. Third, there is a slight inclination in girls, with more pronounced ecocentric attitudes in the dimensions of environmental

protection, recycling-reusing, and lifestyle habits. Finally, the fourth finding suggests that students have achieved an understanding of the biological interaction among all living beings represented in their drawings.

The importance of our study lies in successfully working with all four dimensions—cognitive, affective, conative, and active—allowing students to change and reverse their anthropocentric behaviors to ecocentric ones. In contrast to our results, another study found only favorable results in the cognitive dimension, lacking work on respect, sensitivity, and affective commitment toward the environment [2]. Therefore, educators must consolidate their efforts to create a range of natural interventions, including greening schoolyards, nature views, and curricula focused on biology, horticulture, sustainability, and biodiversity [13]. This is crucial for achieving environmental attitudes that lead to committed behavioral changes in environmental preservation [30], as demonstrated in the six sessions conducted. Additionally, the socio-scientific approach allows students to be shaped as future citizens capable of recognizing problematic scenarios in their complexity and nature, participating in the issues, and taking an ethical stance on conservation and care [4], [31].

Future studies should continue exploring this field with a larger and more diverse sample size, including more institutions and integrating more interdisciplinary courses or areas, using more rigorous content selection criteria. More instruments and strategies are needed to specifically understand and improve the environmental behaviors of our students. It is also necessary to review the curriculum's environmental education content to promote dynamic intercalation with nature and its direct connection to it [1], [19]. Narration becomes a valuable input for understanding what children think about the impact of what they have learned [18]. Our study is in its initial stage, and it would be important to analyze it for a more in-depth exploration of the mechanisms of achieving competencies under a socio-scientific approach in science teaching. While the Peruvian state prioritizes five components in the basic education curriculum: education in climate change, health education, eco-efficiency education, disaster risk management education, and biodiversity education; these should be incorporated into the annual programming and learning experiences [20], there are currently no studies on their impact. This study could be a valuable input for future studies framed in environmental education.

## 6. Conclusions

Several studies have been conducted on the influence of the theater on the elderly, but very few on children, nor on the influence of the theater on children in relation to the environment and its conservation.

In this study, we focused on using ecotheater as a strategy to assess children's attitudes toward the

environment. We found that the intervention was significant, as post-test results showed a notable increase in ecocentric behavior, reflecting positive social attitudes toward care and respect for environmental diversity. We believe that the connection with nature has been a central part of the development of our activities and educational environments, with the environmental protection dimension standing out as the most internalized and achieving optimal outcomes in this study.

Furthermore, we demonstrated that boys and girls engaged in ecotheater activities developed a strong connection with nature, adopting positive pro-environmental ecocentric behaviors. Outdoor activities, in particular, facilitated a deeper connection with nature. Through drawing, the children depicted actions that showcased their understanding of relationships within systems, fostering ecological environmental commitment and interrelations among living beings. This led to effective conservation interventions and well-informed decisions, all for the benefit of the environment. The eco-theater has become a new opportunity of developing innovative materials and resources for environmental education.

Our study not only achieved cognitive mastery but also influenced the attitudinal, conative, and affective domains. Interactions in open spaces that allowed contact with nature were pivotal. For future research, we suggest replicating our study with other science topics and a larger sample of students, considering the components of environmental education in school curricula to enhance the use of theater in the teaching and learning process of natural sciences. In addition to conducting cohort studies to verify environmental behavior change, future studies should continue to explore the usefulness of theater-based approaches and how these strategies influence children's relationship with nature.

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