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SUMMARY OF THE DOCTORAL THESIS

Psycho-pedagogical aspects of environmental education in fostering awareness of the importance of insects

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STRUCTURE OF THE DOCTORAL THESIS

CHAPTER I: THEORETICAL FRAMEWORK

1.1. Rationale of the topic

From the formation of the Earth to the emergence of human civilization, geological and physico-chemical processes have shaped life on the planet, influencing the structure and dynamics of ecosystems. While the evolution of species has always been driven by natural phenomena, a radical shift occurred with the rise of human communities, whose expansion intensified interactions with the environment, often resulting in negative impacts on ecological balance (Hooper et al., 2005; IPBES, 2019).

An anthropocentric worldview, placing humans at the centre of concern and above nature, has significantly contributed to the current ecological crisis. Over the past century, human activity has exerted an increasingly severe impact on the environment, leading to a biodiversity loss, fragmentation of natural habitats, and their contamination with toxic substances (Malcolm & Markham, 2000; Elmqvist et al., 2016).

Despite repeated warnings from the scientific community through studies, publications, and documentaries, the societal response has remained limited. Alarming media messages such as, "Life in the oceans will disappear in the next 50–60 years if we do not change our behavior," have generally failed to bring about significant changes in public attitudes and daily practices. This phenomenon can be explained, at least in part, by a distorted perception of risk, viewed as distant in time and space, which diminishes the motivation for immediate action. Recent studies highlight that emotions and a sense of connection with nature play a crucial role in adopting environmentally responsible behavior (Castillo-Huitrón et al., 2020; Chawla, 2007). This doctoral thesis thus argues for the importance of ecological education grounded in an understanding of psychological and social mechanisms, aiming to promote a sustainable relationship with the natural environment and ensure a durable future.

1.2. General aspects of insects and their conservation

Insects (Class Insecta) represent the most abundant and diverse group of organisms within the animal kingdom (Chowdhury et al., 2017; Stork, 2018). They play a crucial role in ecosystem functioning and are a major component of global biodiversity. Their loss would lead to significant ecological imbalances.

1.2.1. The importance of insects

The utilitarian human perspective on nature often emphasizes the economic benefits, particularly in the case of insects, through the lens of the ecosystem services they provide (Chowdhury et al., 2017; Schowalter et al., 2018; Ramos et al., 2020; Goulson, 2021). However, this approach risks minimizing their ecological, biological, and cultural value. Nature has intrinsic worth, and protecting insects is vital for maintaining ecosystem balance and, by extension, human well-being.

Nevertheless, in a context where political decisions and public perceptions are frequently driven by pragmatic criteria, it is necessary to consider how economic arguments can support conservation efforts (Goulson, 2021). In this light, highlighting services such as pollination, biological control, decomposition, and the maintenance of biodiversity becomes a valuable tool in promoting conservation.

1.2.2. Cultural Entomology

To understand the complex relationship between humans and insects, it is essential to also explore the cultural dimension of this interaction. Cultural entomology, a field conceptually shaped by Charles Hogue (1986), investigates how insects have been represented and integrated into literature, art, mythology, religion, and other symbolic expressions, reflecting both collective and individual perceptions across various socio-cultural and historical contexts.

A clear expression of this relationship can be observed in traditional mythology and religion from various cultures, where insects have been attributed deep symbolic meanings. For example, in Greek and Aztec cultures, butterflies symbolized the soul and rebirth (Burland, 1975), while in Slavic and Romanian folklore, they were seen as manifestations of the soul after death (Moszynski, 1967; Orkusz & Orkusz, 2024). The scarab in Egyptian culture, associated with the sun and immortality, and the bee, viewed as a symbol of diligence and order, reflect the important role of insects in the beliefs and rituals of ancient civilizations (Kritsky, 1991; Crane, 1999).

These mythical-symbolic projections were later reflected in various forms of artistic expression, offering a visual and aesthetic framework through which insects have been portrayed in metaphorical or ornamental ways. In visual arts, insects, especially butterflies, bees, and beetles are used to convey religious, moral, or social messages (Yadav et al., 2024).

The influence of insects also extends to the field of music, where their sounds inspired classical composers such as Josquin des Prez and Robert Schumann. In Chinese traditions, crickets were valued for their chirping and were often kept in cages as symbols of natural harmony (Kritsky & Smith, 2018).

With the advent of cinema, insects have been assigned various roles, either as frightening symbols in horror and science fiction films (e.g., The Fly, The Mist), or as friendly characters in animations such as A Bug's Life and Bee Movie. The recurring portrayal of species like butterflies, ants, bees, or flies reflects collective perceptions related to labor, metamorphosis, and fear or disgust.

Thus, cultural entomology offers a valuable perspective on how insects have been perceived, symbolized, and integrated into human cultures, reflecting the deep and complex relationship between humans and nature.

1.2.3. Issues related to insect conservation

Perceptions and values attributed to species are deeply influenced by personal experiences and the degree of familiarity people have with them (Colléony et al., 2017; Martín-López et al., 2007). In the case of insects, the lack of a charismatic image and their frequent association with negative emotions such as fear or disgust contribute to a low level of interest in their conservation (Cardoso et al., 2011; Samways, 2015). Although arthropods represent approximately 80% of all known animal species and play an essential role in maintaining ecological balance, they receive less than 10% of global biodiversity conservation funding (Zhang, 2011; Cardoso et al., 2011).

Despite their omnipresence in daily life and their crucial role in ecosystem functioning, public attitudes remain the main obstacle to their protection (Fukano & Soga, 2021). Studies show that these attitudes are shaped by cultural and educational influences, and that limited access to accurate information, along with a lack of direct interaction, contributes to the persistence of distorted perceptions (Bjerke & Østdahl, 2004; Soga et al., 2020). In this context, environmental education plays a key role in fostering responsibility toward nature, especially when it is innovative, critical, and adapted to children's interests (Souza, 2009).

1.2.4. Factors influencing changes in attitudes toward insects

The emotional relationship between humans and nature can be explained through the concepts of biophilia and biophobia. Biophilia, introduced by Edward O. Wilson (1984), describes an innate positive predisposition toward nature, while biophobia reflects reactions of fear, disgust, or indifference (Orians, 2007; Ulrich, 1993). The frequency of direct contact with nature strongly influences this relationship. The phenomenon of the "extinction of experience" (Pyle, 1993; Miller, 2005) highlights the decline in time spent in natural environments, especially among children, with negative effects on health and on attitudes toward the environment (Soga & Gaston, 2016; Soga et al., 2020).

To counter these effects, both formal and informal ecological education plays an important role in cultivating attachment to nature and promoting environmentally responsible behavior. Creating direct experiences in nature helps to form positive memories and supports the long-term conservation of biodiversity.

1.3. Environmental education: past, present, and future directions

Environmental education (EE) has deep historical roots, with influences dating back to the 18th century (McCrea, 2006). It has developed over several centuries, shaped by the contributions of philosophers and naturalists who emphasized the importance of human interaction with nature (Palmer, 2002; Biedenweg et al., 2013). This subsection explores the origins of environmental education, highlighting the role of the nature study movement and conservation education in laying the foundation for this discipline.

Environmental education gained international recognition through a series of key conferences, starting with the Stockholm Conference (1972), which emphasized the role of education in addressing environmental issues (Chatzifotiou, 2001). The subsequent documents, the Belgrade Charter (1975) and the Tbilisi Declaration (1977), outlined the main goals and core principles of environmental education, offering a global framework for promoting a responsible and active understanding of the environment (UNESCO-UNEP, 1977; Palmer, 2002; Peterson, 2022).

Today, EE stands at the crossroads of climate crises and educational responsibility. Its objectives aim to shape informed, empathetic citizens capable of taking responsible environmental action (Anderson & Jacobson, 2018; Stern et al., 2014). In Romania, however, EE holds a limited position, often marginalized within the curriculum and primarily supported by non-governmental initiatives (Ollerer, 2012). Academic community involvement and interinstitutional collaboration remain essential for the development of effective environmental education, adapted to current and future challenges.

1.4. Theoretical foundations of environmental education

To understand how education contributes to the formation of ecological attitudes, values, and behaviors, it is essential to anchor it within a solid theoretical framework. This thesis integrates several relevant theoretical perspectives that explain the processes through which individuals learn to relate to the natural environment.

1.4.1. Social learning theory

Social learning theory, proposed by Albert Bandura (1961), emphasizes the role of observation, modeling, and imitation in the learning process, highlighting the interaction between environmental and cognitive factors. Children learn by being exposed to models—parents, teachers, peers, or public figures—whose behaviors they observe and imitate (McLeod, 2016; Licht & Kistner, 1986). Bandura identified four key steps in the modeling process: paying attention to the relevant behavior, retaining it in memory, reproducing the observed behavior, and being motivated to imitate it (Bandura, 1961, cited in Koutroubas & Galanakis, 2022). The famous Bobo doll experiment illustrates how social learning begins at an early age and continues throughout life.

1.4.2. Sociocultural learning theory

Lev Vygotsky's sociocultural theory (1978) emphasizes the essential role of social interaction in cognitive development. According to this perspective, children learn through exchanges with more experienced individuals, internalizing values, strategies, and knowledge specific to the culture in which they live. Unlike Piaget, who believed that development precedes learning, Vygotsky argued that social learning drives development. A central concept of this theory is the Zone of Proximal

Development (ZPD), defined as the range between what a child can do independently and what they can accomplish with the help of an adult or a more capable peer (Bruner, 1997; Shabani et al., 2010). This model highlights the importance of collaboration and guidance in constructing knowledge and developing critical thinking (Nicolopoulou, 1993; Sarmiento-Campos et al., 2022).

1.4.3. The concept of scaffolding

Developed by Wood, Bruner, and Ross (1976) and based on Vygotsky's work, the concept of scaffolding refers to the temporary support provided by an adult or expert to help a learner accomplish a task that they would not be able to perform alone (Kim & Hannafin, 2011; Van Der Stuyf, 2002). Key features of this support include providing gradual assistance that is reduced as the learner gains confidence and autonomy, adapting the intervention to the learner's level of understanding and individual progress, supporting learning through direct interaction and collaboration, and ultimately, transferring responsibility from the adult to the learner to encourage independent learning. Through this mechanism, scaffolding becomes an essential tool in cognitive development, facilitating the learner's transition from dependence to autonomy in the learning process.

1.4.4. Transformative learning theory

Transformative learning theory, formulated by Jack Mezirow (1991), describes the process through which individuals fundamentally change their perspectives in response to challenging or unexpected experiences. This transformation occurs through critical reflection on existing beliefs and values, leading to new frameworks for interpretation and action (Mezirow, 2000; King, 2003). The process involves several stages, from facing a "disorienting dilemma" to adopting new behaviors and reintegrating the new perspective into everyday life (Taylor, 1998). This theory highlights the role of experiential learning and reflective thinking in the development of deeper personal and social awareness.

1.5. Approaches to assessing pro-environmental behavior

Human behavior has a profound impact on the environment, and understanding the relationship between people and nature is essential for mitigating negative effects on ecosystems (Lehman & Geller, 2004). According to Zimbardo and Gerrig (2004, cited in Katarina, 2019), human behavior is an adaptive process, influenced by context and environmental stimuli, as well as by the level of awareness regarding the consequences of one's own actions. Williamson et al. (2018) emphasize the central role of individual behavior in addressing climate change and sustainability challenges. While industry and agriculture are major sources of pollution, individuals' everyday behaviors cumulatively contribute to environmental degradation. In this context, mobilizing the population to adopt environmentally friendly behavior becomes essential, though difficult to achieve on a large scale.

This thesis addresses environmental attitudes and behaviors, with a specific focus on the human-insect relationship. Environmentally responsible behavior includes actions aimed at reducing negative impacts on nature, conserving resources, and promoting sustainability (Jackson, 2005; Steg & Vlek, 2009).

Early theoretical models proposed a direct relationship between knowledge, attitudes, and behavior (Burgess et al., 1998, cited in Kingston, 2016). However, later studies have shown that this relationship is far more complex. Even in the presence of favorable attitudes, pro-environmental behaviors are not automatically adopted, as they are influenced by social, contextual, and psychological factors (Ajzen & Fishbein, 1980; Stern, 2000). Within environmental psychology, two major theories provide a relevant explanatory framework: the Theory of Planned Behavior and the Value-Belief-Norm Theory, both of which analyze how intentions and values influence ecological behavior.

1.6. Objectives of the Doctoral Research

Throughout the doctoral research, the following objectives were pursued:

STUDY I: Systematic review of the literature on educational programs aimed at raising children's awareness of the importance of insects.

STUDY II: Quantitative study – Exploring the perceptions, needs, and educational challenges related to teaching about insects and their conservation among primary school teachers and biology educators.

STUDY III: Quantitative study – Development of an interdisciplinary educational program dedicated to insect conservation, intended for primary school students.

STUDY IV: Quantitative study – Cognitive and social mechanisms associated with insect conservation: an integrated approach based on the Theory of Planned Behavior and the Value-Belief-Norm Theory.

STUDY V: Qualitative study – Development of educational recommendations for promoting responsible behavior toward insects within the context of environmental education.

CHAPTER II: RESEARCH METHODOLOGY

2.1. STUDY I: Systematic Review of the Literature on Educational Programs Aimed at Raising Children's Awareness of the Importance of Insects

The purpose of this study is to analyze, based on specialized literature, the ways in which environmental education related to insect conservation is implemented in pre-university education. The study focuses on identifying and evaluating the effectiveness of educational programs specifically centered on insect conservation. By examining the impact of these initiatives and the methods used to assess their effectiveness, this research aims to highlight the key features of successful programs, thus providing a scientific basis for the development of more effective future initiatives in environmental education.

The research questions addressed in this study were as follows:

1. What are the objectives of environmental education programs (EEPs) focused on insect conservation?
2. What is the optimal duration of an EEP to support the development of environmentally responsible behavior, changes in attitudes toward insects, and improved knowledge about insects and their decline?
3. Who are the beneficiaries of these programs, and who implements them?
4. What variables are used to assess the impact of the programs on participants, and which assessment tools are most frequently used?
5. What insect groups are targeted, and what specific activities are included within the programs?
6. What pedagogical methods are most commonly used in environmental education interventions?
7. What effects have been reported as a result of implementing these programs?

2.1.1. Methodology

To address the research questions, a review of relevant literature in the field of environmental education was conducted using the scoping review methodology. This was based on the five-stage framework proposed by Arksey and O'Malley (2005): (1) identifying the research questions, (2) identifying relevant studies, (3) selecting the studies, (4) charting the data, and (5) collating, summarizing, and reporting the results.

To reflect the diversity of approaches to insect-focused environmental education, studies from both the field of education and entomological research were analyzed. Two sets of keywords were used, selected based on a preliminary analysis: "insects" AND "environmental education" AND "educational programs" (for the education domain), and "entomology" AND "outreach" AND "environmental education" (for the entomology domain).

The review included peer-reviewed articles published in English between 2000 and 2022 that addressed the impact of educational programs on raising awareness of insect conservation among pre-university students. Relevant studies were identified through Google Scholar, and the selection process was conducted using a PRISMA flow diagram (http://www.prisma-statement.org/PRISMAStatement/FlowDiagram).

2.1.2. Results and Discussion

Following the selection process, only nine studies met the inclusion criteria between 2000 and 2022. These articles were published between 2016 and 2022, indicating a relatively recent interest in integrating insect conservation into educational programs. The main findings are presented below, organized according to the research questions.

What are the objectives of environmental education programs focused on insect conservation?

Of the nine studies analyzed, three aimed to improve students' attitudes toward insects by increasing knowledge and providing direct experience (Christ et al., 2022; Fisher-Maltese, 2016; Cho & Lee, 2018), while two focused on developing environmentally responsible behavior toward insects using similar methods (Schönfelder & Bogner, 2018; Sieg & Dreesmann, 2021). Four studies aimed to stimulate interest in entomology (Weeks & Osero, 2018; Aslli et al., 2022; Healy, 2019; Markee et al., 2021), one of which also explored the effects of project-based learning on classroom climate and student motivation (Aslli et al., 2022).

A clear distinction emerged between studies conducted by entomologists or biologists—primarily focused on developing knowledge about insects and their ecological role (Fisher-Maltese, 2016; Weeks & Osero, 2018; Markee et al., 2021)—and those conducted by education specialists, which emphasized changing students' attitudes and behaviors toward insects and the environment (Schönfelder & Bogner, 2018; Christ et al., 2022; Sieg & Dreesmann, 2021; Cho & Lee, 2018; Aslli et al., 2022; Healy, 2019).

What pedagogical methods were most commonly used in environmental education programs?

Most of the studies employed hands-on activities to improve attitudes toward insects, stimulate interest, and promote environmentally responsible behavior (see Table 1). Direct interaction with live insects was a frequently used method, offering students the opportunity to create memorable experiences. Some studies also used project-based learning strategies (Aslli et al., 2022) or game-based pedagogies, such as escape room–style activities (Healy, 2019).

For primary and middle school students, hands-on activities were the most effective, as they support exploratory learning through play. In contrast, for older students, more complex teaching methods are needed, incorporating cognitive challenges that stimulate critical thinking and problem-solving.

What insect groups were used in the educational programs, and what specific activities were implemented?

Bees and bumblebees were the most frequently used insects in the reviewed educational programs, primarily due to their role as pollinators (Schönfelder & Bogner, 2018; Fisher-Maltese, 2016; Christ et al., 2022; Sieg & Dreesmann, 2021; Cho & Lee, 2018; Weeks & Osero, 2018; Aslli et al., 2022). Some studies also included butterflies, appreciated for their aesthetic value (Fisher-Maltese, 2016; Weeks & Osero, 2018; Markee et al., 2021). The popularity of bees, driven by cultural associations and their practical utility, is reflected in both environmental education and in art and literature (Kritsky, 1991; Crane, 1999). However, this focus may lead to the neglect of other pollinators that are equally essential for maintaining ecological balance.

The educational programs predominantly included experiential and interactive activities, combining theoretical instruction with direct observation, insect handling, and simple experiments. Some initiatives integrated project-based learning, encouraging cooperation, independent research, and critical thinking. For example, Aslli et al. (2022) implemented a project-based strategy that supported the development of transversal competencies and environmentally responsible thinking.

What variables were used to evaluate the impact of these programs?

Most studies evaluated attitudes toward insects, pro-environmental intentions, knowledge, and interest in entomology. Additionally, some research examined intrinsic motivation, classroom climate, and learning perspectives. Assessment tools included Likert-scale questionnaires, semantic differential scales, semi-structured interviews, and direct observations.

What effects were observed following the implementation of the programs?

All the studies included in this review reported positive effects as a result of implementing the environmental education programs. Specifically, research that evaluated interest in insects showed significant short- and long-term improvements, and overall attitudes toward insects shifted in a positive direction.

With regard to environmentally responsible behavior toward insects and nature, the results were mixed. Some studies observed no significant changes across evaluation stages (pre-test, post-test, retention test), while others reported immediate positive effects that diminished over time. These findings suggest that maintaining positive outcomes requires recurring interventions and reinforcement strategies.

2.1.3. Conclusions

This study highlights the effectiveness of environmental education programs in improving students' attitudes toward insects by increasing knowledge, managing emotions, and providing direct experiences. Short-term interventions conducted in schools and focused on the emotional component proved effective in raising interest and shifting attitudes. However, the effects on

environmentally responsible behavior toward insects and nature were uneven and more difficult to sustain over the long term.

Hands-on activities and innovative methods, such as project-based learning or educational games, significantly enhance student engagement—especially when adapted to their age group. Collaboration between entomologists and educators is essential for developing balanced and effective programs. However, it is important to note that the analysis was limited by the exclusion of studies for which full-text access was restricted, which may have led to the omission of relevant research.

2.2. STUDY II: Quantitative Study – Exploring the Perceptions, Needs, and Educational Challenges Related to Teaching about Insects and Their Conservation among Primary School Teachers and Biology Educators

2.2.1. Introduction

The primary aim of this research is to analyze the perceptions (opinions), attitudes, level of preparedness, and needs of teaching staff (primary school teachers and biology teachers) regarding the teaching of insects and their conservation in the context of environmental education. The study seeks to identify both internal and external barriers that influence the integration of this topic into the educational process, as well as the resources and strategies considered necessary to optimize teaching practices.

Additionally, the research aims to explore the extent to which personal experiences with insects, professional training, and teaching status (primary teacher vs. biology teacher) are associated with teachers' comfort level, frequency of addressing this topic, and educational goals pursued in lessons related to insects and their conservation.

Research objectives

1. To assess the level of knowledge and initial training of teachers regarding insects and their conservation.
2. To investigate attitudes and perceptions toward insects and their perceived impact on educational activities.
3. To identify internal and external barriers that, from the participants' perspective, limit the teaching of insect-related topics.
4. To determine the types of educational resources perceived as useful or necessary in this process.
5. To analyze differences between teacher groups (primary vs. biology teachers) in terms of their approach to insect-related topics.

2.2.2. Materials and Methods

Research instrument

The study adopted a non-experimental quantitative design, with a correlational and predictive approach. Data were collected through a structured questionnaire specifically developed for this research, based on a review of the specialized literature. The instrument included 20 items, organized into five sections:(1) demographic data and professional background; (2) personal relationship with insects; (3) knowledge and skills related to teaching about insects; (4) educational resources and needs; (5) educational objectives and pedagogical practices. The questionnaire was validated by consulting experts in biology, ecology, educational sciences, and psychology to ensure the relevance and accuracy of the items in exploring attitudinal, cognitive, and behavioral dimensions.

Sampling procedure

A non-probability convenience sampling method was used, based on voluntary self-selection. The questionnaire, distributed online via Google Forms between November 2024 and January 2025, was disseminated through both informal channels (snowball sampling) and with the support of County School Inspectorates and university staff. Participation was voluntary, and confidentiality and anonymity were guaranteed through informed consent. Although this method does not allow for statistical generalization, it is appropriate for the exploratory objectives of the study.

Study participants

The target population included teachers who may cover insect-related topics in their teaching activities—specifically, biology teachers and primary school teachers. The study was conducted on a sample of 178 teachers from 13 counties in Romania. The mean age of participants was 39.05 ± 12.68 years.

Data analysis

Statistical data analysis and visualization of distributions were conducted using Python 3.8 (Van Rossum & Drake, 2009), along with the Pandas (McKinney, 2010), NumPy (Harris et al., 2020), and SciPy (Virtanen et al., 2020) libraries. Graphs were generated using the Matplotlib library (Hunter, 2007).

2.2.3. Results and discussion

The sample consisted of 178 teachers, including 119 biology teachers and 59 primary school teachers. Demographically, most respondents spent their childhood in rural areas, with a higher proportion among primary teachers (57.6%) compared to biology teachers (47.1%). In terms of age distribution, biology teachers were predominantly in the 45–54 age group (49.6%), while primary teachers showed a more balanced distribution, including a significant proportion of younger participants under 25 years old (28.8%).

Geographically, the sample covered 13 counties, with a strong concentration in the northwest of Romania, particularly in Maramureș County (60% of the total), followed by Satu Mare. Regarding academic background, the majority of respondents held degrees in biology and biochemistry (66.3%), reflecting the proportion of biology teachers in the sample. This was followed by the field of educational sciences (26.4%), with other areas being marginally represented.

Teachers' relationship with insects

An analysis of attitudes toward insects revealed significant differences between the two professional groups. Biology teachers predominantly expressed a positive attitude (60.5%), while primary teachers more frequently reported neutral attitudes (45.8%) and less often positive ones (37.3%) (Figure 1). The t-test ($t = 2.92$, $p = 0.004$) indicated a statistically significant difference, suggesting that professional specialization influences perception of insects.

Clear differences also emerged regarding the self-reported level of comfort in the presence of insects. 58.8% of biology teachers felt very comfortable, compared to 39% of primary school teachers, indicating greater familiarity with the subject among those with a biology background (Figure 2).

Attitude analysis via multiple linear regression

The multiple linear regression model showed that attitudes toward insects were significantly influenced by the frequency of direct interaction ($\beta = 0.15$, $p = 0.004$) and general knowledge level ($\beta = 0.33$, $p = 0.002$). Teachers who interacted more frequently with insects and possessed stronger knowledge tended to express more positive attitudes. In contrast, variables such as occupation, age, childhood environment, and education level did not show a significant impact ($p > 0.1$). The model accounted for 17.9% of the variance in attitudes ($R^2 = 0.179$), highlighting the central role of direct experience and knowledge in shaping positive perceptions of insects.

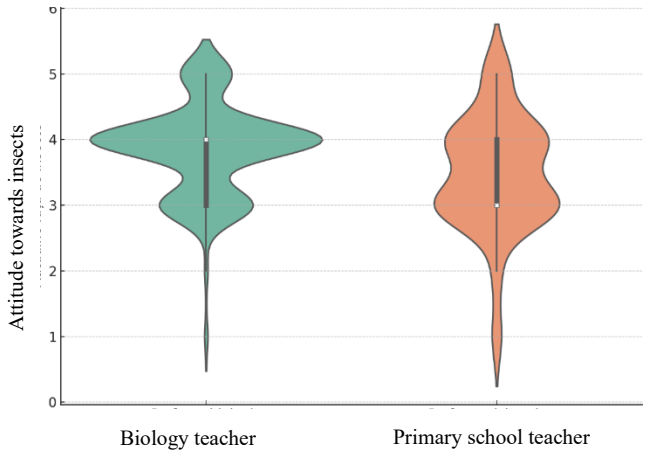


Figure 1. Distribution of attitude scores towards insects for biology teachers and primary school teachers.

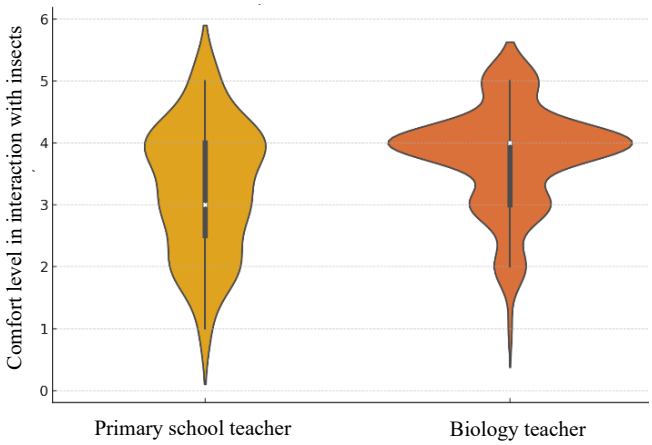


Figure 2. Distribution of scores regarding the comfort level in interaction with insects between the two categories of teachers.

Prediction of teaching behavior

The logistic regression model revealed several factors that significantly influenced the likelihood of teaching about insects (Figure 3). These included: education level (coef. = 0.93, p = 0.009), general knowledge about insects (coef. = 1.02, p = 0.031), specific knowledge score (coef. = 1.70, p = 0.006), total score of perceived barriers (coef. = 0.12, p = 0.040), and years of teaching experience (coef. = 0.39, p = 0.011). Variables related to pedagogical knowledge (p = 0.128) and attitude toward insects (p = 0.876) were not significantly associated with teaching behavior. The model yielded a Pseudo R^2 (McFadden) of 0.217, indicating a good fit for behavioral data and was statistically significant overall ($p < 0.00001$).

In contrast to the findings of Wagler & Wagler (2011, 2012), which indicated a negative relationship between attitudes toward invertebrates and intention to teach, our results show that a favorable attitude toward insects does not significantly influence teaching behavior. This suggests that a positive attitude, while helpful, is not sufficient without a solid theoretical and pedagogical foundation. In line with Kim and Fortner's (2006) conclusions, our respondents identified the lack of both theoretical and pedagogical knowledge as major barriers to teaching topics related to insects and their conservation.

2.2.4. Conclusions

This study provides an overview of teachers' perceptions, knowledge, and teaching practices related to entomological topics in the context of environmental education. The findings emphasize the central role of professional training, direct experience, and access to educational resources in supporting the teaching of insect-related content.

Regarding the determinants of teaching behavior, cognitive factors, particularly general and theoretical knowledge, proved to be the strongest predictors for integrating insect-related topics into teaching activities. Formal education level and teaching experience further reinforce this profile, suggesting that subject-matter expertise and years in the profession significantly contribute to teachers' confidence in addressing complex topics. Unexpectedly, the perception of barriers did not have an inhibiting effect, but rather showed a positive association with teaching, indicating a higher level of awareness and engagement among active educators.

On the attitudinal level, the frequency of interaction with insects and the level of general knowledge emerged as key elements in shaping favorable perceptions. These results support the idea that familiarity and direct exposure help reduce emotional discomfort and foster a more balanced relationship with this group of organisms in terms of attitudes.

Overall, the study's conclusions support the need for systemic interventions that include: the development of contextualized educational resources, the adaptation of initial and continuing teacher training programs, and the promotion of a teaching culture that values lesser-known but essential ecological topics. Insects, through their diversity and crucial ecological roles, can become a valuable educational tool for cultivating genuine ecological awareness, provided that educators are adequately supported in this endeavor.

2.3. STUDY III: Qualitative Study – Development of an Interdisciplinary Educational Program Dedicated to Insect Conservation for Primary School Students

2.3.1. Introduction

The purpose of this study is to design and develop an educational program (including curricular content and activity structure) in the field of environmental education, targeted at primary school students, with a specific focus on insect conservation. The proposed initiative aims to integrate pedagogical strategies for acquiring fundamental knowledge about insects and their ecological role, promoting behavioral change through practical activities, and fostering positive attitudes toward these organisms. In doing so, the program contributes to the development of students' responsibility for biodiversity protection and the maintenance of ecological balance.

2.3.2. Proposed Educational Framework

The field of environmental education already benefits from numerous methodological recommendations (Biedenweg, 2007; Khademi-Vidra, 2017; Thomas, 2018; Tovar-Gálvez, 2021), intended to ensure coherence and effectiveness in the teaching-learning process. The proposed framework is based on an extended understanding of education as a practice oriented toward the development of attitudes, values, skills, motivation, knowledge, and behaviors needed to address environmental issues (Green & Baek, 2022).

In order to define the key competencies of the program, a rigorous analysis was conducted on several specialized environmental education guides (Athman & Monroe, 2001; Bakhtiar, 2016; Green & Baek, 2022), and the essential components were adapted to the specific context of insect conservation (see Table 1).

Table 1. Structure of the educational competences targeted within the insect conservation program

Insects' Conservation Competencies	Competencies Subcategories	Operational Objectives
Knowledge	K1: Insect Biology and Diversity	K1.O1. Understand the basic anatomy, life cycles, and behaviors of insects. K1.O2. Explore the diversity of insect species and their ecological roles. K1.O3. Learn about the importance of insects in pollination, decomposition, and food chains.
	K2: Insect Habitats	K2. O1. Study the different habitats where insects thrive, such as forests, meadows, and water bodies.
Skills	S1: Insect Identification	S1.O1. Develop skills to recognize and differentiate common insect species. S1.O2. Use field guides, magnifying lenses, and observation techniques to identify insects. S1.O3. Learn to classify insects based on their physical characteristics.
	S2: Scientific Observation and Data Collection	S2.O1. Practice observing insects scientifically and documenting their behavior and interactions.
Attitudes	AT1: Appreciation and Respect for Insects	AT1.O1. Cultivate a sense of wonder and appreciation for the beauty and diversity of insects. AT1.O2. Promote ethical behavior towards insects, including responsible handling and release.
Actions	A1: Habitat Preservation and Enhancement	A1. O1. Engage in activities that promote habitats suitable for insects, such as creating insect-friendly gardens or building insect shelters. A1.O2. Engage in friendly practices that support insect populations, such as planting gardens that attract pollinators.

Structure of the educational program on insect conservation for primary school students

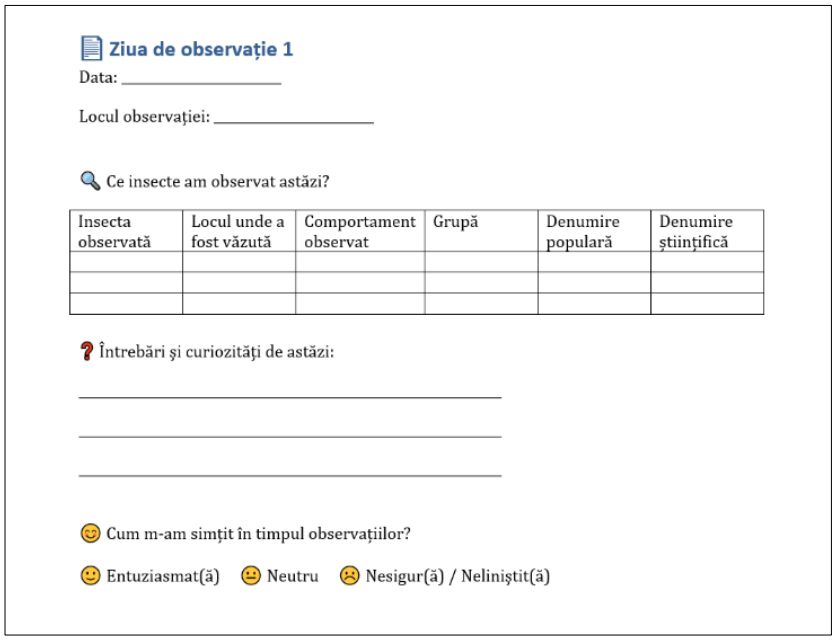
This program was specifically designed for third- and fourth-grade primary school students, but it can also be adapted and successfully used during biology or environmental education classes (optional subject) in fifth and sixth grades. The curriculum does not require any prior knowledge from students, as it begins with introductory concepts, followed by more specific information and practical activities. The content provides a clear and accessible introduction to the world of insects and the challenges of their conservation.

Structured into three thematic modules delivered over the course of three consecutive weeks, the program aims to develop students' ecological competencies through experiential learning and direct involvement in conservation activities. The main goal is to foster a positive attitude toward insects and stimulate students' intention to protect them as a foundation for environmentally responsible behavior. Implementation is recommended during the warmer seasons (spring–summer) to facilitate direct observation of insects in the nearby natural environment.

Below is an example of an educational module from the proposed program, focusing on identifying and exploring insect diversity, designed for primary school students.

Sample Educational Module from the Proposed Program: Module 1 – Identifying Insects and Their Diversity

Module 1 is dedicated to introducing primary school students to insects, focusing on the recognition of basic characteristics, classification of main insect groups, and understanding their role in nature. The activities are designed to convey fundamental concepts in an accessible way, without requiring any prior knowledge. Throughout the module, students complete the "Little Entomologist's Journal" (Figure 3), a reflection and learning tool that encourages observation and the formulation of their own questions.



📄 **Ziua de observație 1**

Data: _____

Locul observației: _____

🔍 Ce insecte am observat astăzi?

Insecta observată	Locul unde a fost văzută	Comportament observat	Grupă	Denumire populară	Denumire științifică

❓ Întrebări și curiozități de astăzi:

_____

_____

_____

😊 Cum m-am simțit în timpul observațiilor?

🙂 Entuziasmat(ă) 😐 Neutru ☹️ Nesigur(ă) / Neliniștit(ă)

Figure 3. Structure of a worksheet from *The Little Entomologist's Journal*

The first lesson introduces students to basic concepts about insects and their classification, using visual materials, identification guides, and, where possible, physical insect collections. The teacher may collaborate with entomologists or specialized organizations to enrich the content and provide scientific support.

The second lesson involves an outdoor activity, during which students observe insects in their natural habitat and record behaviors, morphological traits, and contextual information in their journal. These observations may be complemented by the temporary collection of specimens, in full respect of biodiversity conservation principles.

The third lesson is dedicated to the insect life cycle and includes a hands-on activity in which students create an interactive visual aid (the "life cycle wheel") (Figure 4). Students build a visual

model that allows for the step-by-step exploration of insect development, reinforcing the concepts of complete and incomplete metamorphosis. This activity supports active learning, logical thinking, and the transfer of knowledge to applied contexts.

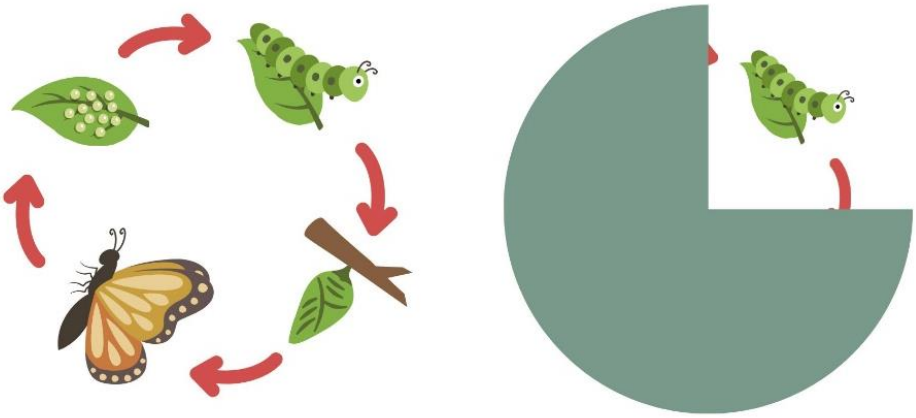


Figure 4. Interactive teaching model for representing the butterfly's life cycle

By combining theoretical, experiential, and creative components, the module contributes to the development of positive attitudes toward insects and nature, as well as to the formation of essential competencies for early ecological literacy.

2.3.3. Conclusions

The proposed educational framework offers an integrated approach to environmental education, with insect conservation as its central theme. Adapted to the primary education level, the program combines theoretical and practical components designed to stimulate curiosity, develop scientific competencies, and promote positive ecological attitudes.

By combining knowledge about insect biology with direct observation and personal reflection activities, students gain a deeper understanding of the role insects play in ecosystems and the importance of protecting them. The adoption of this framework by educators can serve as a valuable tool for fostering a harmonious relationship between students and nature, encouraging active engagement in biodiversity conservation from the early years of schooling.

2.4. STUDY IV: Quantitative Study – Cognitive and social mechanisms associated with insect conservation: an integrated approach based on The Theory of Planned Behavior and The Value-Belief-Norm Theory

2.4.1. Introduction

The main objective of this study is to identify and analyze the predictors of responsible behavior toward insects among a sample of participants from Romania. To achieve this goal, the research aims to investigate both individual and contextual factors that influence ecological behaviors, as well as the psychosocial mechanisms involved in adopting responsible behavior toward insects.

Study Objectives

1. To analyze attitudes toward insects based on individual and contextual factors.
2. To investigate the level of knowledge about insects and identify the factors that influence it.
3. To analyze perceived barriers to adopting responsible behavior, based on demographic variables.
4. To analyze the role of behavioral intention as a mediating variable between attitudes, subjective norms, perceived behavioral control, moral norms, and responsible behavior toward insects.
5. To explore the cognitive and attitudinal mechanisms (ecological beliefs, awareness of consequences, and personal responsibility attribution) through which biospheric values influence the formation of moral norms related to insect protection.

Study Hypotheses

In line with established theoretical models from environmental behavioral psychology, particularly the Theory of Planned Behavior (Ajzen, 1991) and the Value-Belief-Norm Theory (Stern et al., 1999), and drawing from relevant empirical studies in the literature (Gkargkavouzi, Halkos & Matsiori, 2019; Knapp et al., 2021), the following research hypotheses were formulated to explore the relationships among knowledge about insects, attitudes, perceived barriers, and pro-conservation behaviors:

Hypothesis 1: Behavioral intention is expected to mediate the relationship between perceived subjective norms and responsible behavior toward insects.

Hypothesis 2: Behavioral intention is expected to mediate the relationship between perceived behavioral control and responsible behavior toward insects.

Hypothesis 3: Behavioral intention is expected to mediate the relationship between internalized moral norms and responsible behavior toward insects.

Hypothesis 4: Behavioral intention is expected to mediate the relationship between attitudes toward insects and responsible conservation behavior.

Hypothesis 5: Biospheric values are expected to influence moral norms regarding insect protection through ecological beliefs, awareness of the negative consequences of human actions, and the attribution of personal responsibility.

2.4.2. Materials and methods

Research instrument

The study employed a non-experimental quantitative design, using a correlational and predictive approach. Data collection was carried out using a structured questionnaire, adapted from instruments used in two relevant studies:

- Gkargkavouzi, Halkos, and Matsiori (2019) – who operationalized the constructs of the Theory of Planned Behavior (TPB) and Value-Belief-Norm (VBN) Theory to explain pro-environmental behavior in a specific sociocultural context (Greece);
- Knapp et al. (2021) – who developed a TPB-derived instrument focused on pollinator conservation in the United Kingdom.

Sampling procedure

A non-probability convenience sampling method was used, based on voluntary self-selection. The questionnaire was distributed online via Google Forms between November 2024 and January 2025, using informal channels (i.e., snowball sampling). Participation was voluntary, with confidentiality and anonymity guaranteed through informed consent. While this method does not allow for statistical generalization, it is appropriate for the exploratory aims of the study.

Study participants

The study sample consisted of 346 respondents. The majority identified as female (n = 250; 71.4%), followed by male participants (n = 89; 25.4%). A small number of respondents (n = 7; 2.0%) identified as another gender or preferred not to disclose their gender identity.

Data analysis

Statistical analysis and visualization of distributions were conducted using Python 3.8 (Van Rossum & Drake, 2009) in conjunction with the Pandas (McKinney, 2010), NumPy (Harris et al., 2020), and SciPy (Virtanen et al., 2020) libraries. Graphs were generated using the Matplotlib library (Hunter, 2007). To investigate the psychosocial mechanisms underlying responsible behavior toward insects, mediation analyses were conducted using PROCESS macro v5.0 developed by Hayes (2024) in SPSS v29.

The following paragraphs present and summarize the essential results of the study, which focus on attitudes, knowledge levels, and the key predictors of responsible behavior toward insects among respondents. Additional findings are available in the extended version of the thesis.

2.4.3. Results and Discussion

Attitudes toward insects

The Pearson correlation coefficient analysis revealed a moderate positive relationship between the total insect knowledge score and the mean attitude score toward insects, $r(344) = 0.48$, $p < .001$. This association suggests that a higher level of general knowledge about insects is correlated with more favorable attitudes toward their protection (Figure 5).

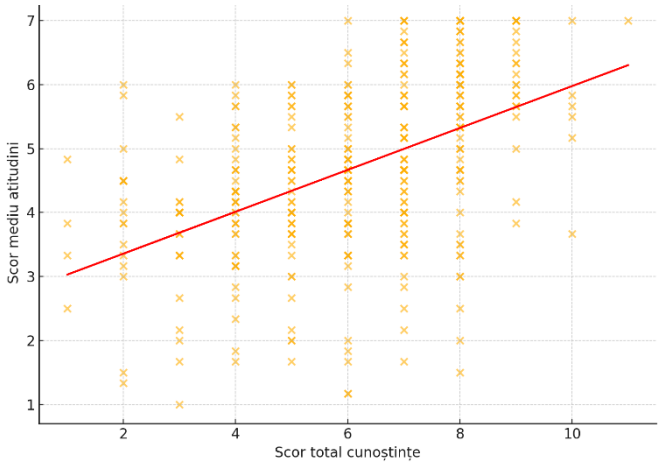


Figure 5. The relationship between the level of knowledge about insects and attitudes towards their protection

Assessment of insect-related knowledge

A detailed analysis of the distribution of correct and incorrect responses for each item (Figure 6) revealed significant differences in participants' levels of knowledge. The highest number of correct answers was recorded for items related to the ecological role of insects and the threats facing pollinator species, such as bees. In contrast, questions targeting common misconceptions—such as the belief that there are only two species of bees or that beekeeping alone can reverse the insect decline—generated a high number of incorrect responses, suggesting the persistence of myths in participants' perceptions.

Additionally, items that assessed knowledge about insect-friendly individual behaviors (e.g., the belief that giving sugar water to bees can help stop their decline) resulted in a high level of uncertainty among respondents. This finding highlights the need for information campaigns and public awareness initiatives that deliver clear, accurate, and accessible messages. The literature on biodiversity conservation documents the knowledge–action gap (Kollmuss & Agyeman, 2002, cited in Knapp et al., 2021), defined as the discrepancy between environmental knowledge and actual behavior. This gap is also reflected in the current study, where—despite a generally

satisfactory level of knowledge about insects—understanding of concrete conservation actions remains limited.

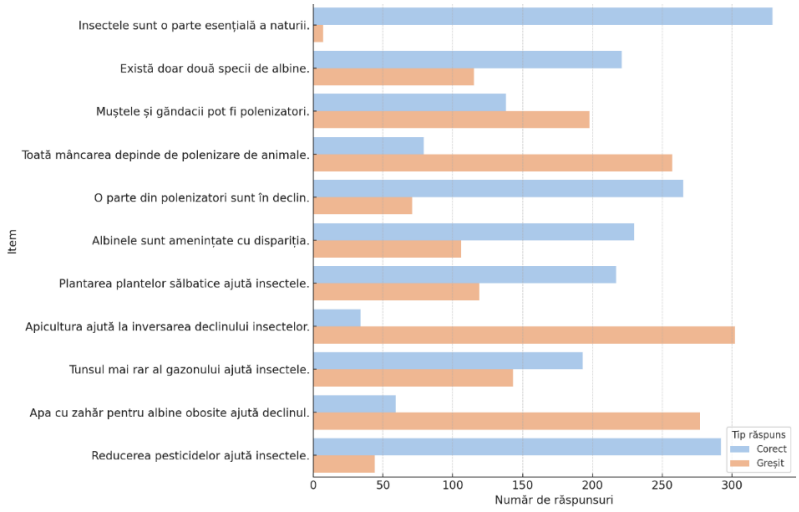


Figure 6. Distribution of correct and incorrect responses for each item in the knowledge scale

Simple and serial multiple mediation relationships between psychosocial predictors and responsible behavior toward insects

The mediation analysis revealed that behavioral intention plays a central role in explaining responsible behavior toward insects. The tested simple mediation models showed that variables such as subjective norms, perceived behavioral control, moral norms, and attitudes toward insects significantly influenced the reported behavior—both directly and indirectly through intention. In all cases, behavioral intention demonstrated a strong predictive effect, confirming the theoretical assumption that intention is a major determinant of ecological behavior (Fishbein & Ajzen, 2010).

Moreover, the serial multiple mediation model demonstrated that biospheric values influence moral norms through a cognitive and attitudinal chain mediated by ecological beliefs, awareness of consequences, and attribution of personal responsibility. This structure of relationships supports the validity of combining the TPB and VBN models, offering a comprehensive perspective on the psychosocial mechanisms involved in the formation of pro-conservation behaviors. The results highlight the importance of integrating cognitive, value-based, and normative components in promoting informed ecological action.

2.4.4. Conclusions

This study investigated the relationships among knowledge about insects, attitudes toward them, perceived barriers, and pro-conservation behaviors, within an integrated theoretical framework based on the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) Theory. To

our knowledge, this is the first empirical study conducted in Romania to examine the human–insect relationship through these internationally validated theoretical models, applied to a general population sample.

The results clearly support the central hypothesis that higher levels of knowledge are positively associated with more favorable attitudes toward insects, a finding consistent with previous literature (Schlegel et al., 2015; Knapp et al., 2021). Furthermore, the multiple regression analysis confirmed that, beyond knowledge, factors such as age, gender, naturalist identity, and emotional connection to nature significantly contribute to predicting attitudes toward insects.

Although respondents demonstrated a moderate level of general knowledge, their knowledge of specific insect-friendly behaviors was considerably lower. This discrepancy points to the existence of a knowledge–action gap (Kollmuss & Agyeman, 2002), where the intention to act ecologically does not automatically translate into actual behavior, particularly in the absence of clear and accessible information.

The tested mediation models confirmed the validity of integrating TPB and VBN theories in explaining pro-conservation behavior. Behavioral intention mediated the relationship between attitudes, norms, perceived control, and behavior, supporting the conclusions formulated by Fishbein & Ajzen (2010) and expanded upon by researchers such as Stern (2000) and Steg et al. (2014). Additionally, the serial mediation model highlighted a coherent path of influence from biospheric values to moral norms, mediated by ecological beliefs and awareness of an important contribution to the literature on ecological behavior.

Overall, the study's findings suggest that improving attitudes and responsible behaviors regarding insects requires integrated educational approaches focused not only on knowledge transmission, but also on fostering ecological identity and reducing perceived barriers.

2.5. STUDY V: Qualitative Study – Development of educational recommendations for promoting responsible behavior toward insects in the context of environmental education

2.5.1. Introduction

This study proposes the development of a set of educational recommendations aimed at strengthening environmental education and supporting the development of responsible behavior toward insects. These recommendations are grounded in the empirical findings obtained throughout the doctoral research and are further enriched by the author's professional experience and national and international collaborations. In addition, observations made during the author's research internship at the Valašsko Museum in Vsetín (Czech Republic) provided relevant examples of best practices regarding community involvement in biodiversity conservation. Furthermore, the author's professional activity as an ecological biologist and interactions with the

general public during volunteering at the Zoological Museum revealed significant gaps in public awareness regarding insect protection.

These insights, together with expertise exchanged with specialists in biology, education, and conservation, have served as the basis for formulating relevant and applicable proposals that can be adapted to a variety of educational and socio-cultural contexts.

The following paragraphs summarize a selection of the recommendations developed as part of this thesis. The full set of proposals can be consulted in the extended version of the dissertation.

Practices supporting insect conservation beyond regulatory frameworks: individual and community-based interventions

Creating insect-friendly green spaces

One of the causes of insect decline is habitat fragmentation. Green spaces, both public and private, are often regarded as "biodiversity deserts". Regularly mown lawns provide inadequate habitats for most insects. To address this issue, it is recommended to create more insect-friendly green areas. Transforming traditional lawns into insect habitats involves following specific principles, as outlined in the literature (The Xerces Society, 2011; Majewska & Altizer, 2020; Goulson, 2021; Kawahara et al., 2021).

Private gardens

Private gardens can be transformed into refuges for insects. To attract and support insect populations, it is essential to plant native species. Alongside ornamental plants like roses, tulips, and peonies, species such as lavender, thyme, mint, and flowering shrubs can be added (Goulson, 2021). To ensure the use of native species, one simple approach is to identify the nearest natural meadow, collect some seeds when mature, and disperse them in your garden. It is not necessary to transform the entire garden; creating a small patch for insects is often sufficient.

In addition to plant selection, maintenance practices are crucial for the conservation of insects and other animal species. Avoiding pesticides is essential to protect insect populations. In many regions of Canada, thanks to the efforts of dermatologist June Irwin (Pinker, 2001), over 90 types of pesticides have been banned from personal or public use. In Romania, however, there is currently no legal framework restricting pesticide use, leaving the responsibility to individual discretion. In this context, education plays a key role in raising awareness of the consequences of pesticide use for both insects and human health.

Other Strategies for Insect Protection

Beyond eco-friendly gardening and insect-conscious urban design, the literature proposes a series of complementary actions with a positive impact on insect conservation (Majewska & Altizer, 2020; Goulson, 2021; Kawahara et al., 2021), including:

- Purchasing eco-certified products made through sustainable practices with minimal ecological impact.
- Responsible consumption, which involves reducing waste, choosing local, reusable or recyclable products, and avoiding single use items.
- Reducing light pollution, which affects nocturnal insects, by limiting artificial lighting and using environmentally adapted light sources.

Furthermore, active involvement in promoting the importance of insects within one's immediate circle can have a powerful multiplier effect. As Goulson (2021) emphasizes, social mobilization can begin with simple conversations with family and friends, sparking a wider dissemination of ecological values within the community. Through daily actions and collective awareness, a favorable environment for insect protection and biodiversity conservation can be built.

CHAPTER III: DISCUSSION AND CONCLUSIONS

3.1. Introductory considerations

The overarching aim of this doctoral research was to develop a coherent and applicable educational framework for insect conservation, primarily designed for primary education, but adaptable for lower secondary levels as well. The research stemmed from the urgent need to integrate this topic into formal environmental education, against the backdrop of growing global concern about biodiversity loss and the critical role of insects in maintaining ecosystem balance.

The first objective of the research was to analyze educational programs dedicated to insect conservation implemented both nationally and internationally in pre-university education. The analysis focused on the pedagogical strategies employed, the proposed content, the educational goals, and the assessment methods used in these initiatives.

The second objective was to identify the needs and challenges faced by Romanian pre-university teachers in teaching about insects and their conservation. Simultaneously, the study sought to assess teachers' knowledge levels and attitudes toward this subject. In the Romanian context, interest in environmental education has grown since the country joined the European Union in 2007, prompting critical reflection on the current tools available within the educational system to support this type of learning. Key questions arise: To what extent does the Romanian educational system have the material and human resources necessary for the effective integration of environmental education focused on insect conservation? Are teachers sufficiently trained to address complex topics related to biodiversity?

Building on these two lines of inquiry, the third objective was to design a curriculum dedicated to insect conservation, suitable for primary education but with the potential for adaptation to grades five and six. One essential question in the context of formal environmental education is: When is the optimal time to introduce a complex topic? Drawing on the learning theories discussed in this thesis, one can argue that while students' cognitive level is an important consideration, it should not be a limiting factor. With appropriate methods and age-adapted content, any topic, no matter how complex, can be introduced from early primary grades. In the case of insect-related topics, the focus of environmental education is on initiating and cultivating responsible behavior, with

attitudes playing a key role in this process. Given that attitudes are still forming during primary school, early intervention can significantly increase the likelihood of developing positive and lasting environmental behaviors.

The fourth objective involved the identification, adaptation, and validation of an assessment tool for responsible behavior toward insects. This tool was intended to allow the analysis of attitudes, knowledge, and psychosocial mechanisms involved in shaping such behavior. Based on internationally validated models of general ecological behavior and human–pollinator relationships, the instrument developed in this study was adapted to the Romanian educational context.

Finally, based on the data gathered throughout the research, the fifth objective focused on developing a set of concrete educational recommendations aimed at promoting responsible environmental behavior and insect conservation. These recommendations were tailored to the specific characteristics of the Romanian educational system and emphasize an integrated, collaborative, and practical approach to environmental education.

3.2. Theoretical Contributions

This research makes a significant contribution to the development of the theoretical framework for insect-centered environmental education by integrating psychological, educational, and social perspectives into a coherent model for understanding responsible ecological behavior. By applying well-established behavioral theories, such as the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) Theory, in the Romanian context, this work contributes to the validation and contextual adaptation of these models to Romania's specific socio-cultural and educational landscape.

A key contribution of the research lies in clarifying the complex relationships between cognitive, attitudinal, and contextual dimensions involved in shaping ecological behavior toward insects. The studies conducted have shown that a higher level of knowledge about insects is positively associated with the development of favorable attitudes and increased intentions to adopt pro-conservation behaviors. While these findings are consistent with international literature, their local contextualization in the Romanian educational and social environment provides a strong empirical foundation for adapting educational interventions accordingly.

A distinctive feature of this thesis is the comparative analysis of perceived barriers to insect conservation among teachers and the public. Among teachers, the main barriers, such as lack of specialized knowledge, insufficient adapted resources, and time constraints, act as obstacles to teaching, but can also be seen as indicators of active engagement and heightened awareness of the need for educational interventions. In contrast, for the public, these same barriers tend to have a predominantly inhibiting effect, particularly among youth, individuals with lower incomes, and those with lower levels of education. This comparison significantly enhances the understanding of the "knowledge–action gap", offering valuable insights for targeted interventions.

Moreover, the research emphasizes the urgent need to develop educational resources tailored to the Romanian context. At present, the Romanian educational environment faces a major challenge in the absence of materials adapted to national specificities, local biodiversity, and cultural realities. Most materials available in Romanian are either translations of international guides or

academic works that are largely inaccessible to the general public, limiting the relevance and impact of environmental education in schools. This research underscores the importance of incorporating native biodiversity and the particularities of Romania's five biogeographical regions (Continental, Alpine, Pannonian, Pontic, and Steppe) in the development of relevant and effective educational materials. The introduction of such resources, such as adapted textbooks, interactive worksheets, and digital platforms, is vital for increasing student engagement and interest in environmental conservation issues.

In this context, an important theoretical contribution is the proposal of an integrated educational framework, tailored to primary education, which combines theoretical content, hands-on activities, and personal reflection. This model supports the development of ecological awareness from an early age and provides a practical foundation for future educational interventions.

This thesis may be regarded as a preliminary step toward the design of adapted educational programs to support teachers interested in integrating entomological topics into their instruction. It may also serve as a starting point for public awareness initiatives, by proposing locally grounded, easily implementable actions within a variety of educational contexts.

3.3. Methodological contributions

This research brings significant methodological contributions to the field of environmental education through the diversity and coherence of the scientific approaches integrated into the five studies. Each study was built on a solid theoretical foundation, provided by the literature review conducted using the scoping review method in Study 1, and was designed to address specific needs related to investigation, intervention, and educational recommendations in the context of insect conservation education in Romania.

Study 2 stands out through the development and validation of an original instrument, a structured questionnaire with five dimensions, designed to explore teachers' perceptions, needs, and perceived barriers regarding insect-related teaching. The comparison between two distinct professional groups (primary school teachers and biology teachers) provides a differentiated and replicable perspective on didactic practices and ecological education training.

Study 3 provides an applied methodological contribution through the design of an integrated educational framework for the primary level, structured around four core dimensions of ecological literacy: knowledge, skills, attitudes, and actions. The program includes experiential activities and original materials, such as the Little Entomologist's Journal, which serves as a pedagogical tool for scientific documentation and personal reflection. The modular structure, seasonal implementation, and grounding in direct observational learning contribute to a replicable model with potential for adaptation to other educational areas.

Study 4 offers valuable methodological input through the integration of two internationally validated behavioral theories, the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) Theory, within a unified analytical framework. The adaptation of international questionnaires to the Romanian cultural context, the expert validation, and the use of advanced analysis methods (mediation and serial mediation) allow for a comprehensive understanding of the psychosocial mechanisms driving pro-conservation behavior.

Study 5 contributes methodologically by reinforcing a research, action approach, in which empirical findings are complemented by professional practice observations, international case studies, and interdisciplinary expertise. The formulation of educational and community-based recommendations is grounded not only in quantitative data but also in experiences derived from direct collaboration with institutions, NGOs, and communities involved in insect conservation.

Taken together, the research proposes an integrated and adaptable methodological model that combines validated quantitative instruments, applicative educational planning, and mechanisms for translating scientific findings into practical solutions. This inter-, multi-, and transdisciplinary approach strengthens the foundations for relevant ecological research, with replication potential and scalability to other educational and cultural contexts.

3.4. Empirical and practical contributions of the research

At the empirical level, this research provides a detailed mapping of teachers' perceptions and perceived barriers in teaching insect-related topics, offering clear evidence of the influence of knowledge, experience, and professional status on educational behavior (Study 2). Additionally, through the testing and validation of an educational program for primary school students, the thesis offers a concrete example of a structured pedagogical intervention, focused on the development of ecological literacy and the cultivation of responsible behaviors toward insects (Study 3).

Study 4 broadens the scope of contributions by applying an integrated framework based on the Theory of Planned Behavior (TPB) and the Value-Belief-Norm (VBN) Theory, providing a rigorous explanatory model of pro-conservation behavior in the general population. This represents the first time in Romanian academic literature that the relationship between biospheric values, attitudes, intention, and behavior toward insects has been systematically analyzed. The results offer a solid foundation for educational and public communication interventions tailored to perceived barriers and the cognitive and emotional profiles of individuals.

On a practical level, the research stands out for the development of a coherent set of educational and community-based recommendations (Study 5), grounded in both empirical evidence and the author's professional experience, as well as examples of international best practices. These recommendations propose feasible and adaptable actions, ranging from creating insect-friendly green spaces in schoolyards and private gardens to strategies for reducing light pollution and engaging local communities in the conservation of umbrella species.

Notably, the research contributes to bridging the gap between intention and action in insect protection by offering concrete educational and community-level solutions, applicable in both formal and non-formal contexts. By promoting active citizen involvement, from students and teachers to urban and rural residents, this work puts forward an integrated vision of environmental education, where behavioral change is supported by knowledge, direct experience, and community support.

In summary, the practical and empirical contributions of this research not only directly support the development of an authentic ecological consciousness but also provide concrete tools for transforming environmental education into a practical, sustainable, and locally adapted endeavor.

3.5. Limitations of the Studies

Although this doctoral research brings a relevant contribution to the understanding of environmental education focused on insect conservation and proposes applicable solutions in educational and community contexts, it is important to acknowledge certain methodological and conceptual limitations that may influence the interpretation and generalization of the results.

Regarding Study 1, which involved a scoping review analysis, the rigorous selection process led to the inclusion of a small number of studies (9 in the field of education and 11 in entomology) out of an initial total of over 9,500 identified results. It is possible that some relevant educational programs were omitted following the application of inclusion criteria, which limits the exhaustiveness of the theoretical synthesis carried out.

Study 2, conducted on a sample of 178 teachers, mostly from the counties of Maramureș and Satu Mare, provides a regionally contextualized perspective, but does not represent the national situation. In order to substantiate an educational program with wide applicability in Romania, it would be necessary to extend the research to various regions, with different socio-educational contexts.

Study 4, although it generated valuable results regarding the relationships between knowledge, attitudes, perceived barriers, and pro-conservation behaviors, is limited by its cross-sectional design, which only allows for the identification of associations and does not allow firm causal inferences.

The representativeness of the general sample (N = 346) is also limited for certain socio-demographic categories, such as elderly people, residents of isolated rural areas, or those with low educational level, who were underrepresented. Consequently, extending the conclusions to the entire Romanian population should be done with caution.

Overall, these limitations do not diminish the value of the results obtained but provide a necessary critical framework for nuanced interpretation of the conclusions and for outlining future research directions that can consolidate and validate the proposed model.

3.6. Future Research Directions

Starting from the methodological and contextual limitations of the present research, several relevant directions are outlined for the extension and deepening of studies on environmental education and insect conservation:

1. Integration of qualitative methods: To complement the predominantly quantitative dimension of this thesis, future research could include semi-structured interviews, focus groups, or visual methods (e.g., the Photovoice method) that allow for an in-depth exploration of the perceptions, emotions, and motivations of educational actors in relation to insects.

2. Geographic expansion and sample diversification: To ensure better national representativeness, future studies should include participants from all regions of Romania, with a focus on isolated rural areas, vulnerable socio-economic groups, or those with low levels of education. This extension is essential for validating and adapting educational resources to the diverse realities of the Romanian system.

3. Application of experimental and longitudinal designs: Considering the limitations of the cross-sectional designs used, future research could test the impact of the proposed educational interventions through experimental studies (e.g., with control group and pre-/post-test) or longitudinal research that would follow over time the evolution of attitudes and pro-conservation behaviors toward insects.

4. Validation of the educational program in real learning contexts: The curricular program intended for primary education proposed in Study 3 needs empirical validation through pilot implementation in schools. The evaluation of its impact on competencies, attitudes, and student behaviors would offer additional evidence regarding the efficiency of the proposed model.

5. Testing of complex theoretical models (e.g., SEM): For a deeper understanding of the relationships between the TPB and VBN constructs, future research could use structural equation models (SEM), applied to large samples ($N > 1000$), which would allow simultaneous testing of direct, indirect, and mediated relationships between variables.

3.7. Final Conclusions

This research offers a complex and interdisciplinary contribution in the field of environmental education, by focusing on insect conservation—a topic essential for ecosystem balance yet often marginalized in Romanian educational and ecological discourse. Through the five integrated studies, the thesis combines theoretical approaches, empirical investigations, and practical proposals, building a rigorous foundation for understanding and educational intervention related to this topic.

The results highlight a series of systemic and attitudinal challenges: the underrepresentation of insects in the curriculum, the lack of adapted resources, the low level of ecological literacy, as well as the perceived barriers by both teachers and the general public in adopting pro-conservation behaviors. At the same time, the research identifies key transformative factors, such as direct experience, knowledge level, community support, and involvement in practical activities with ecological relevance.

On a methodological level, the thesis contributes through the development and validation of instruments adapted to the Romanian context, through the integrated application of the TPB and VBN theories in explaining responsible behavior toward insects, and through the design of a replicable educational framework focused on four essential dimensions: knowledge, skills, attitudes, and actions.

From a practical perspective, the thesis offers concrete, scientifically documented solutions for teachers, educational institutions, NGOs, and authorities, by proposing structured educational activities, community recommendations, initiatives for creating insect-friendly green spaces, and civic engagement strategies. These proposals are anchored both in the realities identified through research and in the best international practices, observed and adapted to the local context.

Thus, this thesis stands not only as a scientific endeavor but also as an educational and civic call to reconfigure the relationship between humans and insects. In a time marked by accelerated biodiversity loss and global ecological crises, revaluing insects in public and educational consciousness can become a fundamental act of responsibility. By learning to know, appreciate,

and protect these organisms, education can contribute to shaping a new generation of empathetic, informed, and active citizens in support of nature conservation.

In conclusion, this research opens new directions for reflection and action, proposing a sustainable and contextualized educational model meant to bring humans closer to nature through science, empathy, and responsibility.

References

Actions for Insects. Accesat la data de 17.02.2024 pe https://www.actionsforinsects.com/help-insects.

Affolter, C. & Varga, A. (2018). *Environment and school initiatives: Lessons from the ENSI Network – past, present and future.* Vienna / Budapest: Environment and School Initiatives; Eszterházy Károly University. ISBN: 978-3-200-05834-7.

Aizen, M.A. & Harder, L.D. (2009). The global stock of domesticated honey bees is growing slower than agricultural demand for pollination. *Current Biology*, 19(11), pp.915–918.

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), pp.179–211.

Ajzen, I. (2011). Design and evaluation guided by the theory of planned behavior. *In: M.M. Mark, S.I. Donaldson & B.C. Campbell* (eds.) *Social psychology and evaluation.* New York: Guilford Publications, pp. 74–100.

Akeroyd, J. & Bădărău, S. (2012). *The High Nature Value Dry Grasslands of Southern Transylvania.* Produced by Fundația ADEPT Transilvania as part of EU LIFE+ Project LIFE09 NAT/RO/000618.

Aktepe, S. & Girgin, S. (2009). İlköğretimde eko-okullar ve klasik okulların çevre eğitimi açısından karşılaştırılması. *İlköğretim Online*, 8(2), pp. 401–414.

Aldabbus, S. (2018). Project-based learning: Implementation & challenges. *International Journal of Education, Learning and Development*, 6(3), pp. 71–79.

Al-Shuaibi, A. (2014). The importance of education. *Salalah College of Technology*.

Alyani, E. (2024). Teachers' perspective on addressing environmental issue in English language learning. *Loquen: English Studies Journal*, 17(2), pp. 19–34.

Andersen, H.V. & Koivula, M.J. (2019). Insect decomposition of cadavers—A protocol. In: R.K. Purchase, P. Vassallo & M.R. Wilkinson (eds.) *Forensic ecology handbook: From crime scene to court.* Wiley, pp. 241–256.

Anderson, C. & Jacobson, S. (2018). Barriers to environmental education: How do teachers' perceptions in rural Ecuador fit into a global analysis? *Environmental Education Research*, 24(12), pp. 1684–1696.

APIA. (2024). Accesat la data de 12.02.2025 pe https://apia.org.ro/

Awayehu Gugssa, M. (2024). Barriers to environmental education in Ethiopia: do they differ from a global analysis. *International Research in Geographical and Environmental Education*, 1–18. https://doi.org/10.1080/10382046.2024.2352285

Bajd, B. & Leščanec, T. (2011). The influence of the eco-school and healthy school projects on environmentally responsible behavior of primary school pupils. *Education and Health Care*, 21, pp.79–85.

Bandura, A. Ross, D., & Ross, S. A. (1961). Transmission of aggression through the imitation of aggressive models. *Journal of Abnormal and Social Psychology*, 63, 575-582

Bardgett, R.D. & van der Putten, W.H. (2014). *Belowground biodiversity and ecosystem functioning*. Oxford: Oxford University Press.

Barnosky, A.D., Matzke, N., Tomiya, S., Wogan, G.O., Swartz, B., Quental, T.B., Marshall, C., McGuire, J.L., Lindsey, E.L., Maguire, K.C. & Mersey, B. (2011). Has the Earth's sixth mass extinction already arrived?. *Nature*, 471(7336), pp.51-57.

Baumgartner, C. (2014). *Environmental education in protected areas along the Danube – report of the assessment tour*. Brussels, Belgium: European Union. Accesat la data 25.03.2025, pe https://danubeparks.org/sharepoint/public/1576503465_uploads.pdf

Bădărău, C. (2014). *Biodiversitatea în România. Repere pentru educația ecologică*. București: Editura Didactică și Pedagogică.

Bebbington, A. (2005). The ability of A-level students to name plants. *Journal of Biological Education*, 39(2), pp.63–67.

Bégouen, M.M. & Bégouen, L. (1928). Découvertes nouvelles dans la Caverne des Trois Frères à Montesquieu-Avantés (Ariège). *Revue Anthropologique*, 38, pp.358–364.

Bellon, A. M. (2019). Does animal charisma influence conservation funding for vertebrate species under the US Endangered Species Act?. *Environmental Economics and Policy Studies*, *21*(3), 399-411.

Benedek-Sîrbu, A.M., Filip, R. & Gheoca, A. (2016). *Îndrumar pentru educația ecologică în grădinițe*. Sibiu: Asociația pentru Protecția Animalelor și a Naturii ANIMAL LIFE. Accesat la data 25.03.2025, pe https://animallife.ro/

Biedenweg, K. (2007). A framework for environmental education strategies. *Applied Environmental Education & Communication*, 6(3–4), pp.205–216.

Biedenweg, K., Monroe, M.C. & Wojcik, D.J. (2013). Foundation of environmental education. In: M.C. Monroe & M.E. Krasny, eds. Across the spectrum: Resources for environmental educators. Florida: North American Association for Environmental Education, pp.7–16. Accesat la data 25.06.2024, pe http:///acrossthespectrum.pdf

Biriș, I.A. (2017). *Situația pădurilor virgine din România*. București: Greenpeace. Accesat la data 25.11.2024, pe https://www.greenpeace.org/

Bjerke, T., & Østdahl, T. (2004). Animal-related attitudes and activities in an urban population. *Anthrozoös*, 17(2), 109-129.

Boca, G.D., & Saraçli, S. (2019). Environmental education and student's perception, for sustainability. *Sustainability*, 11(6), 1553.

Bornemissza, G.F. (1979). The Australian Dung Beetle Research Unit of Pretoria. *South African Journal of Sciences*, 75: 257-260.

Bostan, C., Copăcean, L., Cojocariu, L., Pascu, M.S., Horablaga, A., Horablaga, M., Borlea, F., Dunea-Bănățean, I. & Agapie, A. (2020). Natural protected areas in the continental biogeographic region (Romania). *Research Journal of Agricultural Science*, 52(1), pp.51–60.

Bowker, R., & Tearle, P. (2007). Gardening as a learning environment: A study of children's perceptions and understanding of school gardens as part of an international project. *Learning Environments Research*, 10, pp.83-100.

Braund, M., & Reiss, M. (2006). Towards a more authentic science curriculum: The contribution of out-of-school learning. *International Journal of Science Education,* 28(12), 1373–1388. https://doi.org/10.1080/09500690500498419

Bruner, J., 1997. Celebrating divergence: Piaget and vygotsky. *Human development*, *40*(2), pp.63-73.

Buckler, C. & Creech, H. (2014). *Shaping the future we want: UN Decade of Education for Sustainable Development (2005–2014) – Final report*. Paris: UNESCO. Accesat la data 10.06.2024, pe https://unesdoc.unesco.org/ark:/48223/pf0000230171 .

Burgess, J., Harrison, C.M. & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A*, 30(8), pp.1445–1460.

Burland, C. (1975). *The Aztecs: Gods and fate in ancient Mexico*. London: Orbis Publishing.

Busse, M., Zoll, F., Siebert, R., Bartels, A., Bokelmann, A., & Scharschmidt, P. (2021). How farmers think about insects: perceptions of biodiversity, biodiversity loss and attitudes towards insect-friendly farming practices. *Biodiversity and conservation*, 30, 3045-3066.

Buxton, M. (1984). The influence of William James on John Dewey's early work. *Journal of the History of Ideas*, 45(3), 451-463.

Buzinschi, E. & Andon, C. (2004). *Formarea culturii ecologice elementare la copiii de vârstă preşcolară mare*. Chişinău.

Cardoso, P. (2012). Habitats Directive species lists: urgent need of revision. *Insect Conservation and Diversity*, 5 (2): 169-174.

Cardoso, P., Erwin, T.L., Borges, P.A., & New, T.R. (2011). The seven impediments in invertebrate conservation and how to overcome them. *Biological Conservation,* 144(11), 2647-2655.

Carlisle, A. (1972). The United Nations Conference on the Human Environment, Stockholm 1972. *The Forestry Chronicle*, 48(3), p.118.

Carroll, A. (1979). "A Three Dimensional Conceptual Model Of Corporate Performance". *Academy of Management Review*. 4(4), p.497-505.

Carter, R.L. & Simmons, B. (2010). The history and philosophy of environmental education. In: A.M. Bodzin, B.S. Klein & S. Weaver, eds. *The inclusion of environmental education in science teacher education*. Dordrecht: Springer Netherlands, pp.3–16.

Castillo-Huitrón, N.M., Naranjo, E.J., Santos-Fita, D., & Estrada-Lugo, E. (2020). The importance of human emotions for wildlife conservation. *Frontiers in Psychology*, 11, 1277.

Cawood, R. A., Samways, M. J., & Pryke, J. S. (2024). Umbrella index as a conservation tool across pondscapes: A case study using frogs, aquatic insects, and plants in South Africa. *Environmental and Sustainability Indicators*, 24, 100478.

Ceballos, G., Ehrlich, P. R., Barnosky, A. D., García, A., Pringle, R. M., & Palmer, T. M. (2015). Accelerated modern human–induced species losses: Entering the sixth mass extinction. *Science advances*, 1(5), e1400253.

Charoenca, N. (2023). Environmental Action is a Responsibility for a Viable Planet. *Thai Journal of Public Health*, 53(1), 326-332.

Chatzifotiou, A. (2001). *Primary school teachers' awareness of and motivation to teach environmental education in two European countries*. PhD thesis, Durham University. Accesat la data 10.06.2024, pe http://etheses.dur.ac.uk/4217/

Chawla L. & Cushing D. 2007. Education for strategic environmental behaviour. Environmental *Education Research*, 13(4): 437–452

Chawla, L. (2007). Childhood experiences associated with care for the natural world: A theoretical framework for empirical results. *Children Youth and Environments*, 17(4), 144-170.

Chen, M.L., Lou, S.J., & Shih, R.C. (2013). Effects of integrating garden-based learning and e-learning into life education. Life Science Journal, 10(2), 2037-2047.

Chowdhury, G.R., Datta, U., Zaman, S., & Mitra, A. (2017). Ecosystem services of insects. *Heart*, 17, 23.

Chung, A., & Rimal, R.N. (2016). Social norms: A review. *Review of Communication Research*, *4*, pp.1-28.

Cocoradă, E. (2010). *Introducere în teoriile învățării*. Iași: Polirom.

Cole, M. & Cole, S.R. (2001). *The development of children*. 4th ed. New York: Worth Publishers.

Colléony, A., Clayton, S., Couvet, D., Saint Jalme, M., & Prévot, A. C. (2017). Human preferences for species conservation: Animal charisma trumps endangered status. *Biological conservation,* 206, 263-269.

Condliffe, B. (2017). *Project-Based Learning: A Literature Review.* Working Paper. MDRC.

Copaci, I. (2018). *Rolul învățării orientate înspre comunitate în optimizarea pregătirii pedagogice și a responsabilizării sociale a studenților nativi digitali*. Teză de doctorat, Universitatea Babeș-Bolyai, Cluj-Napoca.

Council of Europe. (1979). *Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)*. Accesat la data 10.03.2025 pe https://bern-convention.

Council of the European Communities. (1992). Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. L 206, pp.7–50. Accesat la data 10.03.2025 pe https://faolex.fao.org/docs/pdf/eur34772.pdf .

Couvillon, M.J., Dornhaus, A., Bouchebti, S. & Fewell, J.H. (2014). Social complexity and nest architecture in the ant, *Aphaenogaster cockerelli*. *Behavioral Ecology and Sociobiology*, 68(11), pp.1671–1680.

Coyle, K. (2005). *Environmental literacy in America*. Washington, DC: National Environmental Education & Training Foundation.

Crane, E. (1999). *The world history of beekeeping and honey hunting*. London: Routledge.

Crane, E. (2005). *Bees and beekeeping: Science, practice and world resources*. Ithaca, NY: Comstock Publishing Associates.

Crane, E. (2007). *The buzz about bees: Biology of a superorganism*. Berlin: Springer Science & Business Media.

Creager, J.G. (1976). Why entomology? *American Science Teacher*, 38(4), p.203.

Cristea, M. & Cristea, V. (2008). *Educația ecologică în școala românească*. Pitești: Editura Paralela 45.

Crișan, A. (2020). *Ghid de ecoturism în situl Natura 2000 Dealurile Clujului de Est / Ecotourism routes in the Natura 2000 site "Eastern Cluj Hills"*. Cluj-Napoca: Presa Universitară Clujeană. ISBN: 978-606-37-0908-1.

Dannenberg, C.J., Hausman, B.L., Lawrence, H.Y. & Powell, K.M. (2012). The moral appeal of environmental discourses: The implication of ethical rhetorics. *Environmental Communication: A Journal of Nature and Culture*, 6(2), pp.212–232.

Dawson, N.M., Coolsaet, B., Sterling, E.J., Loveridge, R., Gross-Camp, N.D., Wongbusarakum, S. & Rosado-May, F.J. (2021). The role of Indigenous peoples and local communities in effective and equitable conservation. *Ecology and Society*, 26(3), p.19.

Den Broeder, L., Devilee, J., Van Oers, H., Schuit, A.J. & Wagemakers, A. (2018). Citizen science for public health. *Health Promotion International*, 33(3), pp.505–514.

Dewey, J. (1938). *Experience and education*. New York: Simon and Schuster.

Dewey, J. (1992). *Fundamente pentru o știință a educației*. București: Editura Didactică și Pedagogică.

Dirzo, R., Young, H.S., Galetti, M., Ceballos, G., Isaac, N.J. & Collen, B. (2014). Defaunation in the Anthropocene. *Science*, 345(6195), pp.401–406.

Disinger, J.F. (1994). Environmental education: From the classic to the contemporary. In: *EE Toolbox – Workshop Resource Manual: Defining Environmental Education*, 1994.

Dobson, A. (2007). Environmental citizenship: Towards sustainable development. *Sustainable Development*, 15(5), pp.276–285.

Eagly, A.H. & Chaiken, S. (1993). *The psychology of attitudes*. Fort Worth, TX: Harcourt Brace Jovanovich College Publishers.

European Commission. (1992). *Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora*. Accesat la data 10.03.2025 pe https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0043

Evans, D. (2006). The habitats of the European Union habitats directive. In *Biology and Environment: Proceedings of the Royal Irish Academy*, 106(3), pp.167–173. Royal Irish Academy.

Fishbein, M. & Ajzen, I. (2010). *Predicting and changing behaviour: The reasoned action approach*. Hove: Psychology Press.

Fisher, J. (2018). *Garden-based learning for 21st century education*. Doctoral dissertation, California State University, Sacramento.

Foundation for Environmental Education. (2020). *Annual report*. Accesat la data 10.02.2025 pe https://www.fee.global/our-annual-reports .

Foundation for Environmental Education. (2023). *Annual report*. Accesat la data 10.02.2025 pe https://www.fee.global/our-annual-reports .

Fukano, Y. & Soga, M. (2021). Why do so many modern people hate insects? The urbanization–disgust hypothesis. *Science of The Total Environment*, 777, 146229.

Galante, E. & Marcos-Garcia, M.A. (2008). Decomposer insects. In: J.L. Capinera, ed. *Encyclopedia of entomology*. 2nd ed. Dordrecht: Springer, pp.1158–1169.

Gallo, M., Malovrh, Š.P., Laktić, T., De Meo, I. & Paletto, A. (2018). Collaboration and conflicts between stakeholders in drafting the Natura 2000 Management Programme (2015–2020) in Slovenia. *Journal for Nature Conservation*, 42, pp.36–44.

Gaston, K.J. & Soga, M. (2020). Extinction of experience: The need to be more specific. *People and Nature*, 2(3), pp.575–581.

Gayford, C. (2002). Environmental literacy: Towards a shared understanding for environmental education and teacher education. *International Journal of Science Education*, 24(3), pp.377–391. https://doi.org/10.1080/09500690110098973

Gâștescu, P. (2021). The biodiversity of the Danube Delta Biosphere Reserve reflected in the structure of the ecosystems. In: Gâștescu, P. & Bretcan, P., eds. *Water resources and wetlands: 5th International Hybrid Conference Water Resources and Wetlands*, pp.8–12.

Geacu, S. (2006). Rezervațiile și parcurile naturale și naționale din România. *Mediul Ambiant*, 28(4), pp.31–36.

Gibson, E.J. & Pick, A.D. (2000). *An ecological approach to perceptual learning and development*. New York: Oxford University Press.

Gibson, E.J. (1992). How to think about perceptual learning: Twenty-five years later. In: H.L. Pick Jr., P.W. van den Broek & D.C. Knill, eds. *Cognition: Conceptual and methodological issues*. Washington, DC: American Psychological Association, pp.215–237. https://doi.org/10.1037/10564-009 .

Gillis, K. & Gatersleben, B. (2015). A review of psychological literature on the health and wellbeing benefits of biophilic design. *Buildings*, 5(3), pp.948–963.

Gkargkavouzi, A., Halkos, G. & Matsiori, S. (2019). Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit. *Resources, Conservation and Recycling*, 148, pp.145–156.

Gomez, J. (2015). Methodological and curricular restructuring of environmental education: Main course of action (Reestructuración metodológica y curricular de la educación ambiental: Principales líneas de actuación).

Gorman, C.E., Torsney, A., Gaughran, A., McKeon, C.M., Farrell, C.A., White, C., Donohue, I., Stout, J.C. & Buckley, Y.M. (2023). Reconciling climate action with the need for biodiversity protection, restoration and rehabilitation. *Science of the Total Environment*, 857, 159316.

Goulson, D. (2019). The insect apocalypse, and why it matters. *Current Biology*, 29(19), pp. R967–R971.

Goulson, D. (2021). *Silent Earth: Averting the insect apocalypse*. London: Random House.

Gregory, P.J., Ingram, J.S. & Brklacich, M. (2005). Climate change and food security. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1463), pp.2139–2148.

Griswold, E. (2012). How 'Silent Spring' ignited the environmental movement. The New York Times, 21, 2012.

Guevara-Herrero, I., Bravo-Torija, B. & Pérez-Martín, J.M. (2024). Educational practice in education for environmental justice: A systematic review of the literature. *Sustainability*, 16(7), 2805.

Güler Yıldız, T., Öztürk, N., İlhan İyi, T., Aşkar, N., Banko Bal, Ç., Karabekmez, S. & Höl, Ş. (2021). Education for sustainability in early childhood education: A systematic review. *Environmental Education Research*, 27(6), pp.796–820.

Guvernul României. (2018). *Hotărârea nr. 877/2018 privind aprobarea Planului național de acțiune pentru implementarea Strategiei naționale privind incluziunea socială și reducerea sărăciei pentru perioada 2015–2020*. Monitorul Oficial.

Guvernul României. (2018). *Strategia națională pentru dezvoltarea durabilă a României 2030*. Departamentul pentru Dezvoltare Durabilă. Accesat la data 6.04.2025, pe https://dezvoltare-durabila.gov.ro/web/wp-content/uploads/2020/10/Strategia-DD-final-1.pdf

Guvernul României. (2023). *Hotărârea nr. 59/2023 privind aprobarea Strategiei naționale pentru dezvoltarea durabilă a României 2030*. Monitorul Oficial.

Hall, S. (2005). *Peace and freedom: The civil rights and antiwar movements of the 1960s*. Philadelphia: University of Pennsylvania Press.

Hardy, T.N. (1992). Entomophobia: The case for Miss Muffet. In: R.L. Horne, ed. *Phobias: A handbook of theory, research and treatment*. pp.307–320.

Harris, C.R., Millman, K.J., van der Walt, S.J., et al. (2020). Array programming with NumPy. *Nature*, 585(7825), pp.357–362.

Harvey, J.A., Tougeron, K., Gols, R., Heinen, R., Abarca, M., Abram, P.K., Basset, Y., Berg, M., Boggs, C., Brodeur, J. & Cardoso, P. (2023). Scientists' warning on climate change and insects. *Ecological Monographs*, 93(1), p.e1553.

Hayes, A.F. (2012). *PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling.*

Hermoso, V., Carvalho, S.B., Giakoumi, S., Goldsborough, D., Katsanevakis, S., Leontiou, S., Markantonatou, V., Rumes, B., Vogiatzakis, I.N. & Yates, K.L. (2022). The EU Biodiversity Strategy for 2030: Opportunities and challenges on the path towards biodiversity recovery. *Environmental Science & Policy*, 127, pp.263–271.

Herzog, T.R. & Kutzli, G.E. (2002). Preference and perceived danger in field/forest settings. *Environment and Behavior*, 34(6), pp.819–835.

Hoang, T.T.P. & Kato, T. (2016). Measuring the effect of environmental education for sustainable development at elementary schools: A case study in Da Nang city, Vietnam. *Sustainable Environment Research*, 26(6), pp.274–286.

Hogue, J.N. (2009). Cultural entomology. In: R.G. Foottit & P.H. Adler, eds. *Encyclopedia of insects*. 2nd ed. London: Academic Press, pp.239–245.

Holfelder, A.K. (2019). Towards a sustainable future with education? *Sustainability Science*, 14(4), pp.943–952.

Hooper, D.U., Chapin III, F.S., Ewel, J.J., Hector, A., Inchausti, P., Lavorel, S., Lawton, J.H., Lodge, D.M., Loreau, M., Naeem, S., Schmid, B., Setälä, H., Symstad, A.J., Vandermeer, J. & Wardle, D.A. (2005). Effects of biodiversity on ecosystem functioning: A consensus of current knowledge. *Ecological Monographs*, 75(1), pp.3–35.

Hume, T. & Barry, J. (2015). Environmental education and education for sustainable development. In: J.D. Wright, ed. *International Encyclopedia of the Social & Behavioral Sciences*. 2nd ed. Oxford: Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.91081-X

Hung, S.H. & Chang, C.Y. (2021). Health benefits of evidence-based biophilic-designed environments: A review. *Journal of People, Plants, and Environment*, 24(1), pp.1–16.

Hungerford, H., Peyton, R.B. & Wilke, R.J. (1980). Goals for curriculum development in environmental education. *The Journal of Environmental Education*, 11(3), pp.42–47.

Hunnewell, V. & Gorbett, E. (2016). Using insects to promote science inquiry in elementary classrooms. *University of Nebraska–Lincoln*. Accesat la data de 6.04.2025, pe https://digitalcommons.unl.edu/entomologyfacpub/360

Hunter, J.D. (2007). Matplotlib: A 2D graphics environment. *Computing in Science & Engineering*, 9(3), pp.90–95.

Iacob, G.M., Craioveanu, C., Hula, V., Aurelian, V.M., Beldean, M. & Sitar, C. (2021). Improving the knowledge on distribution, food preferences and DNA barcoding of Natura 2000 protected species *Paracossulus thrips* (Lepidoptera, Cossidae) in Romania. *Insects*, 12(12), 1087. https://doi.org/10.3390/insects12121087

Info Natura 2000. (n.d.). *Catalogul habitatelor, speciilor și siturilor Natura 2000 în România*. București: Fundația Centrul Național pentru Dezvoltare Durabilă. ISBN: 978-606-8534-17-6.

Insect Week. (2024). Learning Resources – Lesson Plan. Accesat la data de 12.04.2025 pe https://www.insectweek.org/learning-resources/?_what_is_it=lesson_plan

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Bonn, Germany: IPBES Secretariat.

Iorgu, I.S., Surugiu, V., Gheoca, V., Popa, O.P., Popa, L.O., Sîrbu, I. & Vizauer, T.C. (2015). *Ghid sintetic pentru monitorizarea speciilor de nevertebrate de interes comunitar din România*. Asocierea SC Compania de Consultanță și Asistență Tehnică SRL și SC Integra Trading SRL, București.

IPBES. (2019). *Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Bonn, Germany: IPBES Secretariat. https://ipbes.net/global-assessment

Ivan, C.C. & Bîzocu, C.N. (2023). *Ghid de bune practici în învățarea și aplicarea conceptelor ecologice: Auxiliar curricular, discipline de specialitate, domeniul: Protecția mediului*. Târgu Jiu. ISBN: 978-973-0-38915-9.

Jackson, T. (2005). *Motivating sustainable consumption: A review of evidence on consumer behaviour and behavioural change*. Report to the Sustainable Development Research Network. Nottingham, UK: Centre for Environmental Strategies, University of Surrey.

Jeffs, T. & Smith, M. (2005). *Informal education: Conversation, democracy and learning*. Vol. 142. Nottingham: Educational Heretics Press.

Johansson, M., Sjöström, M., Karlsson, J. & Brännlund, R. (2012). Is human fear affecting public willingness to pay for the management and conservation of large carnivores? *Society & Natural Resources*, 25(6), pp.610–620.

Johnson, C.N., Balmford, A., Brook, B.W., Buettel, J.C., Galetti, M., Guangchun, L. & Wilmshurst, J.M. (2017). Biodiversity losses and conservation responses in the Anthropocene. *Science*, 356(6335), pp.270–275.

Johnson, M.G., Glass, J.R., Dillon, M.E. & Harrison, J.F. (2023). How will climatic warming affect insect pollinators? In: S.J. Simpson, ed. *Advances in Insect Physiology*, Vol. 64. London: Academic Press, pp.1–115.

Karimi, S. & Mohammadimehr, S. (2022). Socio-psychological antecedents of pro-environmental intentions and behaviors among Iranian rural women: An integrative framework. *Frontiers in Environmental Science*, 10, 979728. https://doi.org/10.3389/fenvs.2022.979728

Kawahara, A.Y., Reeves, L.E., Barber, J.R. & Black, S.H. (2021). Eight simple actions that individuals can take to save insects from global declines. *Proceedings of the National Academy of Sciences*, 118(2), e2002547117.

Kegan, R. (2000). What form transforms? In: J. Mezirow, ed. *Learning as transformation: Critical perspectives on a theory in progress*. San Francisco: Jossey-Bass, pp.35–69.

Kellert, S. & Calabrese, E. (2015). *The practice of biophilic design*. London: Terrapin Bright LLC.

Kellert, S.R. (1993). Values and perceptions of invertebrates. *Conservation Biology*, 7(4), pp.845–855.

Kendra, R.L. & Krasny, M.E. (2014). Memories as useful outcomes of residential outdoor environmental education. *The Journal of Environmental Education*, 45(3), pp.178–193. https://doi.org/10.1080/00958964.2014.905431

Khademi-Vidra, A. (2017). Curriculum planning of the environmental education. *Journal of Central European Green Innovation*, 5(1), pp.65–80.

Khan, Y., Yuan, C., Roy, M., Khan, Z., Yaqub Khan, M., Hsu, P.C. & Srivastava, H. (2020). Insects as a source of food for human hunger: A glimpse of hope for the future. *International Journal of Food Science and Nutrition*, 5, pp.132–137.

Kim, M.C. & Hannafin, M.J. (2011). Scaffolding problem solving in technology-enhanced learning environments (TELEs): Bridging research and theory with practice. *Computers & Education*, 56(2), pp.403–417.

King, K.P. (2003). *Keeping pace with technology: Educational technology that transforms – The challenge & promise for higher education faculty*. Cresskill, NJ: Hampton Press.

Kingston, T. (2016). Cute, creepy, or crispy—how values, attitudes, and norms shape human behavior toward bats. Bats in the Anthropocene: Conservation of bats in a changing world, 571-595.

Knapp, J.L., Phillips, B.B., Clements, J., Shaw, R.F. & Osborne, J.L. (2021). Socio-psychological factors, beyond knowledge, predict people's engagement in pollinator conservation. *People and Nature*, 3(1), pp.204–220.

Koballa Jr, T.R. (1988). Attitude and related concepts in science education. *Science Education*, 72(2), pp.115–126.

Kohlstedt, S.G. (2005). Nature, not books: Scientists and the origins of the nature-study movement in the 1890s. *Isis*, 96(3), pp.324–352.

Kong, H.M., Ko, E., Chae, H. & Mattila, P. (2016). Understanding fashion consumers' attitude and behavioral intention toward sustainable fashion products: Focus on sustainable knowledge sources and knowledge types. *Journal of Global Fashion Marketing*, 7(2), pp.103–119.

Kopec, K. & Brown, L.A. (2017). *Pollinators in peril: A systematic status review of North American and Hawaiian native bees*. Tucson, AZ: Center for Biological Diversity.

Kopnina, H. (2012a). Education for sustainable development (ESD): The turn away from 'environment' in environmental education? *Environmental Education Research*, 18(5), pp.699–717. https://doi.org/10.1080/13504622.2012.658028

Kopnina, H. (2012b). *Anthropology of environmental education*. New York, NY: Nova Science Publishers.

Kopnina, H. (2014). Revisiting education for sustainable development (ESD): Examining anthropocentric bias through the transition of environmental education to ESD. *Sustainable Development*, 22(2), pp.73–83.

Koutroubas, V. & Galanakis, M. (2022). Bandura's social learning theory and its importance in the organizational psychology context. *Psychology*, 12(6), pp.315–322.

Kritsky, G. & Cherry, R.H. (2000). *Insect mythology*. Bloomington, IN: iUniverse.

Kritsky, G. & Smith, J.J. (2018). Insect biodiversity in culture and art. In: R.G. Foottit & P.H. Adler, eds. *Insect biodiversity: Science and society*, vol. 2. Hoboken, NJ: Wiley-Blackwell, pp.869–898.

Kritsky, G. (1991). Beetle gods of ancient Egypt. *American Entomologist*, 37, pp.85–87.

Krnel, D. & Naglič, S. (2009). Environmental literacy comparison between eco-schools and ordinary schools in Slovenia. *Science Education International*, 20(1), pp.5–24.

Lalitha, B.S., Babu, K.R. & Charyulu, G.M. (2024). Exploring the benefits of integrating outdoor and experiential learning into traditional classroom settings: A review and analysis. *Educational Administration: Theory and Practice*, 30(4), pp.6920–6929.

Larmer, J. & Mergendoller, J.R. (2010). Seven essentials for project-based learning. *Educational Leadership*, 68(1), pp.34–37.

Larson, L.R., Castleberry, S.B. & Green, G.T. (2010). Effects of an environmental education program on the environmental orientations of children from different gender, age, and ethnic groups. *Journal of Park and Recreation Administration*, 28(3), pp. 95-113.

Leakey, R. & Lewin, R. (1997). *The sixth extinction: Patterns of life and the future of humankind*. New York: Doubleday.

Liefländer, A.K. & Bogner, F.X. (2014). The effects of children's age and sex on acquiring pro-environmental attitudes through environmental education. *The Journal of Environmental Education*, 45(2), pp.105–117. https://doi.org/10.1080/00958964.2013.875511

Litter Less Campaign Report. (2017). *Learning, leading, action & community: The Litter Less Campaign impact measurement & evaluation project (2014–2017)*. [publisher/organizator – adaugă dacă este cunoscut].

Liu, P., Teng, M. & Han, C. (2020). How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. *Science of the Total Environment*, 728, 138126.

Lockwood, J. (2013). *The infested mind: Why humans fear, loathe, and love insects*. Oxford: Oxford University Press.

Louv, R. (2009). Do our kids have nature-deficit disorder. *Educational Leadership*, 67(4), pp.24–30.

Majewska, A.A. & Altizer, S. (2020). Planting gardens to support insect pollinators. *Conservation Biology*, 34(1), pp.15–25.

Mammola, S., Riccardi, N., Prié, V., Correia, R., Cardoso, P., Lopes-Lima, M. & Sousa, R. (2020). Towards a taxonomically unbiased European Union biodiversity strategy for 2030. *Proceedings of the Royal Society B*, 287(1940), 20202166.

Mancha, R.M. & Yoder, C.Y. (2015). Cultural antecedents of green behavioral intent: An environmental theory of planned behavior. *Journal of Environmental Psychology*. https://doi.org/10.1016/j.jenvp.2015.06.005

Martín-López, B., Montes, C. & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation*, 139(1–2), pp.67–82.

Masenya, M. (2015). In the ant's school of wisdom: A holistic African-South African reading of Proverbs 6:6–11. *Old Testament Essays*, 28(2), pp.421–432.

Masud, M.M., Akhtar, R., Afroz, R., Al-Amin, A.Q. & Kari, F.B. (2015). Pro-environmental behavior and public understanding of climate change. *Mitigation and Adaptation Strategies for Global Change*, 20, pp.591–600.

Matthews, R.W., Flage, L.R. & Matthews, J.R. (1997). Insects as teaching tools in primary and secondary education. *Annual Review of Entomology*, 42(1), pp.269–289.

McCrea, E.J. (2006). *The roots of environmental education: How the past supports the future*. Environmental Education and Training Partnership (EETAP).

McKinney, W. (2010). Data structures for statistical computing in Python. In: *Proceedings of the 9th Python in Science Conference*, pp.51–56.

McLeod, S.A. (2016). Bandura - social learning theory. *Simply Psychology*. Available at: https://www.simplypsychology.org/bandura.html

Melis, C., Falcicchio, G., Wold, P.A. & Billing, A.M. (2021). Species identification skills in teacher education students: The role of attitude, context and experience. *International Journal of Science Education*, 43(11), pp.1709–1725.

Menta, C. (2018). *Insect ecology: An ecosystem approach*. London: Academic Press.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. San Francisco, CA: Jossey-Bass.

Mezirow, J. (2000). *Learning as transformation: Critical perspectives on a theory in progress*. San Francisco, CA: Jossey-Bass.

Michener, C.D. (2000). *The bees of the world*. 2nd ed. Baltimore, MD: Johns Hopkins University Press, pp.803–829.

Miller, J.R. (2005). Biodiversity conservation and the extinction of experience. *Trends in Ecology & Evolution*, 20(8), pp.430–434.

Miller, P.H. (2011). *Theories of developmental psychology*. New York: Worth Publishers.

Ministerul Educației, Cercetării și Tineretului, „Anexa 1 la Ordinul nr. 1862/30.08.2007: Educație ecologică și de protecție a mediului – învățământ preșcolar, primar, gimnazial (V–VII)", 2007, accesat la data 05.03.2025, pe https://educatie-ecologica2007.

Moore, J.W. (2017). The Capitalocene, Part I: On the nature and origins of our ecological crisis. *The Journal of Peasant Studies*, 44(3), pp.594–630.

Moszyński, K. (1967). *Kultura ludowa Słowian II. Kultura duchowa*. Vol. II. Kraków: Polska Akademia Umiejętności.

Mráz, P. & Ronikier, M. (2016). Biogeography of the Carpathians: Evolutionary and spatial facets of biodiversity. *Biological Journal of the Linnean Society*, 119(3), pp.528–559.

Mundaca, E.A., Lazzaro-Salazar, M., Pujol-Cols, L. & Muñoz-Quezada, M.T. (2021). The emotional and cognitive scale of the human–nature relationship (ECS-HNR). *SAGE Open*, 11(1), 21582440211004142.

National Association for Environmental Education (NAEE). (1976). *A statement of aims*. Walsall, Staffordshire: NAEE.

New, T.R. (1997). Are Lepidoptera an effective 'umbrella group' for biodiversity conservation? *Journal of Insect Conservation*, 1(1), pp.5–12.

Nicolopoulou, A. (1993). Play, cognitive development, and the social world: Piaget, Vygotsky, and beyond. *Human Development*, 36(1), pp.1–23.

Noor, Z., Harahap, A.K. & Dewi, U. (2023). Problem of teaching English in elementary school based on teacher involvement: Exploring teacher's perspective. *LLT Journal: Journal on Language and Language Teaching*, 26(1), pp.379–386. https://doi.org/10.24071/llt.v26i1.5708

North American Association for Environmental Education (NAAEE). (2021). *Guidelines for excellence: Environmental education materials*.

Ogbeide, O.A., Ford, C. & Stringer, R. (2015). The environmental benefits of organic wine: Exploring consumer willingness-to-pay premiums? *Journal of Food Products Marketing*, 21(5), pp.482–502.

Ollerer, K. (2012). Educația ecologică – între necesitate și oportunitate. *Calitatea Vieții*, 23(1), pp.25–44.

Ord, J. (2009). Experiential learning in youth work in the UK: A return to Dewey. *International Journal of Lifelong Education*, 28(4), pp.493–511.

Orians, G.H. (2017). Human behavioral ecology: 140 years without Darwin is too long. In: T.K. Shackelford & R.D. Hansen, eds. *Evolutionary perspectives on environmental problems*. New York: Routledge, pp.259–280.

Orr, D.W. (1993). Love it or lose it: The coming biophilia revolution. In: S.R. Kellert & E.O. Wilson, eds. *The biophilia hypothesis*. Washington, DC: Island Press, pp.414–440.

Orr, D.W. (2004). *Earth in mind: On education, environment, and the human prospect*. Washington, DC: Island Press.

Özbuğutu, E., Karahan, S. & Tan, Ç. (2014). Environmental education and its alternative methods – A literature review. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 11(25), pp.393–408.

Özsoy, S., Ertepınar, H. & Sağlam, N. (2012). Can eco-schools improve elementary school students' environmental literacy levels? *Asia-Pacific Forum on Science Learning and Teaching*, 13(2), Article 3, p.1.

Palmer, J. A. (2002). *Environmental education in the 21st century: Theory, practice, progress and promise*. London: Routledge.

Pandit, R., Dhakal, M. & Polyakov, M. (2015). Valuing access to protected areas in Nepal: The case of Chitwan National Park. *Tourism Management*, 50, pp.1-12.

Paño, J.D., Jumao-as, J.R. & Picardal, M.T. (2022). Cognitive dimension of learning using garden-based education towards sustainability: A meta-synthesis. *Recoletos Multidisciplinary Research Journal*, 10(1), pp.141–157.

Peck, N. (2002). "The perfect socialism": The social philosophy of Anna Botsford Comstock in the Nature Study movement. *Doctoral dissertation*, University of Oklahoma.

Pennock, M.T. & Bardwell, L.V. (1994). *Approaching environmental issues in the classroom*. Ann Arbor, MI: National Consortium for Environmental Education and Training.

Peterson, C. (2022). Environmental education, awareness, and movements: A historical overview. *OSF Preprints*.

Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching*, 2(3), pp.176–186.

Pievani, T. (2014). The sixth mass extinction: Anthropocene and the human impact on biodiversity. *Rendiconti Lincei*, 25(1), pp.85–93.

Pinker, S. (2001). Passionately opposed to pesticides. *CMAJ*, 165(1), p.136.

Piščalkienė, V. & Lottrup, H.I. (2019). Benefits of experiential-based learning: A case of students' participation in the project 'Villages on Move Baltic'. *Visuomenės Sveikata*, 28(6), pp.5–15.

Ploscariu, N. (2021a). *Ştiinţe ale naturii. Manual pentru clasa a III-a*. Bucureşti: Editura Art Klett. ISBN: 978-606-076-338-3. Available at: https://infomediapro.ro

Ploscariu, N. (2021b). *Ştiinţe ale naturii. Manual pentru clasa a IV-a*. Bucureşti: Editura Art Klett. ISBN: 978-606-076-369-7. Available at: https://infomediapro.ro

Pluess, M. (2015). Individual differences in environmental sensitivity. *Child Development Perspectives*, 9(3), pp.138–143. https://doi.org/10.1111/cdep.12120

Prokop, P. & Randler, C. (2018). Biological predispositions and individual differences in human attitudes toward animals. In: R. Alves & U.P. Albuquerque, eds. *Ethnozoology*. London: Academic Press, pp.447–466.

Prokop, P., Usak, M. & Fančovičová, J. (2010). Health and the avoidance of macroparasites: A preliminary cross-cultural study. *Journal of Ethology*, 28, pp.345–351. https://doi.org/10.1007/s10164-009-0195-3

Pyle, R.M. (1993). *The thunder tree: Lessons from an urban wildland*. Boston, MA: Houghton Mifflin.

Quan, N.T.N.V.N. (2008). A critical reflection on Jean Jacques Rousseau's conception of education. *Theologos*, 99(2), p.166.

Rákosy, L., Corduneanu, C., Crișan, A., Dincă, V., Kovács, S., Stănescu, M. & Székely, L. (2021). *Lista roșie a fluturilor din România / Romanian Red List of Lepidoptera*. Cluj-Napoca: Presa Universitară Clujeană.

Rákosy, L., Crișan, A. & Craioveanu, C. (2018). *Beneficiile naturii în situl Natura 2000 "Dealurile Clujului de Est" / The benefits of nature in the Natura 2000 site "Eastern Cluj Hills"*. Sofia: Pensoft. ISBN: 978-954-642-918-6.

Ramola, G.C., Nidhi, R., Ravindra, S., Singh, A., Lekhendra, S. & Pravin, R. (2024). Insects as ecological indicators: A review. *International Journal of Environment and Climate Change*, 14(12), pp.260–279. https://doi.org/10.9734/ijecc/2024/v14i124623

Ramos, D.D.L., Cunha, W.L.D., Evangelista, J., Lira, L.A., Rocha, M.V.C., Gomes, P.A. & Togni, P.H.B. (2020). Ecosystem services provided by insects in Brazil: What do we really know? *Neotropical Entomology*, 49, pp.783–794.

Ramsar Convention on Wetlands (Ramsar). (2018). *Global wetland outlook: State of the world's wetlands and their services to people*. Gland, Switzerland: Ramsar Convention Secretariat.

Reed, A.L. (1986). *Race, politics, and culture: Critical essays on the radicalism of the 1960s*. Contributions in Afro-American and African Studies, No. 95. Westport, CT: Greenwood Press.

Rickinson, M. (2001). Learners and learning in environmental education: A critical review of the evidence. *Environmental Education Research*, 7(3), pp.207–320. https://doi.org/10.1080/13504620120065230

Roberts, T.G. (2003). An interpretation of Dewey's experiential learning theory.

Sahin, E. (2013). Predictors of Turkish elementary teacher candidates' energy conservation behaviors: An approach on Value-Belief-Norm theory. *International Journal of Environmental and Science Education*, 8(2), pp.269–283.

Sahlins, M. (1972). *Stone age economics*. Chicago, IL: Aldine.

Sammet, R., Andres, H. & Dreesmann, D. (2015). Human-insect relationships: An ANTless story? Children's, adolescents', and young adults' ways of characterizing social insects. *Anthrozoös*, 28(2), pp.247–261.

Samways, M.J. (2005). *Insect diversity conservation*. Cambridge: Cambridge University Press.

Samways, M.J. (2015). Future-proofing insect diversity. *Current Opinion in Insect Science*, 12, pp.71–78.

Sarmiento-Campos, N.V., Lázaro-Guillermo, J.C., Silvera-Alarcón, E.N., Cuellar-Quispe, S., Huamán-Romaní, Y.L., Apaza, O.A. & Sorkheh, A. (2022). A look at Vygotsky's sociocultural theory (SCT): The effectiveness of scaffolding method on EFL learners' speaking achievement. *Education Research International*, 2022 (1), pp.1–11.

Sauvé, L. (1997). Sustainable development: A further appraisal. *Canadian Journal of Environmental Education*.

Sauvé, L. (2005). Currents in environmental education: Mapping a complex and evolving pedagogical field. *Canadian Journal of Environmental Education*, 10(1), pp.11–37.

Schlegel, J., Breuer, G. & Rupf, R. (2015). Local insects as flagship species to promote nature conservation? A survey among primary school children on their attitudes toward invertebrates. *Anthrozoös*, 28(2), pp.229–245.

Schönfelder, M.L. & Bogner, F.X. (2017). Individual perception of bees: Between perceived danger and willingness to protect. *PLoS ONE*, 12(6), e0180168.

Schowalter, T.D., Noriega, J.A. & Tscharntke, T. (2018). Insect effects on ecosystem services—Introduction. *Basic and Applied Ecology*, 26, pp.1–7.

Schubert, S.D., Suarez, M.J., Pegion, P.J., Koster, R.D. & Bacmeister, J.T. (2004). On the cause of the 1930s Dust Bowl. *Science*, 303(5665), pp.1855–1859.

Seeley, T.D. (2010). *Honeybee democracy*. Princeton, NJ: Princeton University Press.

Shabani, K., Khatib, M. & Ebadi, S. (2010). Vygotsky's zone of proximal development: Instructional implications and teachers' professional development. *English Language Teaching*, 3(4), pp.237–248.

Shavrina, E.V. (2000). Global responsibility and ecological culture through ecological education. In: *Proceedings of the "Higher Education for Peace Conference"*, Tromsø, 4–6 May 2000.

Sheehan, P.M. (2001). The late Ordovician mass extinction. *Annual Review of Earth and Planetary Sciences*, 29(1), pp.331–364.

Sitar, C., Sitar, G.M., Ionică, A.M., Hula, V., Spitzer, L., Rusu, A.S. & Rákosy, L. (2024). Multi-annual study of *Eriogaster catax* (Linnaeus, 1758) (Lepidoptera, Lasiocampidae) oviposition strategy in Transylvania's largest population: Key insights for species conservation and local land management. *Insects*, 15(10), 794. https://doi.org/10.3390/insects15100794

Smyth, J.C. (1995). Environment and education: A view of a changing scene. *Environmental Education Research*, 1(1), pp.3–20.

Soga, M. & Gaston, K.J. (2016). Extinction of experience: The loss of human–nature interactions. *Frontiers in Ecology and the Environment*, 14(2), pp.94–101.

Soga, M. & Gaston, K.J. (2022). Towards a unified understanding of human–nature interactions. *Nature Sustainability*, 5(5), pp.374–383.

Soga, M., Evans, M.J., Yamanoi, T., Fukano, Y., Tsuchiya, K., Koyanagi, T.F. & Kanai, T. (2020). How can we mitigate against increasing biophobia among children during the extinction of experience? *Biological Conservation*, 242, 108420.

Southwood, T.R.E. (1977). Entomology and mankind: Insects over the ages have greatly affected man's health and food supply and have played an important role as religious and cultural symbols. *American Scientist*, 65(1), pp.30–39.

Srbinovski, M., Erdogan, M. & Ismaili, M. (2010). Environmental literacy in the science education curriculum in Macedonia and Turkey. *Procedia - Social and Behavioral Sciences*, 2(2), pp.4528–4532.

Stanišić, J. & Maksić, S. (2014). Environmental education in Serbian primary schools: Challenges and changes in curriculum, pedagogy, and teacher training. *The Journal of Environmental Education*, 45(2), pp.118–131. https://doi.org/10.1080/00958964.2013.829019

Stapp, W.B., Bennett, D., Bryan, W., Fulton, J., Harlick, S., MacGregor, J.M., Nowak, P., Swan, J. & Wall, R. (1969). The concept of environmental education. *The Journal of Environmental Education*, 1(1), pp.30–31.

Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A. & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223), 1259855.

Steg, L. & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29(3), pp.309–317.

Steg, L., Bolderdijk, J.W., Keizer, K. & Perlaviciute, G. (2014). An integrated framework for encouraging pro-environmental behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology*, 38, pp.104–115. https://doi.org/10.1016/j.jenvp.2014.01.002

Stern, P.C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, 56(3), pp.407–424. https://doi.org/10.1111/0022-4537.00175

Stevenson, R.B. (2007). Schooling and environmental education: Contradictions in purpose and practice. *Environmental Education Research*, 13(2), pp.139–153.

Stewart, M. (2014). *Student learning outcomes of garden-based education: A literature review*. Master's thesis, University of Minnesota, pp.1–22.

Stork, N.E. (2018). How many species of insects and other terrestrial arthropods are there on Earth? *Annual Review of Entomology*, 63, pp.31–45.

Taylor, E.W. (1998). *The theory and practice of transformative learning: A critical review*. Information Series No. 374. Columbus, OH: ERIC Clearinghouse on Adult, Career, and Vocational Education.

Tănăselea, A. (2019). Învățarea prin experiență ca sursă a cunoașterii. In: *Probleme actuale ale științelor umanistice*, 18, pp.304–315.

The Tbilisi Declaration. (1977). *Intergovernmental Conference on Environmental Education*. Organized by UNESCO in cooperation with UNEP. Tbilisi, Georgia (USSR), 14–26 October. Available at: http://www.gdrc.org/uem/ee/tbilisi.html .

The Xerces Society. (2011). *Attracting native pollinators: The Xerces Society guide, protecting North America's bees and butterflies*. North Adams, MA: Storey Publishing.

Thomas, G. (2005). Facilitation in education for the environment. *Australian Journal of Environmental Education*, 21, pp.107–116.

Thomas, G.J. (2018). Pedagogical frameworks in outdoor and environmental education. *Journal of Outdoor and Environmental Education*, 21, pp.173–185.

Tilbury, D. (1995). Environmental education for sustainability: Defining the new focus of environmental education in the 1990s. *Environmental Education Research*, 1(2), pp.195–212. https://doi.org/10.1080/1350462950010204

Tilbury, D., Coleman, V. & Garlick, D. (2005). *A national review of environmental education and its contribution to sustainability in Australia: School education*. Canberra: Australian Government Department of the Environment and Heritage and Australian Research Institute in Education for Sustainability (ARIES).

Tovar-Gálvez, J.C. (2021). Bringing environmental education to the curriculum: Practical elements emergent from teaching experiences and research. *Interdisciplinary Journal of Environmental and Science Education*, 17(3), e2236.

Treagust, D.F., Amarant, A., Chandrasegaran, A.L. & Won, M. (2016). A case for enhancing environmental education programs in schools: Reflecting on primary school students' knowledge and attitudes. *International Journal of Environmental and Science Education*, 11(12), pp.5591–5612.

Tüzün, A., Kalemci, B. & Murat, H.G. (2015). Cultural entomology. *Türk Bilimsel Derlemeler Dergisi*, (2), pp.30–32.

Ținutul Fluturelui Albastru. Accesat la data de 16.03.2025 pe https://tinutulflutureluialbastru.ro/

Ulrich, R.S. (1993). Biophilia, biophobia, and natural landscapes. In: S.R. Kellert & E.O. Wilson, eds. *The biophilia hypothesis*. Washington, DC: Island Press, pp.73–137.

UNESCO. (2011). *Education for sustainable development—An expert review of processes and learning*. Paris: UNESCO. Available at: http://unesdoc.unesco.org/images/0019/001914/191442e.pdf [Accessed 26 May 2016].

UNESCO. (2014). *Ecological sciences for sustainable development*. Paris: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2017). *Education for Sustainable Development Goals*. Paris: UNESCO. Available at: https://unesdoc.unesco.org/ark:/48223/pf0000247444 [Accessed 24 Jan. 2025].

UNESCO-UNEP. (1976). The Belgrade Charter. *Connect: UNESCO-UNEP Environmental Education Newsletter*, 1(1), pp.1–2.

UNESCO-UNEP. (1996). *Education for sustainable development*. Paris: UNESCO-UNEP.

Universitatea Babeș-Bolyai. (2023). *Plan de învățământ anul universitar 2023–2024: Facultatea de Psihologie și Științe ale Educației*. Accesat la data de 12.04.2025 pe https://psiedu.ubbcluj.ro/

Universitatea Babeș-Bolyai. (2024). *Plan de învățământ anul universitar 2024–2025: Facultatea de Biologie și Geologie, Biologie ambientală*. Accesat la data de 12.04.2025 pe https://biogeo.ubbcluj.ro/planuri-de-invatamant/ .

UNO. (2017). *Declaration on Education for Sustainable Development*. Accesat la data de 12.05.2024 pe www.heacademy.ac.uk

Uzzell, D. (1988). *As crianças como agentes de mudança ambiental*. Porto: Campo das Letras.

Van Der Stuyf, R.R. (2002). Scaffolding as a teaching strategy. *Adolescent Learning and Development*, 52(3), pp.5–18.

van Rees, C.B., Waylen, K.A., Schmidt-Kloiber, A., Thackeray, S.J., Kalinkat, G., Martens, K., Domisch, S. et al. (2021). Safeguarding freshwater life beyond 2020: Recommendations for the new global biodiversity framework from the European experience. *Conservation Letters*, 14(1), e12771.

Van Rossum, G. & Drake, F.L. (2009). *Python 3 Reference Manual*. Scotts Valley, CA: CreateSpace.

Vanbergen, A.J. & The Insect Pollinators Initiative. (2013). Threats to an ecosystem service: Pressures on pollinators. *Frontiers in Ecology and the Environment*, 11(5), pp.251–259.

Vanderstock, A., Grandi-Nagashiro, C., Kudo, G., Latty, T., Nakamura, S., White, T.E. & Soga, M. (2022). For the love of insects: Gardening grows positive emotions (biophilia) towards invertebrates. *Journal of Insect Conservation*, 26(5), pp.751–762.

Vascan, T. (2022). Învățarea bazată pe proiecte – o metodă de implementare a abordării STEAM în educație. In: *Materialele Conferinței Republicane a Cadrelor Didactice*, 1, pp.324–329.

Vasileva-Tcankova, R.S. (2022). Global ecological problems of modern society. *Acta Scientifica Naturalis*, 9(2).

Virtanen, P., Gommers, R., Oliphant, T.E., et al. (2020). SciPy 1.0: Fundamental algorithms for scientific computing in Python. *Nature Methods*, 17, pp.261–272.

Wagner, D.L. (2020). Insect declines in the Anthropocene. *Annual Review of Entomology*, 65(1), pp.457–480.

Wagner, D.L., Grames, E.M., Forister, M.L., Berenbaum, M.R. & Stopak, D. (2021). Insects decline in the Anthropocene: Death by a thousand cuts. *Proceedings of the National Academy of Sciences*, 118(2), e2023989118.

Wall, R. & Strong, L. (1987). *Environmental physiology and biochemistry of insects*. New York: Springer Science & Business Media.

Wals, A.E. & Kieft, G. (2010). *Education for sustainable development: Research overview*.

Waters, C.N., Zalasiewicz, J., Summerhayes, C., Barnosky, A.D., Poirier, C., Gałuszka, A., Cearreta, A. et al. (2016). The Anthropocene is functionally and stratigraphically distinct from the Holocene. *Science*, 351(6269), aad2622.

WEEC. (2013). *7th World Environmental Education Congress*, Marrakesh, Morocco. Theme: Environmental education and the issues of a greater harmony between town and countryside.

West, P. et. al. (2010). Transition matters: pupils' experiences of the primary-secondary school transition in the West of Scotland and consequences for well-being and attainment, Research Papers in Education, 25:1, p.21-50

Whiteman, N.K. & Sites, R.W. (2008). Aquatic insects as umbrella species for ecosystem protection in Death Valley National Park. *Journal of Insect Conservation*, 12, pp.499–509.

Wilson, E.O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.

Wood, D., Bruner, J.S. & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, 17(2), pp.89–100.

Wyles, K.J., Pahl, S., White, M., Morris, S., Cracknell, D. & Thompson, R.C. (2013). Towards a marine mindset: Visiting an aquarium can improve attitudes and intentions regarding marine sustainability. *Visitor Studies*, 16(1), pp.95–110.

Yadav, D., Ray, S., Maheshwari, S. & Saikanth, D.R.K. (2024). Influence of insects on art and culture. In: *Recent Trends in Entomology (Innovations and Sustainable Practices for Plant Protection)*. Academic Publication & Distributors in collaboration with Research Floor.

Zhang, W., Goodale, E. & Chen, J. (2014). How contact with nature affects children's biophilia, biophobia and conservation attitude in China. *Biological Conservation*, 177, pp.109–116.

Zhang, Z.Q. (2011). Animal biodiversity: An introduction to higher-level classification and taxonomic richness. *Zootaxa*, 3148(1), pp.7–12.

Zsóka, Á., Szerényi, Z.M., Széchy, A. & Kocsis, T. (2013). Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students. *Journal of Cleaner Production*, 48, pp.126–138.