

Research

Understanding Nature in Early Adolescence: Conceptions among Urban Middle School Students

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Abstract:

This qualitative study investigates how Austrian sixth-grade students attending urban academic secondary schools understand the concept of nature. Within the context of Education for Sustainable Development, the study focuses on students' human-nature relationships, because conceptions of nature may shape emotional engagement, environmental attitudes, and later pro-environmental behaviour. Data were collected through an anonymous questionnaire administered to 324 students from 14 classes in four schools located in urban areas. The analysis focused on the open-ended question "What is nature to you?" Valid responses (n = 306) were analysed using qualitative content analysis. An inductively developed coding scheme identified eleven main categories describing students' conceptions of nature. The most frequent categories were ecosystems (44.4%), living nature (41.2%), and leisure and recreation (34.0%). Students most often referred to forests, plants, animals, green spaces, and opportunities for relaxation, physical activity, and spending free time outdoors. Abiotic elements, aesthetic descriptions, and emotional associations such as joy, freedom, calmness, and affection were also present, but less frequent. By contrast, environmental protection, untouched nature, and rural references were rarely mentioned. The findings suggest that students mainly understand nature as a familiar, living, aesthetically pleasing, and emotionally meaningful space, rather than primarily as a system requiring protection or as a sphere independent of human influence. These results highlight the need for biology and sustainability education to build on students' everyday experiences while strengthening conceptual links between nature, ecological interdependence, human impact, and environmental responsibility in urban learning contexts for future sustainable action and reflection.

Keywords: Education for Sustainable Development; Human-Nature Relationship; Middle School Students; Urban Environment

1. Introduction

1.1. Education for Sustainable Development

Human survival depends on nature; nevertheless, natural resources are often used as if they were inexhaustible. To illustrate the increasing impact of human activities on the Earth system, Crutzen & Stoermer (2000) proposed the term Anthropocene to describe a new geological epoch shaped by human influence. Climate change, the increasing frequency of extreme weather events, and the ongoing loss of biodiversity can be understood as consequences of human action (Cook et al., 2016; Folke et al., 2021). Reducing these negative impacts requires profound changes in human lifestyles and a transition towards more sustainable ways of interacting with the planet (Oskamp, 2000; Crutzen, 2002). In this context, the concept of sustainability has become highly significant.

One widely used definition of sustainability was introduced in the Brundtland Report, *Our Common Future*, published in 1987. Sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Hauff, 1987). The continuing relevance of sustainable development is also reflected in the United Nations’ Agenda 2030 and its 17 Sustainable Development Goals (SDGs), through which all member states committed themselves to promoting a more sustainable relationship with the Earth (UN, 2015). Since the SDGs comprise ecological, economic, and social dimensions, Education for Sustainable Development (ESD) is considered a key approach to their implementation (UN, 2017). ESD is inherently interdisciplinary and aims to enable learners to act in environmentally responsible ways while also considering the economic and social dimensions of sustainability (UNESCO, 2014).

Promoting environmentally responsible behavior, however, requires more than the transmission of environmental knowledge. Several studies have shown that knowledge alone is not sufficient to foster pro-environmental action (Nisbet et al., 2009; Otto & Pensini, 2017). Instead, the human–nature relationship plays an essential role. This relationship is reflected, among other aspects, in an individual’s connectedness to nature. A high level of nature connectedness has been associated with more environmentally responsible attitudes and behaviors (Clayton, 2003; Clayton et al., 2021; Davis et al., 2009; Dutcher et al., 2007; Nisbet et al., 2009). In addition to nature connectedness, students’ individual understanding of nature provides insight into how they relate to nature and may shape their behavior towards it (Dittmer & Gebhard, 2020; Meske, 2011).

Environmental education is particularly relevant for younger students, as educational interventions at this age may have stronger and more lasting effects on nature connectedness and later environmental behavior than interventions targeting older learners (Liefänder et al., 2013; Wells & Lekies, 2006). Understanding students’ human–nature relationships can therefore provide important implications for school practice. It enables educators to connect teaching with students’ existing conceptions of nature and to design learning environments that support both ecological understanding and emotional engagement with nature.

Therefore, the aim of the present study is to investigate the human–nature relationship of Austrian sixth-grade students attending academic secondary schools in urban areas. Particular attention is given to students’ individual understanding of nature, explored through the open-ended question: “What is nature to you?”

1.2. Human-nature relationship

One influential approach to conceptualizing the human–nature relationship is Wilson’s biophilia hypothesis. Wilson (1984) defines biophilia as the “innate tendency to focus on life and lifelike processes” (p. 1). According to this perspective, humans possess an inherent inclination towards living organisms and natural processes. Wilson (1993) later specified this tendency as an emotional affiliation with other forms of life. Biophilia is therefore understood not merely as an interest in nature, but as a deep-rooted emotional connection that may have developed through human evolution. Kellert (1993) similarly argues that human attachment to nature may have offered evolutionary advantages and contributed to survival.

Kellert (1993) expanded the concept by identifying nine values of biophilia: utilitarian, naturalistic, ecologicistic-scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic,

and negativistic. These values describe different ways in which humans relate to nature. For example, the utilitarian value refers to the practical and material use of nature, while the naturalistic value describes the satisfaction derived from direct contact with natural environments. The aesthetic value concerns the attraction to natural beauty, whereas the humanistic value concerns emotional attachment and affection for nature. The moralistic value includes ethical responsibility and spiritual respect for nature. Importantly, Kellert also included negative or ambivalent dimensions, such as fear, aversion, domination, and control, showing that human–nature relationships may range from attraction to rejection. Several studies have indirectly supported the relevance of the biophilia hypothesis. Kahn (1999), for example, provides an overview of empirical findings indicating children’s affinity for nature. Lumber et al. (2017) further show that engagement with nature through naturalistic, aesthetic, symbolic, humanistic, and moralistic pathways can strengthen nature connectedness. However, the biophilia hypothesis has also been criticized. Joye & De Block (2011) question its evolutionary explanation, while Kahn et al. (2009) argue that the concept is so broad that it is difficult to falsify empirically.

For this reason, the present study does not treat biophilia as a hypothesis to be tested. Instead, following Kahn et al. (2009), biophilia is used as a theoretical construct for interpreting students’ human–nature relationships and their individual understandings of nature. The main research question of the study was how secondary school students understand the concept of nature.

2. Materials and Methods

In this study, we follow a qualitative approach. Qualitative inductive research methods were adopted (Mayring, 2015). An anonymous questionnaire was used to collect the data.

2.1. Sample and Methods

The study was part of a broader longitudinal project investigating environmental attitudes among Austrian middle school students. For this paper, we focused solely on the open question of understanding nature and sociodemographic data. The students’ understanding was assessed using the open-ended question, “What is nature to you?”

The study sample consisted of 324 Austrian students in 6th grade (second year of lower secondary education) attending academic secondary schools. In total, 14 classes participated in the study. Data were collected at four schools located in urban regions. Three of these schools were in Vienna (1st, 2nd, and 18th districts), and one was in Lower Austria. Of the 324 participating students, 147 were female (45.5%), and 176 were male (54.5%). One student provided an unclear response to the gender question. The students’ ages ranged from 10 to 14 years, with a mean age of 11.28 years ($SD = 0.56$).

2.2. Data analysis

The analysis was conducted with the Qualitative Data Analysis (QDA) software MAXQDA 2022, which also allowed a semi-quantitative analysis (e.g. the occurrence of technical terms) (Rädiker & Kuckartz 2019). The coding was dominantly inductive, focusing on the most common patterns emerging from the dataset. The coding frame was data-driven, with codes and themes emerging from the students’ descriptions. The author and one trained graduate research assistant applied the coding guideline, which was continuously adapted throughout the analysis through iterative reviews, discussions, categorization, and re-coding. The final coding structure was also validated through discussions and refinement. We first did the analysis in German and then translated a selection of the students’ statements for our manuscript. The translation was done by a bilingual researcher and then retranslated to confirm the original meaning and information. Additionally, all translated descriptions were discussed with the bilingual team (native languages: German and English), as we are aware of the risk that information may be changed or misrepresented.

The developed coding guideline includes a clear category definition and an example from the student’s answers for each category to ensure the validity of the coding scheme (Table 1).

Table 1: Coding scheme for students' understanding of nature

Rank	Main Category	Definition	Anchor example
1	Ecosystems	Students describe nature by referring to ecosystems such as forests, meadows, and lakes. Urban green spaces, such as parks and gardens, are also included in this category as urban ecosystems.	"For me, nature means forest and meadow." (male, 11 years)
2	Living nature	Students describe nature through living organisms, such as plants, animals, fungi, or more generally, as something living.	"Calmness, love, forests, life, air." (female, 11 years)
3	Leisure and recreation	Students describe nature as a place for leisure activities. This includes playing, physical activity in nature, nature as a meeting place or place of discovery, and nature as a recreational space.	"A recreational space where I like to spend my free time. You can observe and discover many things, and it is good for me." (female, 12 years)
4	Abiotic nature	Students describe nature by referring to its non-living components, such as water, rocks, oxygen, and air.	"Nature is freedom. Nature is fresh air. Minecraft." (male, 12 years)
5	Aesthetic description	Students describe nature as something beautiful or associate it with the colour green.	"I think nature is the green with different animals and the fresh air. Unfortunately, we are currently destroying it." (male, 12 years)
6	Emotions and attitudes	Students describe their affection or aversion towards nature and the feelings that nature evokes in them. Statements expressing enjoyment, enthusiasm, or excitement about nature are also included in this category.	"Nature is the best thing in the world for me; I cannot live without nature. I forget all stressful things when I am in nature." (female, 12 years)
7	Freedom	Students describe nature as freedom or as a place that evokes a feeling of freedom.	"A place where I can feel free." / "For me, nature is freedom. There you can do anything you want." (female, 11 years)
8	Importance of nature	Students describe nature using the general term "important" or as a basis for human life.	"Nature is very important to me because without nature, there is no oxygen." (male, 11 years)
9	Almost free from humans	Students describe nature as neither created nor influenced by humans, or as a place where almost no humans are present.	"For me, nature is everything that has not been created by humans." (male, 12 years)
10	Environmental protection	Students describe nature as something worth protecting or state how nature or the environment can be protected.	"You should not throw rubbish on the street or into the sea." (female, 11 years)
11	Rural reference	Students describe nature through buildings commonly found in rural areas or through rural places where acquaintances or relatives live.	"Forest and meadow. At both of my grandparents' villages." (male, 11 years)

3. Results

The eleven inductively developed main categories, including definitions and anchor examples in the original wording, are presented in **Table 1**.

As shown in **Figure 1**, “ecosystems” (44.4%) was the most frequently mentioned category, followed by “living nature” (41.2%) and “leisure and recreation” (34.0%). Approximately one fifth of the students referred to “abiotic nature” (20.9%) and provided an “aesthetic description” of nature (18.0%). “Emotions/attitudes” were mentioned by 14.7% of the respondents. These six categories are further divided into subcategories, which are discussed in more detail. Among the categories without subcategories, “freedom” (9.2%) was the most frequently mentioned, followed by “importance of nature” (6.5%). The remaining three categories were each mentioned by fewer than 5% of the surveyed students.

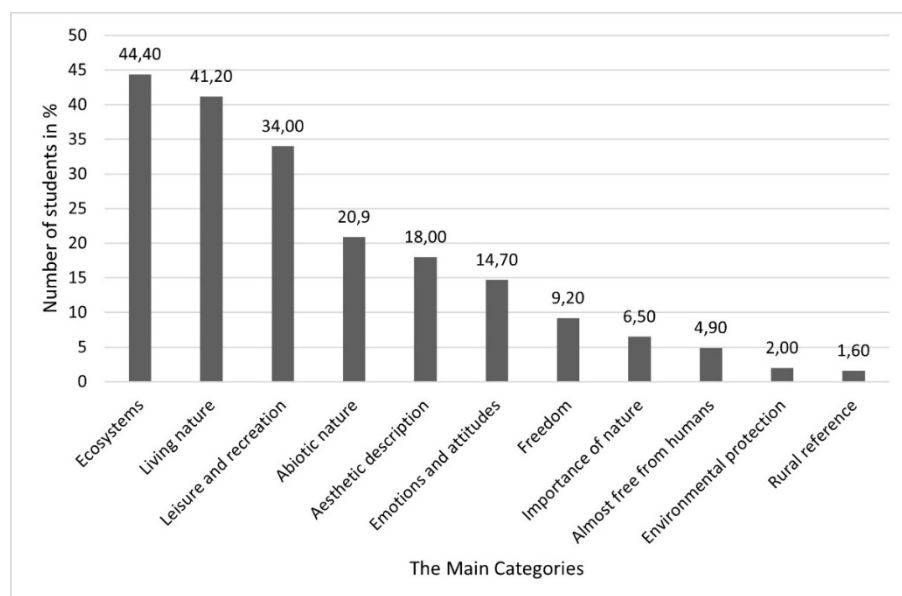


Figure 1. Percentage frequencies of the main categories regarding 6th-grade students' understanding of nature. The percentages refer to the valid responses ($n = 306$) and indicate what percentage of students mentioned the respective category. In total, the percentage exceeds 100%, as each student could mention several categories.

3.1. Ecosystems

The category “ecosystems” consists of the five subcategories “forest,” “meadow,” “green spaces,” “aquatic ecosystems,” and “other ecosystems.” In total, 136 students described nature as an ecosystem or explicitly mentioned ecosystems. Approximately 83% of all students mentioned an ecosystem referring to forests, around one-third to meadows (33.1%), and one-fifth to green spaces, such as parks and gardens (20.6%). Aquatic ecosystems were mentioned by 20 of the 136 students (14.7%). Other ecosystems, such as deserts and caves, were mentioned by only a small proportion of the students (3.7%).

Some examples:

- “Forest, animals of all kinds, natural rivers, sea, plants” (female, 11 years old)
- “Rivers, mountains, desert, caves, forest, sea” (male, 11 years old)

3.2. Living Nature

The category “living nature” includes the subcategories “flora,” “fauna,” “fungi,” and “living organisms”. Overall, the category “living nature” was mentioned by 126 students. “Flora” was described most frequently (72.2%), followed by “fauna” (61.1%). Eight of the 126 students used the term “living organisms” (6.4%), and four mentioned “fungi” (3.2%) as an example of nature.

For example:

- “Nature means to me, for example, many plants, animals, green spaces and yes. Many living beings” (female, 14 years old)
- “Plants, fungi, forests, lakes, mountains, seas, streams and rivers” (male, 11 years old)

3.3. Leisure and Recreation

The category "leisure and recreation," which was described by 104 students, is divided into five subcategories. More than half of all students who mentioned "leisure and recreation" described nature as a "place of recreation" (53.8%). The second most frequently mentioned subcategory was "physical activity in nature" (40.4%). Nature was described considerably less frequently as a "place of discovery" (10.6%), a "meeting place" (7.7%), or a "place to play" (6.8%).

For example:

- "In the forest or somewhere where you can spend time without traffic noise." (female, 11 years old)
- "To me, nature is pure relaxation!" (female, 11 years old)
- "Lots of trees, relaxing, climbing, hiking, having peace and quiet" (female, 12 years old)

3.4. Abiotic Nature

The category "abiotic nature" is divided into the three subcategories "Air," "Mountains," and "Other Parts of abiotic nature" and was mentioned by 64 students. Most students who mentioned parts of abiotic nature referred to "Air" (64.1%). The subcategory "Mountains" was mentioned second most frequently (35.9%). The remaining responses fall under other parts of abiotic nature or abiotic factors, such as sun, water, snow, wind, and stones (17.2%).

For example:

- "I think of lots of fresh air (...)" (female, 11 years old)
- "Forest, wind, sun, mountains, animals, huts, long meadows" (male, 11 years old)

3.5. Aesthetic

The category "aesthetic description" consists of the subcategories "green color" and "beauty." It was mentioned by 55 students, with 34 responses assigned to the subcategory "green color" (58.2%) and 24 responses to the subcategory "beauty" (43.6%).

For instance:

- "Home of animals and the greenery of the world" (male, 11 years old)
- "To me, nature is something especially beautiful. I feel most comfortable there." (male, 11 years old)

3.6. Emotions and attitudes

The category "emotions" is divided into "positive emotions" and "negative emotions". It was mentioned by 45 students, almost all of whom described a positive emotional connection to nature (95.6%). Two students expressed negative emotions toward nature (4.4%).

Their responses are presented below:

- "Something special. Nature is like a good friend to me (...)" (female, 11 years old)
- "Nature makes me happy. I like nature." (female, 11 years old)
- "Nature is beautiful, but I hate mosquitoes and I hate insects" (male, 11 years old)
- "Very beautiful, can be boring, can smell musty" (female, 11 years old)

4. Discussion

The findings indicate that Austrian middle school students' understanding of nature is multidimensional but strongly shaped by concrete, familiar natural elements. Most frequently, students described nature through ecosystems, especially forests, as well as through living nature, leisure and recreation, and, to a lesser extent, abiotic components, aesthetic qualities, and emotional responses. This pattern is broadly consistent with previous research showing that children and adolescents often conceptualize nature primarily through visible natural elements such as plants, animals, landscapes, forests, water, and other ecosystems (Aaron & Witt, 2011; Bolzan-de-Campos et al., 2018; Collado et al., 2016; Hahn, 2018; Kleespies et al., 2021; Pointon, 2014; Tillmann et al., 2019).

A particularly prominent result is the central role of forests in students' conceptions of nature. Among those who mentioned ecosystems, the forest was by far the most frequent example. Similar findings have been reported by Hahn (2018) and Kleespies et al. (2021), who also identified forests as highly salient elements in children's and adolescents' understanding of nature. This dominance may be explained by several interacting factors. First,

forests are highly visible in Austria, where forested areas constitute a substantial part of the landscape. Gebhard (2020) further highlights the psychological and cultural significance of forests, which may represent freedom, calmness, mystery, and emotional depth. Third, the school curriculum and biology textbooks may reinforce this emphasis, as forests are prominently featured in the Austrian biology curriculum for this age group. However, because the timing of classroom instruction was not controlled, it remains unclear whether recent forest instruction influenced students' responses.

Students also frequently described nature through living organisms, especially plants and trees. This finding is noteworthy in relation to the concept of "plant blindness" proposed by Wandersee & Schussler (1999), which holds that plants are often overlooked relative to animals. In the present findings, however, plants were more frequent than animals, although this may partly be due to the inclusion of trees in the plant category. The strong presence of trees may again reflect their association with forests and their symbolic importance in children's perceptions of nature (Gebhard, 2020).

Beyond ecological elements, many students understood nature as a place for recreation, relaxation, movement, and leisure. This supports earlier findings that children's definitions of nature often include outdoor activities and personal experiences (Aaron & Witt, 2011; Collado et al., 2016; Tillmann et al., 2019). The frequent description of nature as a place of calmness and recovery also corresponds with research demonstrating positive effects of nature contact on mental and physical health, including stress reduction, attention restoration, and psychological well-being (Claßen & Bunz, 2018). In terms of Kellert's (1993) biophilia framework, these responses reflect a naturalistic value orientation, in which nature is appreciated for its positive effects on human experience.

Aesthetic and emotional dimensions were also present, although less dominant. Students associate nature with the color green, beauty, freedom, joy, relaxation, and affection. These findings indicate that nature understanding is not merely cognitive or ecological, but also relational and effective. This supports Meske's (2011) argument that concepts of nature provide insight into children's relationship with nature. At the same time, explicitly negative emotions were rare, suggesting that nature was predominantly associated with positive experiences. Unlike findings from contexts where nature may be linked to danger or insecurity (Adams & Savahl, 2015), Austrian students rarely described nature as threatening.

Interestingly, nature conservation and untouched nature were mentioned only rarely. This contrasts with studies in which environmental protection or human-free nature played a stronger role (Collado et al., 2016; Hahn, 2018; Vining et al., 2008). One possible explanation is the participants' urban background, as previous studies suggest that rural children more often refer to conservation, food production, and human dependence on natural resources (Bolzan-de-Campos et al., 2018; Collado et al., 2016). Overall, the results show that students' understanding of nature is shaped by ecological knowledge, everyday experience, cultural symbols, school learning, and emotional relationships. Future studies should complement open written responses with interviews to clarify whether the absence of references to humans, conservation, or untouched nature reflects genuine conceptual exclusion or simply the limits of the chosen method.

5. Conclusions

The findings show that Austrian students' understanding of nature largely corresponds with previous research. Differences mainly concern the frequency of individual categories and the way categories are defined, which is to be expected in qualitative research. More than 40% of the students described nature through ecosystems, particularly forests, or through living nature, with plants, especially trees, being mentioned slightly more often than animals. In addition, one quarter of the students referred to abiotic elements of nature, while around one-fifth associated nature with green and/or beauty.

Furthermore, one-third of the students integrated aspects of leisure and recreation into their understanding of nature. Their responses also reveal an emotional relationship with nature: students described nature through feelings such as freedom, relaxation, and joy,

while some expressed affection using words such as “love”, “great”, and “wonderful”. However, nature conservation was rarely included in students’ descriptions. Similarly, the idea of untouched nature was mentioned only infrequently, unlike in several previous studies. Overall, the results suggest that students mainly understand nature as a familiar, living, aesthetically pleasing, and emotionally meaningful space, but less often as a system requiring protection or as a space independent of human influence.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki. For this study, ethical approval was not required. The sample was informed in advance that participation is voluntary, and that data collection takes place anonymously. According to Austrian law, approval of an ethics committee was not necessary as this study did not involve patients, was non-invasive, and participation was voluntary and anonymous.

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