UNDERSTANDING ECOLOGICAL ROLES OF ORGANISMS AMONG KINDERGARTEN CHILDREN: IMPLICATIONS FOR ENVIRONMENTAL EDUCATION

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Abstract
Understanding ecological relationships among living organisms represents an important foundation for environmental education, as knowledge about ecosystem functioning can foster more responsible attitudes toward nature. This study explores how children perceive living organisms in relation to three dimensions: identification, understanding of ecological roles, and perceived importance for nature. Data were anonymously collected from 60 children attending three state kindergartens. Children were individually presented with visual representations of selected organisms representing different trophic levels within an ecosystem. They were asked to identify the organisms, explain their ecological roles, and evaluate their importance for natural systems. Relationships among these dimensions were analysed using correlation analysis, while potential gender differences were examined using multivariate analysis (MANOVA). The results revealed a positive correlation between identification and understanding of ecological roles ($r = 0.517$, $p < 0.001$). However, perceived importance was not significantly associated with either identification or understanding of ecological roles. Multivariate analysis did not reveal statistically significant gender differences (Wilks' $\lambda = 0.949$, $F(3,56) = 1.00$, $p = 0.399$). These findings highlight the importance of strengthening ecological literacy as a foundation for environmental education in early childhood.

Key words: ecological literacy; early childhood learning; biodiversity awareness; ecosystem functioning; environmental education

Introduction

Ecology as a scientific discipline provides a basic framework for understanding the relationships between organisms and their environment, as well as the processes that ensure the functioning of ecosystems. Biodiversity plays a key role in the stability and functioning of ecosystems, and its disruption may lead to significant changes in the provision of ecosystem services (Hooper et al., 2005; Millennium Ecosystem Assessment, 2005). Current environmental challenges, including biodiversity loss and ecosystem degradation, point to the need for a deeper understanding of ecological processes and relationships in nature (IPBES, 2019). Ecological knowledge is followed by an environmental dimension, which reflects the relationship between humans and the natural environment and emphasizes the need for its protection. For this reason, environmental education is characterized not only by the transmission of knowledge, but also by the formation of attitudes and values of individuals (Stapp, 1969). From this perspective, the integration of ecological understanding with environmental thinking can be considered essential.

Particular attention should be paid to early childhood, as it represents an important phase in the formation of basic ideas about nature. Research indicates that children already develop ideas about the relationships among organisms during this period; however, these ideas are often incomplete or simplified (Leach et al., 1996; Washinawatok et al., 2017). At the same time, research has confirmed that although children are able to identify organisms, their understanding of ecological roles and relationships is more limited. Despite the growing interest in environmental education, the relationship between ecological understanding and the evaluation of the importance of organisms in children remains insufficiently explored. Existing findings suggest that the evaluation of the importance of organisms is not necessarily directly linked to the level of ecological knowledge, but may also be influenced by other factors, such as experience or preferences (Melis et al., 2020). Based on the above, there is a need for a deeper examination of the relationships between knowledge, understanding, and the evaluation of natural phenomena in early childhood. Therefore, the aim of the present study is to analyse how preschool children perceive selected living organisms in terms of their identification, understanding of ecological roles, and evaluation of their importance for nature. The study also focuses on examining the relationships among these dimensions.

Material and methods

Research Design and Data Collection

Data were collected using individual semi-structured interviews with children. The interviews were conducted in a quiet and familiar environment within the kindergarten (e.g., classroom or relaxation area) in order to ensure that the children felt comfortable and relaxed during the conversation. At the beginning of each interview, the researcher established rapport with the child through simple introductory questions such as asking the child's name or whether they liked animals and plants. These introductory questions were used only to create a relaxed atmosphere and were not included in the research data. During the interview, children were gradually shown six pictures representing different living organisms commonly found in nature: a bumblebee, earthworm, squirrel, tree, mushroom, and wolf. These organisms were selected to represent different ecological roles within ecosystems, including producers, consumers, and decomposers, similar to previous studie investigating children's perception of ecological roles of organisms (Melis et al., 2020). To avoid order bias, the sequence in which the pictures were presented varied between interviews. Each child was asked the same set of questions for every organism. The interview consisted of three main types of questions. Children were first asked to identify the organism shown in the picture using the question: *"What is shown in the picture? What is it called?"* To verify familiarity with the organism, a follow-up question was asked: *"Have you ever seen it in real life? Where?"*

Responses were scored according to accuracy:

- 2 points – correct identification
- 1 point – partially correct identification (e.g., calling a bumblebee a bee)
- 0 points – incorrect answer or no answer

If the child could not identify the organism, the researcher provided the correct name before continuing with the interview. Children were then asked to evaluate the importance of the organism for nature using the question: *"Do you think this organism is very important for nature, somewhat important, or not very important?"*

Responses were scored as:

- 2 points – very important
- 1 point – somewhat important
- 0 points – not important

Children were then asked to explain their reasoning: *"Why do you think so? What is it good for in nature?"* Children were encouraged to elaborate on their answers, but the interviewer avoided suggesting possible explanations. After discussing all six organisms, children were asked to compare them directly. They were asked: *"Which of these would nature miss the most?"*,*"Which would nature miss the least?"* Children were then asked to arrange the cards from the most important organism to the least important organism. The final order was recorded for further analysis.

Coding of Explanations

Children's verbal explanations were transcribed and categorized according to a predefined coding scheme. Responses were classified into five main categories:

1. Ecological understanding – references to ecological processes or ecosystem functions (e.g., pollination, oxygen production, decomposition).
2. Anthropocentric usefulness – explanations referring to benefits for humans (e.g., food production).
3. Emotional evaluation – statements expressing sympathy, fear, or aesthetic judgments.
4. Misconceptions or irrelevant answers – statements not related to ecological roles.
5. No answer / "I don't know."

For quantitative analysis, responses indicating ecological understanding were coded as **1**, while all other responses were coded as 0.

Data Analysis

The collected data were analysed using descriptive and inferential statistical methods. First, descriptive statistics were calculated for the three evaluated dimensions: organism identification, understanding of ecological roles, and perceived importance for nature. Differences between boys and girls were analysed using multivariate analysis of variance (MANOVA). To explore relationships between the evaluated dimensions, Pearson correlation analysis was performed. Correlation coefficients were visualised using a heat map, which provided a graphical representation of the relationships among the studied variables. All statistical analyses were conducted using standard statistical software, with the significance level set at $p < 0.05$.

Results

Descriptive statistics of the evaluated variables

The descriptive statistics revealed differences in the average scores obtained for the three evaluated dimensions: organism identification, understanding of ecological roles, and perceived importance for nature. The highest mean value was recorded for identification (M = 1.76), followed by ecological role understanding (M = 1.51) and perceived importance for nature (M = 1.41). These results indicate that children were generally able to recognize the organisms presented in the images more successfully than they were able to explain their ecological function or evaluate their importance for nature. Overall, these descriptive results provide an initial overview of children's abilities to identify organisms, understand their ecological roles, and evaluate their importance for nature. When analysing the perceived importance of individual organisms, the highest average ranking was attributed to the earthworm (M = 4.17), followed by the squirrel (M = 3.47) and bee/bumblebee (M = 3.47). Slightly lower mean values were recorded for tree (M = 3.47) and mushroom (M = 3.50), while the wolf received the lowest average score (M = 2.93). These results suggest that children tended to attribute greater ecological importance to organisms that are either more familiar or perceived as directly related to ecosystem processes.

Differences between boys and girls

The comparison of boys and girls showed only minor differences in the average scores for the three evaluated dimensions. Boys achieved slightly higher scores in organism identification, whereas girls showed marginally higher scores in perceived importance for nature. However, multivariate analysis did not reveal statistically significant gender differences across the evaluated variables (Wilks' λ = 0.949, $F(3, 56) = 1.00$, $p = 0.399$). This suggests that the perception of ecological roles and the importance of organisms for nature was comparable between boys and girls in the studied sample. Figure 1 illustrates the mean values for identification, ecological role understanding, and perceived importance for nature according to gender.

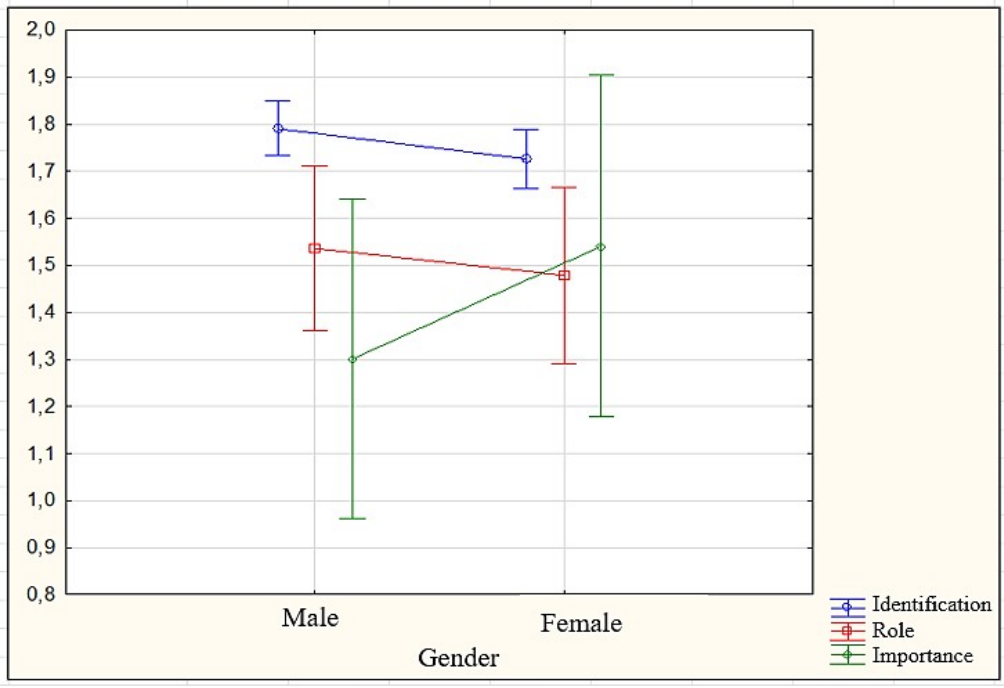

Fig. 1: Mean values of organism identification, ecological role understanding, and perceived importance for nature by gender.

Relationships between identification, ecological understanding and perceived importance

The relationships between the three evaluated variables were examined using correlation analysis. A moderate positive correlation was found between organism identification and ecological role understanding ($r = 0.517$, $p < 0.001$). This indicates that children who were better able to identify organisms also tended to demonstrate a better understanding of their ecological roles. In contrast, perceived importance for nature was not significantly correlated with either identification ($r = –0.091$, $p = 0.487$) or ecological role understanding ($r = 0.089$, $p = 0.495$). These findings suggest that children's evaluation of the importance of organisms for nature was relatively independent of their ability to correctly identify the organisms or explain their ecological functions. To provide a clearer visual

representation of these relationships, the correlation matrix is presented in Figure 2 in the form of a heat map.

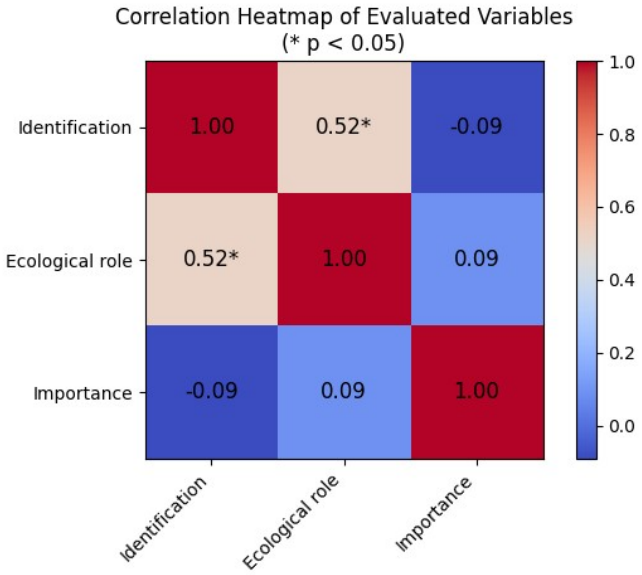

Fig. 2: Heat map of correlations between organism identification, ecological role understanding, and perceived importance for nature. Values represent Pearson correlation coefficients. Significant correlations ($p < 0.05$) are marked with an asterisk (*).

Discussion

The present study focused on analysing how preschool children perceive selected living organisms in terms of their identification, understanding of ecological roles, and evaluation of their importance for nature. The results indicate that children were generally more successful in identifying organisms than in explaining their ecological functions or evaluating their importance. This pattern suggests that while basic recognition of organisms is relatively well developed at an early age, deeper ecological understanding and evaluative reasoning remain less developed. The observed difference also corresponds with previous research, which points to the incompleteness of children's ideas about ecological relationships (Leach et al., 1996; Washinawatok et al., 2017). Similarly, Melis et al. (2020) report that although children are able to recognize common organisms, their explanations of ecological roles are often incomplete or based on simplified reasoning. The presented findings therefore point to the assumption that the development of ecological literacy requires more than mere contact with individual organisms, while at the same time highlighting the need to include the gradual development of understanding of ecological processes. Understanding ecological relationships thus represents a fundamental prerequisite for the development of ecological literacy, which involves the ability to comprehend the integrity of natural systems and their interconnections (Orr, 1992). A key finding of this study is the absence of a significant relationship between the evaluation of the importance of organisms for nature and their identification, as well as ecological understanding. This result suggests that children's evaluation of the importance of organisms is largely independent of their level of cognitive understanding of ecological roles, meaning that children may assign importance based on factors other than ecological knowledge. This conclusion corresponds with research indicating that environmental knowledge, attitudes, and behaviour are related, but their relationship is not necessarily strong or direct (Blaikie, 1993). This observed discrepancy may point to a broader trend in which the cognitive and affective components of environmental perception develop at different rates, potentially influenced by emotional and anthropocentric factors. Children tended to assign higher importance to organisms that are closer to them or associated with visible processes in nature, such as earthworms, squirrels, or bees, whereas organisms such as wolves were evaluated as less important, which is in line with findings emphasizing the role of emotional responses and personal experience in shaping environmental attitudes (Borg et al., 2017).

The interpretation of the results may also be approached from the perspective of ecological literacy. As Cutter-Mackenzie and Smith (2003) argue, environmental education has long faced the problem of insufficient levels of ecological literacy, with emphasis often placed more on the formation of attitudes than on the systematic development of content knowledge. This trend may contribute to a situation in which children develop a positive relationship with nature, yet their understanding of ecological

processes remains limited. The absence of a relationship between ecological understanding and the evaluation of the importance of organisms may thus reflect a broader issue of insufficient integration between the cognitive and value-based components of education. In this context, it is also necessary to consider the selective perception of nature, particularly the phenomenon of “plant blindness”, which refers to the tendency to overlook plants and underestimate their importance compared to animals (Wandersee & Schussler, 1999; Knapp, 2019), as similar tendencies have been identified in children who often do not perceive plants as key components of ecosystems (Amprazis et al., 2021). From an educational perspective, these findings highlight the need to integrate the cognitive and affective dimensions of environmental education. As noted by Erdoğan (2011), educational approaches that connect ecological knowledge with emotional experience and personal engagement may contribute to the development of more consistent environmental understanding and responsible behaviour. At the same time, research by Ayotte-Beaudet et al. (2023) suggests that experiential and contextualized forms of teaching can support a deeper understanding of ecological relationships, which creates space for bridging the gap between knowledge and evaluation identified in this study. Despite the contributions of this study, its limitations should also be considered, as the research was conducted within a relatively narrowly defined educational context involving children from a single type of educational environment, which limits the generalizability of the findings. Future research could therefore focus on expanding the sample to include different types of kindergartens, such as forest kindergartens, Montessori settings, or other alternative educational approaches, as well as larger and more diverse samples to allow for a more comprehensive understanding of the development of ecological thinking.

Conclusion

The results of the present study indicate that although preschool children are relatively successful in identifying selected organisms, their understanding of ecological roles and their evaluation of the importance of these organisms for nature remain more limited and mutually unconnected. The observed absence of a relationship between ecological understanding and the evaluation of organism importance suggests the need for a more systematic integration of cognitive and affective components of environmental education already in early childhood. Strengthening ecological literacy thus appears to be a key prerequisite for the development of environmentally responsible thinking, with emphasis placed on a deeper understanding of ecological relationships and the functions of organisms within ecosystem processes.

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Souhrn
Výsledky předkládané studie poukazují na to, že ačkoli děti předškolního věku dokážou relativně úspěšně identifikovat vybrané organismy, jejich porozumění ekologickým rolím a hodnocení jejich významu pro přírodu zůstává omezenější a vzájemně nepropojené. Zjištěná absence vztahu mezi ekologickým porozuměním a hodnocením významu organismů naznačuje potřebu systematičtějšího propojení kognitivní a afektivní složky environmentálního vzdělávání již v raném věku. Posilování ekologické gramotnosti se tak jeví jako klíčový předpoklad pro rozvoj environmentálně odpovědného myšlení, přičemž důraz by měl být kladen na hlubší porozumění ekologickým vztahům a funkcím organismů v kontextu fungování ekosystémů.

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