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RESEARCH ARTICLE

Exploring young people's visual perceptions of nature on urban school grounds: Insights from a visitor-employed photography walk for environmental education

Johanna Trummer[1] | Lucas Weinberg[2] | Jerylee Wilkes-Allemann[3] | Karin Oberauer[1,4] | Lars Keller[1]

[1]Research Unit Education and Communication for Sustainable Development, Department of Subject-Specific Education, University of Innsbruck, Innsbruck, Austria

[2]Research Unit Mathematics and Science Education, Department of Subject-Specific Education, University of Innsbruck, Innsbruck, Austria

[3]Bern University of Applied Sciences (BFH), School of Agricultural, Forest and Food Sciences (HAFL), Zollikofen, Switzerland

[4]Department of Geography, University of Innsbruck, Innsbruck, Austria

Correspondence
Johanna Trummer
Email: johanna.trummer@uibk.ac.at

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Abstract

1. Urban growth and densification increasingly limit children's and young people's access to natural environments. Since they spend a considerable amount of time within school grounds and their immediate surroundings during their childhood, daily encounters with nature are often closely linked and restricted to these environments. Research shows that exposure to nature on school grounds fosters well-being and resilience, and even a green view from the classroom window supports stress recovery. However, little research has focused on how young people (aged 14–16 years) visually perceive nature in this particular environment and how these perceptions reflect their understanding of nature itself.
2. This study uses a mixed-methods approach, combining visitor-employed photography walks with young people ($n = 58$) on school grounds and their surroundings in Austria and Germany, with a quantitative survey. A total of 570 photographs and accompanying written log book entries were analysed using qualitative content analysis. Correlational analyses were conducted to identify the relationships between quantitative responses and visual perceptions.
3. Our findings reveal that young people's perceptions of nature are multifaceted, ranging from detailed observations of specific natural elements, such as blossoms and flowers, to landscape scenes that encompass multiple natural components. Participants who rank nature as less important tend to photograph landscape scenes rather than detailed natural elements.
4. Additionally, the results highlight young people's perceptions of anthropogenic influences, for example, littering, recreation and sports grounds (e.g. volleyball courts and football fields). These observations reflect young people's understanding of, on the one hand, the negative impact of humans on nature and, on the other hand, the opportunities school grounds and their surroundings offer for recreation and social interaction.

5. This study demonstrates the potential of school grounds and their immediate surroundings to serve as accessible natural spaces that support daily experiences of nature. By integrating existing natural elements, for example, vegetation, specific plant species and water bodies, into formal education, educators can foster environmental awareness, well-being and social interaction among young people. More broadly, the findings provide evidence to inform urban planners and policymakers in designing multifunctional school grounds that meet the diverse needs of young people.

KEYWORDS
education, nature, urban environment, visitor-employed photography, visual perception, young people

1 | INTRODUCTION

'*A dandelion that finds its way through a path sealed by humans*' (66_01, participant from Vienna, 15 years old). This quote by a young person participating in this study is an interesting example of how this age group perceives nature in urban environments today. Environments that are subject to continuing urban growth and densification at the expense of natural environments (Díaz et al., 2019). Urban densification, a strategy that increases infrastructure density to accommodate rising populations (Broitman & Koomen, 2015), further reduces access to natural environments, as land is repurposed for construction (Hartig & Kahn, 2016; Rantala & Puhakka, 2020; Verheij et al., 2023). Therefore, in modern and densely populated residential areas, space for urban green areas is restricted and underrepresented (Bäcklin et al., 2024). For these reasons, the increasing number of children (i.e. aged 5–14 years; UN, 2024) and young people (i.e. aged 15–24 years; UN, 2024) growing up in urban environments tend to experience fewer direct interactions with nature due to declining biodiversity and disrupted ecosystems compared to those in rural settings (Collado et al., 2015; Montràs-Janer et al., 2024; Price et al., 2022; UNICEF, 2022). A trend that is further intensified with children's increasing age and the development of turning into young people (Keith et al., 2021; Michaelson et al., 2023; Rivera et al., 2022). Consequently, these trends significantly impact how young people interact and relate to nature, for example, how much they value nature (Keith et al., 2021).

The need and interest to explore young people's experiences and perceptions of nature becomes particularly evident in the increasing number of published research addressing this topic (Chawla, 2020). A key motivation for this research is that young people often perceive nature differently from adults (Gebhard, 2020; Tillmann et al., 2019). For instance, young people are more likely to have a more diverse understanding of nature by also including abiotic elements, such as mountains and rocks, whereas adults rarely do so (Gebhardt et al., 2020). Children and young people also tend to experience contact with nature as more 'dynamic, surprising, and adventurous', particularly when playing. As a probable consequence, adults frequently emphasize their emotional bonds to nature formed during childhood (Kellert, 2002).

The exponential increase of published research on this topic in recent years is also reflected in studies focused on urban environments. It is well documented that spending time outdoors and directly experiencing nature enhances young people's appreciation and perception of both nature and the natural environment (Rastgo et al., 2024). Furthermore, increasing engagement with nature can also foster behavior change promoting an increased sense of responsibility for biodiversity and pro-environmental action (Soga & Gaston, 2024). Besides behaviour change, research reveals that engagement with urban green environments promotes young people's physical well-being and mental health (Kabisch et al., 2017; McCormick, 2017; Tillmann et al., 2018), supports stress relief (Akpinar, 2016) and helps develop a sense of belonging (Hallam et al., 2021). Moreover, urban green environments serve as vital social settings that foster the development of social skills (e.g. interaction with peers) and social relationships (Chawla et al., 2014; Del Pérez Pulgar et al., 2020; Ward et al., 2016).

Since children and young people spend a considerable amount of time during their childhood within school grounds and their immediate surroundings, daily encounters with nature are often closely linked and limited to these environments (Baró et al., 2022; OECD, 2024). In recent years, these spaces have gained more research attention in addition to formal green spaces, such as parks and urban forests. For example, Baró et al. (2021), Shoari et al. (2021), Gallez et al. (2024), Howlett and Turner (2023a) and van Velzen and Helbich (2023) examine urban children's and young people's unequal access to nature from a school perspective. Unequal access to nature is also evident along school routes and can be traced back to socio-economic differences (Khanian, Łaszkiewicz, & Kronenberg, 2024; Khanian, Łaszkiewicz, Kronenberg, & Sikorska, 2024). Children with lower socio-economic status typically pass fewer natural elements on their school routes than their peers with a higher socio-economic status (Khanian, Łaszkiewicz, & Kronenberg, 2024). Even if green areas are available in the close surroundings of schools, factors such as lack of time or transport possibilities limit access possibilities (Gajdek et al., 2025; Walker et al., 2021). These studies often employ spatial

analyses and remote sensing data to detect such patterns. However, children's and young people's perspectives are also included in research investigating their interactions with nature in school contexts. For instance, Lindemann-Matthies (2006) explores the perceptions of biodiversity of primary school students on their way to school, and Montgomery et al. (2022) and Chawla et al.'s (2014) research focus on young people's and children's perceptions of nature on their school grounds in the light of well-being and resilience. According to Li and Sullivan (2016), already a green view from the classroom window assists in recovering from stress and supports perceived well-being. Jansson et al. (2014) examine how young people experience the greening process of a school yard, while Akoumianaki-Ioannidou and Tachou (2016) go more into detail and investigate children's and young people's knowledge about the specific plant species present on school grounds and Aminpour (2021) reveals that children prefer plant species (e.g. bushes) that can be integrated into their games.

Already Kaplan and Kaplan (1989) demonstrate that the way individuals perceive and experience nature is initially visual, which consequently results in the value they associate with it. They propose that landscape perception and preferences are shaped by both informational and aesthetic qualities (Kaplan & Kaplan, 1989). This importance of visual sensory perception is also highlighted by To and Grierson (2020, 2024), who investigate children's visual and non-visual sensory experiences on three primary school grounds. They explore primary children's visual perceptions of in-class and school yard environments by collecting drawings and short questionnaires (To & Grierson, 2024). To and Grierson (2020) develop an evaluation scheme of school grounds to assess visual and non-visual sensory experiences. Liu and Green (2025) combine photographs as visual stimuli with interviews to explore visual perceptions of urban nature among children aged 8–12 years in Beijing, China. Similarly, Tunstall et al. (2004) analyse more than 500 photographs taken by children to investigate their perceptions of London's river landscapes, while Shakespear et al. (2020) apply the same method in Ontario, Canada, to gain a deeper understanding of children's conceptions of, and connections to nature in general. Collectively, these publications underscore the value of examining children's and young people's visual perspectives. However, none of these studies neither focus on young people older than 12 years, nor do they extend their focus beyond primary school settings when school grounds were the research context. Addressing these gaps, the present study examines visual perceptions of nature among young people aged 14–16 years on school grounds and in their immediate surroundings.

Given the impacts of urbanization on natural environments, preserving natural ecosystems in urban environments is becoming increasingly urgent (van der Plas, 2019). However, simple exposure to nature contributes only partially to long-term engagement, such as the commitment to conservation (Keith et al., 2022b; Lumber et al., 2017), but in combination with nature-focused activities and learning about nature and the outdoors, sustained engagement can be fostered more impactfully (Deisenrieder et al., 2022; Keith et al., 2022b; Kowarik et al., 2025). Laying the foundation for long-term engagement requires a better understanding of how young people visually perceive nature on school grounds and in their surroundings, as these perceptions are shaped by the qualities Kaplan and Kaplan (1989) have identified. Gaining deeper insights into young people's relationship with nature in these environments can help illustrate their perceptions and identify suitable settings for environmental education and nature-based activities in an accessible distance. By doing so, this not only contributes to the long-term goal of fostering contact with nature, enhancing environmental awareness and knowledge, but also going beyond by including 'meaning, emotion, compassion and beauty' (Lumber et al., 2017, 21), thereby supporting urban young people's relationship with nature, a key area of interest in this study.

Thus, this study's objective is to investigate (i) how young people visually perceive nature, (ii) which natural elements attract their interest and (iii) how these perceptions reflect their understanding of nature on school grounds and in their immediate surroundings. To achieve these goals, we performed workshops with young people from two high schools in Austria and Germany.

2 | MATERIALS AND METHODS

This study, applying a visitor-employed photography walk followed by a short questionnaire, was conducted as part of a school workshop and took place on the school grounds of the two schools and their immediate surroundings in March 2024. According to Balomenou and Garrod's (2014) literature review on visitor-employed photography, the majority of published studies that revealed the number of analysed photographs (63%) worked with a maximum of 500 photographs. To achieve this number, two schools are thus sufficient.

Before the study's implementation, approval was obtained from the responsible authorities, and informed consent was obtained from the participants themselves and their parents or legal guardians. The ethical review board of the University of Innsbruck had approved this approach (Certificate of Good Standing, 69/2023).

2.1 | The selection of the schools as case study areas

The project applied a case study approach that was implemented in two German-speaking high schools, one in Vienna, Austria, and the other in Eggenfelden, Germany (see Figure 1). Both schools are partner institutions in the Austrian climate change research-education project *kidZ-21* (Keller et al., 2019; Kubisch et al., 2022), and the data collection was performed during the first *kidZ-21* school workshop of the school year. Thus, at the time of data collection, no prior knowledge about climate change or related topics could have been acquired or assumed through the *kidZ-21* project. The schools have been selected based on convenience sampling, while also considering local environmental conditions in the selection process.

Both schools are located in urban environments. Although defining 'urban' is challenging due to diverse global characteristics,

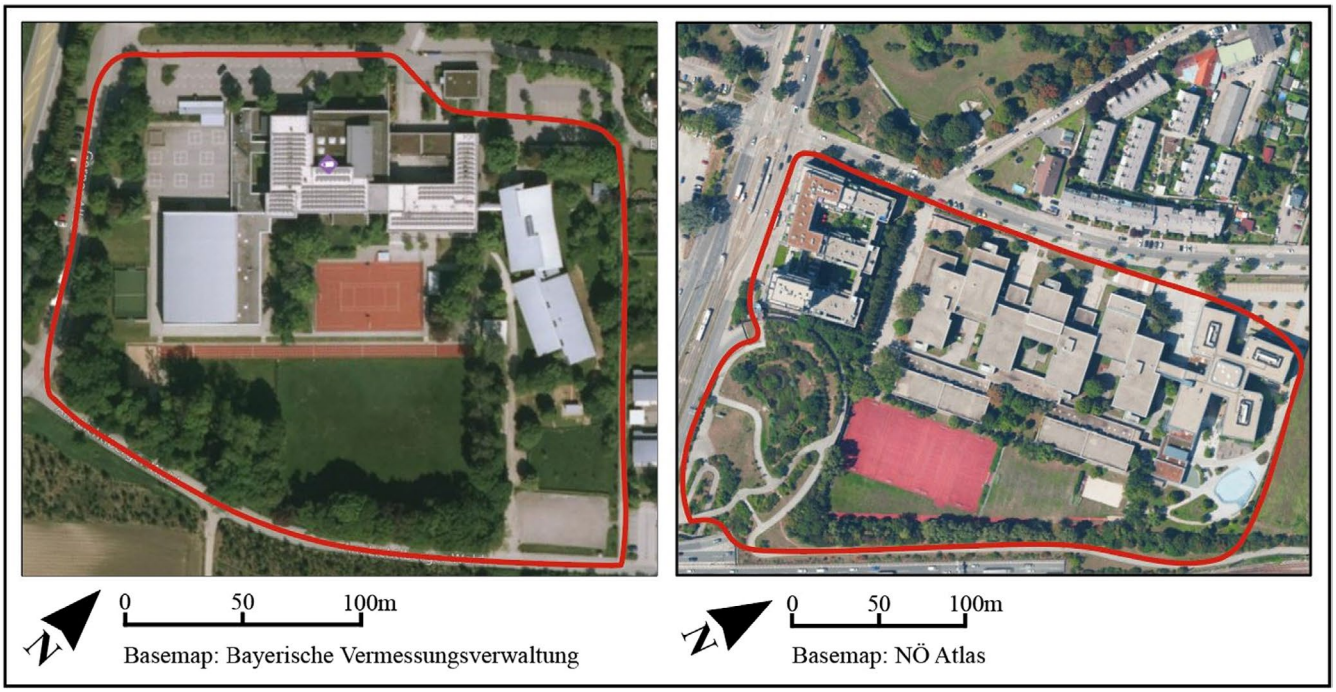


FIGURE 1 Overview map of the two school grounds and their close surroundings. Left: School in Eggenfelden, Germany. Right: School in Vienna, Austria. The red line marks the study area's border (*Source*: by authors).

common features include high population density, extensive infrastructure and significant human influence (Gebhardt et al., 2020). For this study, urban environments are defined as areas with densely built infrastructure, extensive transportation networks and constructed urban green spaces (i.e. parks, playgrounds and other vegetation on public and private grounds; World Health Organization, 2017). While natural environments consist of a variety of physical elements, for example, water, soil and biodiversity, and can be diverse in their appearance (Coppola, 2015), they do exist within cities as well but are subject to strong anthropogenic influences (World Health Organization, 2017). Parks and urban forests embody a high proportion of natural elements within urban environments. They are predominately institutionally managed by municipalities and therefore are defined as formal green spaces (Rupprecht & Byrne, 2014). In contrast, school grounds are sometimes categorized as informal green spaces due to the lack of municipal management (Rupprecht & Byrne, 2014). However, this distinction cannot be generalized as management practices may vary between countries and depend on the school management system.

In this study, the surroundings of the two participating schools qualify as urban environments yet exhibit a rather moderate population density similar to smaller towns (German school) or developing urban outskirts (Austrian school). Due to their similar geographic position with respect to the locations' latitude, both represent similar central European deciduous vegetation. In both locations, strong anthropogenic influences impact the natural environment of the school ground and its surroundings, as evidenced by the presence of man-made water bodies, recreational and housing infrastructure, and road networks (see Figure 1).

2.2 | The methodological approach

2.2.1 | Visitor-employed photography

Visitor-employed photography describes the methodological technique of using photographs taken by participants and is commonly based on a specific research question. The term was coined in the 1970s and fits under the umbrella term of participant-generated images (Cherem & Driver, 1983). Participant-generated images have primarily emerged from the social sciences, for example, anthropology and sociology (Balomenou & Garrod, 2016; Glaw et al., 2017). However, its use has also been successfully applied in landscape planning and perception studies (e.g. Nielsen et al. (2012); Rathmann et al. (2020)), outdoor recreation and tourism research (Balomenou & Garrod, 2014; Fefer et al., 2020; Winter & Adu-Ampong, 2021), as well as urban planning (Beckley et al., 2007; Gawryszewska et al., 2024; Sun et al., 2019). As depending on the various disciplines, different terms are used and more than 40 are currently established in literature (Balomenou & Garrod, 2016). For this study, the term *visitor-employed photography* was chosen, as it represents the most commonly used wording in nature and landscape studies (Cherem & Driver, 1983; Gawryszewska et al., 2024; Heyman, 2012; Nielsen et al., 2012; Oku & Fukamachi, 2006; Rathmann et al., 2020; Sun et al., 2019; Ye et al., 2020).

This method was selected for numerous reasons. First, the study aims to capture young people's visual perceptions of the study areas through this approach. Second, participant-collected visual data increase the richness of data quality beyond written and verbal information (Glaw et al., 2017). It allows participants to express their ideas in a non-verbal way, which is a particularly relevant aspect when working with an elusive concept such as 'nature'. Third, it enables a new perspective through the eyes of young people by documenting their experiences without predefined categories or patterns. Fourth, today's young people are growing up with a personal mobile phone at hand. Allowing them to engage with research using a familiar device ensures accessibility and encourages participation. Finally, this research takes advantage of the explorative character of visitor-employed photography (Rathmann et al., 2020).

Data were collected using the open-access online tool KoboToolbox, which supports qualitative and quantitative survey data collection, including the upload of visual data (KoboToolbox, 2024). The participating young people used their personal mobile phones for data collection. Since all participating young people owned a personal mobile phone, no one was excluded from data collection.

2.2.2 | Quantitative questionnaire

Its aim was to collect further information about how the participants spend time in nature in their daily lives and their attitudes towards nature. These data were intended to complement the findings from the visitor-employed photography walk and to provide a more detailed description and understanding of the study sample.

The questionnaire includes a main section covering the preferred leisure time activities, outdoor activities performed in nature and the reasons for visiting or not visiting nature. Furthermore, sociodemographic information (i.e. age and gender) and young people's personal relation with nature are recorded today and during their childhood. The questionnaire consists of closed-ended questions with single or multiple response options. Preference rankings are measured on a 5-point scale, except for one question regarding the participants' perceived importance of nature, which uses a 10-point scale. The survey items are adapted from previously tested, validated and published sources (Hegetschweiler et al., 2022; Keith et al., 2022b). The questionnaire was provided in German to the participants by using the online survey tool SoSci Survey (SoSci Survey, 2024) and took between 8 and 13 min to complete.

2.3 | Data collection

The data collection was embedded in workshops that took place in March 2024. For each school, a whole morning was designated for the workshop, of which 80 and 100 min were needed for the data collection. Warm spring temperatures and sunny conditions characterized the data collection days. The participants were between 14 and 16 years old. Their participation was voluntary, resulting in a convenience sample.

The data collection was structured as follows: First, in an indoor setting, the participants were asked to document their perception of nature by taking at least 10 photographs with their personal mobile phones during a walk around the school grounds and their immediate surroundings. To avoid preintervention bias, no predefined definition of nature was provided. Second, participants were asked to provide a short log entry for each photograph to document their motivation for capturing the image and to describe its content and key elements. Third, participants were introduced to the online tool KoboToolbox, its functions, and the data collection method of visitor-employed photography (see Chapter 2.2.1). Access to the tool was provided via a prepared QR code. Finally, they were instructed to complete this exercise individually and to avoid taking pictures of people for anonymity and privacy reasons.

As the research area represented the school grounds and their immediate surroundings, the participants were already familiar with the study area. The study area is depicted in Figure 1. After the walk, the participants completed the short quantitative questionnaire (see Chapter 2.2.2).

After removing 17 invalid photographs from the dataset, 570 photographs and the corresponding photo log entries from 58 participants were used for further analysis. The data were processed to meet the prerequisites of the qualitative data analysis software MAXQDA, version 24.1.0 (MAXQDA, 2024). The survey data of the corresponding 58 participants were screened for completeness and prepared for statistical analysis.

2.4 | Theoretical framework for data analysis

To guide the data analysis, we refer to Kaplan and Kaplan's (1989) theory on landscape perception. A central aspect of their theory is that they are shaped by both informational and aesthetic qualities. Based on this theory, they have developed the distinction between 'content' and 'spatial configuration', which influences how individuals process and engage with the surrounding environment. The former refers to the content, specific details, or elements present in a scene, whereas spatial configuration refers to the arrangement of multiple elements in a scene, where the general situation is the focus rather than one particular element (Kaplan & Kaplan, 1989). According to Kaplan and Kaplan (1989), any perceived situation is automatically assessed according to these two main categories. This framework provides a foundation for analysing the data collected through the visitor-employed photography walk.

2.5 | Data analysis

To analyse the content of the photographs, a qualitative content analysis according to Mayring and Fenzl (2019) is conducted. This is

TABLE 1 Overview of the classification of the inductively developed coding system based on the 570 analysed photographs.

Classification of codes
1. Atmospheric phenomena
1.1. Sky
1.2. Sun
1.3. Clouds and fog
2. Vegetation
2.1. Forest
2.2. Trees
2.3. Tree details
2.4. Bushes
2.5. Dead wood and fallen leaves
2.6. Flowers and blossoms
2.7. Grass and moss
2.8. Other plants
3. Water bodies
3.1. Running water
3.2. Stagnant water
4. Geological materials
5. Animal related
6. Intensive anthropogenic influence
6.1. Aesthetics
6.2. Recreation
6.3. Forestry and agriculture
6.4. Transport and infrastructure
6.5. Pollution
7. Reference to nature

Source: by authors.

combined with the content of the photo log entries. The main classification is based on Kaplan and Kaplan's (1989) theory introduced in Section 2.4. This primary form of classification is prevalent when analysing visitor-employed photographs and was already applied in comparable studies of, for example, by Qiu et al. (2013), Rathmann et al. (2020) and Nielsen et al. (2012). Both categories are subsequently further divided into additional categories that developed inductively during the bottom-up coding approach. A detailed list of the classification system is presented in Table 1. Visual examples for each of the represented categories are included in the results section and in the Supporting Information S1.

The comments in the photo logs are checked simultaneously during the coding process to understand the participants' perception of the motives. Only objects and elements referred to in the photo log entries and visible on the photographs are coded. As certain photographs contain more than one natural element, they are assigned to multiple categories. The photo log entries cited in this paper are directly translated from German. No wording is altered in order to preserve the accuracy of the information conveyed by the participants.

Consequently, the photo log entries ($n = 570$) are analysed not as supporting information, but as text data. This is also performed by qualitative content analysis (Mayring & Fenzl, 2019), and the analysis focused on the description of the natural elements and settings referred to in the entries in order to gain deeper insights into the understanding of young people's perception of nature. Categories are created inductively based on the underlying data. As with the photographs, it is possible that photo log entries are assigned to multiple categories because the participants refer to multiple elements in the photograph. The derived coding system is included in Table 2.

The coding and the first suggestion of the coding system was primarily conducted by one researcher. Subsequently, 50% of the data was coded by a second researcher. The two researchers revisited divergent codings. After a consensus was reached, the coding system was finalized and applied to the entire dataset.

Finally, to determine the relationship between the perception of nature on school grounds and its surroundings (i.e. absolute number of coded photographs per person) and the participants' interactions with and attitudes towards nature in general (i.e. corresponding quantitative questionnaire results) as well as within the two categories, Spearman-correlation analyses were performed. The survey's data analysis was performed with the software program IBM SPSS Statistics, Version 29.0.0.0 (IBM, 2024).

3 | RESULTS

3.1 | Socio-demographics, personal habits and relations to nature

Out of the 58 participating young people, 37 (64%) are female and 21 (36%) male. They are between 14 and 16 years old (mean = 15.5 years, SD = 0.5 years). The importance of nature in general is ranked high, with an average score of 8.0 (SD = 1.8) out of 10. High rankings are particularly associated with the motive of simply enjoying the experience (0.517; $p < 0.001$) and the preference for observing nature (0.365; $p < 0.005$). Additionally, 60% of the participants report spending childhood holidays on campsites, farms or outside hiking, and 70% mention taking weekend trips to the countryside with their family several times a year with a high correlation between these two categories (0.639; $p < 0.001$).

The participants most frequently spend their time outside in green areas/lawns or at outdoor sports facilities, for example, football fields and basketball courts. They like to spend their leisure time with friends (mean = 4.3; SD = 0.9) or family (mean = 3.8; SD = 1.1) as well as doing sports (mean = 3.8; SD = 1.1). While not explicitly stated, these activities can also be pursued outdoors. The most common outdoor activities reported are meeting friends (57%), going for a walk (47%), playing team sports (28%) and observing nature (19%). A correlation between participants who included observing nature as a main activity and the high general importance of nature is detected (0.365; $p < 0.005$). The primary motives for spending time in nature include its calmness, the

TABLE 2 Overview of the inductively developed coding system based on the analysed photo log entries ($n = 570$).

Classification of codes	Description	Examples
Simple description	The participant named the content of the photograph without additional descriptions, unless descriptions of location in the scene	A forest and sky (photo log entry 32_01) Tree stump, flowers and grass (photo log entry 13_04) Forest (photo log entry 22_06)
Descriptive adjectives	The participant described the content of the photographs by using colours, information on height, dimension or state of the natural elements	Purple flower (photo log entry 14_03) Big tree (photo log entry 26_02) Another tree with yellow flowers (photo log entry 38_09)
Approval/disapproval	The participant made a subjective statement of approval or disapproval when describing the content of the photograph	Grass with bushes. Everything is very well maintained (photo log entry 13_01) A beautiful green meadow with beautiful flowers 38_07 Lots of plastic in a beautiful landscape (photo log entry 64_03)
Specific definitions	The participant described the, for example, flower by using its colloquial name or specifically included the official name of a place, street, river	View on the small river Gera (photo log entry 4_09) Black bird (photo log entry 5_14) Daffodils (photo log entry 27_06)
Unspecified naming	The participant applied colloquial, unspecific language to describe the content on the photographs	Yellow thing on the tree (photo log entry 32_05) Sausages on trees (photo log entry 46_06) Trees with these kind of things (photo log entry 57_06)
Anthropogenized nature	The participant chose terms connoted a human influence, for example, 'field', 'lawn', 'alley' and 'garden' to describe the content on the photographs	Tress Meadows and fields (photo log entry 13_08) Garden (photo log entry 17_01) Alley (photo log entry 21_10)

Source: by authors.

opportunity to meet friends and simply enjoying the experience. The most frequently cited barriers to spending time in nature are a lack of time and the fact that their peers often do not spend time outdoors either.

3.2 | Visual perception of young people through visitor-employed photography

Out of the 570 photographs analysed, 369 (65%) are categorized as spatial configurations, as they either depict a specific landscape scene or do not focus on a single object. The remaining 201 (35%) are classified as content configurations. This significant dominance is also reflected in the correlations (−0.841; $p < 0.001$). Participants refer to a minimum of one object and a maximum of three distinct elements in a single photograph. Generally, content configurations feature a single object, while spatial configurations include at least one object. In Table 3, the distribution of tags according to their affiliation with the corresponding classification codes is listed. Tags refer to the number of coded elements ($n = 793$). These do not correspond to the number of photographs ($n = 570$), as multiple codings are possible.

Considering the identified categories in the context of existing nature studies involving young people, they align with previously published findings. However, a closer examination reveals novel insights that can be attributed to the methodological approach employed in this study.

As expected and in line with the literature (e.g. see Howlett and Turner (2023b) and Gebhard (2020)), vegetation is the most frequently photographed element (519 coded tags). Spatial configurations dominate *Vegetation* (315 tags), while 204 coded tags are assigned to content configurations. For spatial configurations, the three main subcategories consist of *Trees* (111 tags), *Grass and mosses* (62 tags) and *Bushes* (52 tags). Moreover, the results depict a trend that participants who rank low in general importance of nature preferably take photographs of *Vegetation* categorized as spatial configurations (0.295; $p < 0.025$). Content configurations include *Flowers and blossoms* (84 tags), *Trees* (36 tags) and *Grass and mosses* (31 tags) as the most frequently captured subcategories. Considering each category's number of tags, the findings show that particularly small natural elements are captured as content configurations. These specific results are associated with the applied method and go beyond previous research in this field. For each of the categories (2.1–2.8), one example is included in Figure 2. For more examples, see Supporting Information S1.

The second most frequent category coded is *Intensive anthropogenic influence*. In total, 129 tags are recorded with a majority as spatial configurations (101 tags; 0.411; $p < 0.001$). It refers to the anthropogenic impact that the participants perceived as worth documenting as part of this study, although the exercise focused on the perception of nature. Examples for categories 6.1–6.5 are depicted in Figure 3; for more examples, see Supporting Information S1. This category contains a surprisingly high number of photographs because 'animals' often form the category most frequently mentioned after vegetation, as shown in many other studies related to nature (e.g. see Howlett and Turner (2023b) and Gebhard (2020)). Thus, further analysis and differentiation are necessary.

According to the photo log entries, the participants refer to these anthropogenic elements not as part of nature, but rather to indicate a spatial reference to a natural element in the photograph

TABLE 3 A summary of the photographs' codings listed according to the respective category.

Classification of codes	Number of tags[a]	
	Spatial configuration (% of total number of mentioned tags)	Content configuration (% of total number of mentioned tags)
1. Atmospheric phenomena	14	3
1.1. Sky	5	3
1.2. Sun	6	0
1.3. Clouds and fog	3	0
2. Vegetation	315	204
2.1. Forest	26	2
2.2. Trees	111	36
2.3. Tree details	0	13
2.4. Bushes	52	18
2.5. Dead wood and fallen leaves	22	14
2.6. Flowers and blossoms	42	84
2.7. Grass and mosses	62	31
2.8. Other plants	0	6
3. Water bodies	51	3
3.1. Running water	10	0
3.2. Stagnant water	41	3
4. Geological materials	1	8
5. Animal related	10	6
6. Intensive anthropogenic influence	101	22
6.1. Transport and infrastructure	43	6
6.2. Aesthetics	4	0
6.3. Forestry and agriculture	8	5
6.4. Recreation	23	5
6.5. Pollution	23	6
7. Reference to nature	37	12
Total number of tags	535	258

[a]Tags refers to the number of coded elements.

Source: by authors.

(Figure 4, left), emphasize the environmental issues that develop due to the presence of this infrastructure (Figure 4, middle), or point out infrastructural resources that support access to nature or outdoor recreation (Figure 4, right).

The subcategory *Transport and infrastructure* (49 tags) includes photographs of road and railroad infrastructure, as well as vehicles and buildings, for example, school and industrial buildings. Photographs related to *Recreation* (28 tags) feature outdoor sports facilities, for example, basketball courts and football fields, park benches, as well as walking paths and bike lanes. *Pollution* (29 tags) is represented by various forms of litter. These photographs are generally associated with neutrally to negatively connoted photo log entries that stress young people's dissatisfaction with littering in the context of nature, for example, photo log entry 64_03: 'Lots of plastic in a beautiful landscape'. Two seldom mentioned categories are *Aesthetics* (four tags) and *Forestry and agriculture* (13 tags). The former includes an alley, and the latter features natural elements that, based on the photo log entries, are directly connected to anthropogenic influence due to forestry and agriculture. For example, a 'Tree nursery' (photo log entry 28_05), consisting of an accumulation of planted trees, is correctly identified and assigned to the latter category.

The category of *Water bodies* is coded 51 times in the context of spatial configurations and counts three tags for content configuration. This category combines rivers and lakes documented by the participants (see Figure 5).

Reference to nature (49 tags) refers to photo log entries where the participants do not indicate a specific natural element, but rather use terms such as 'nature', 'green' or 'natural landscape' to describe the perceived scene. For example, 'A path into nature' (photo log entry 63_01).

The three remaining categories are only captured by a minority of the participants: *Animal related* (16 tags), *Atmospheric phenomena* (17 tags) and *Geological materials* (nine tags). The first category includes documented animals, for example, insects and birds, and animal traces, for example, molehills and mouseholes. The second

2.1. Forest	2.2. Trees	2.3. Tree details
		
Photo log entry 47_05: mini forest	Photo log entry 37_01: A beautiful tree	Photo log entry 5_08: Tree bark
2.4. Bushes	2.5. Dead wood and fallen leaves	2.6. Flowers and blossoms
		
Photo log entry 38_02: Bushes and flowers	Photo log entry 13_04: Stump, flowers and grass	Photo log entry 31_04: Flowers
2.7. Grass and mosses	2.8 Other plants	
		
Photo log entry 5_03: Moss	Photo log entry 55_07: Pond with dead reeds	

FIGURE 2 Examples of how vegetation was documented by this study's participants. One example per subcategory is included (*Source*: by authors).

summarizes photographs of the sky, the sun, as well as clouds and fog. The third category features soil, stones and minerals. These categories are summarized and visualized in Figure 6.

3.3 | Additional insights of the photo log entries

The photo log entries allow for deeper insight into young people's perceptions of nature. The participants use the photo log entries to primarily name the natural elements they had visually perceived and captured on the corresponding photograph, for example, 'A forest and sky' (photo log entry 32_01) (number of tags = 374). This is supported by the numbers represented in Table 4. Furthermore, the short comments also include expressions of approval, such as 'Beautiful landscape with bushes' (photo log entry 45_07) or disapproval, for example, 'Lots of plastic in a beautiful landscape' (photo log entry 64_03) (number of tags = 69). Descriptive adjectives are inserted to better illustrate the perceived natural elements (number of tags = 187). These include predominantly descriptions of height, shape and colour, such as 'purple flower' (photo log entry 4_07) and 'big tree' (photo log entry 32_02).

Only a small number of participants is able to call documented plants and flowers by their names, apart from locally widespread daisies (*Bellis perennis*) and dandelions (*Taraxacum sect. Ruderalia*) (number of tags = 29). Instead, they distinguish flowers by their coloured attributes, for example, 'purple flower' (photo log entry 4_07),

FIGURE 3 Examples of how *Intensive anthropogenic influence* was documented by this study's participants. One example per subcategory is included (*Source*: by authors).

6.1. Aesthetics	6.2. Recreation	6.3. Forestry and agriculture
 Photo log entry 31_09: Alley	 Photo log entry 66_03: In the middle of a seemingly untouched spot, a path is visible.	 Photo log entry 69_10: flower bed
6.4. Transport and infrastructure	**6.5. Pollution**	
 Photo log 58_07: moss grows on the paths	 Photo log 66_10: Garbage in the middle of nature.	

FIGURE 4 Examples of how anthropogenic influence is referred to by participants in this study. Left: spatial reference to a natural element; middle: environmental issues that develop due to the presence of this infrastructure; right: infrastructural resources that support access to nature or outdoor recreation (*Source*: by authors).

 Photo log entry 20_08: Rusted fire hydrant with moss [lichens]	 Photo log entry 64_10: Destruction of the landscape and promotion of industry	 Photo log entry 18_05: Bridge leads into the forest

and a small number of elements are described with unspecific terms. For example, the male blossoms of the hazel (*Corylus avellana*) are named 'Sausages on trees' (photo log entry 46_06) and the 'Yellow thing on the tree' (photo log entry 32_05) (number of tags = 9).

Furthermore, while the majority of photo log entries refer to 'soil', 'grass' or 'bushes', when describing the documented aspects of nature, a small number of participants chose words that already connote a human influence, such as 'field', 'lawn', 'alley' and 'garden' (number of tags = 11). This implies that natural elements that are directly human-made and -influenced are perceived as natural and nature.

4 | DISCUSSION

In light of the identified categories derived from the collected photographs, this study supports previous research on young people's

TABLE 4 A summary of the codings of the photo log entries listed according to the respective category.

Classification of codes	Number of tags[a]
Simple description	374
Descriptive adjectives	187
Approval/disapproval	69
Specific definitions	29
Unspecified naming	9
Anthropogenized nature	11

[a]Tags refers to the number of coded elements.
Source: by authors.

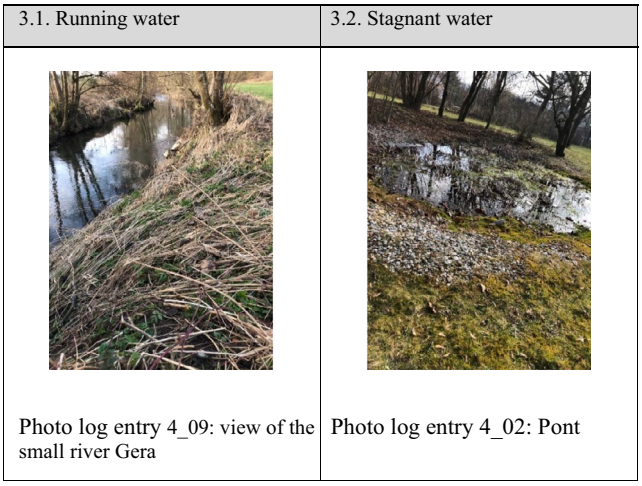


FIGURE 5 Examples of how *Water bodies* were documented by this study's participants. One example per subcategory is included (*Source*: by authors).

perceptions of nature, such as Gebhard (2020), Keith et al. (2022a) and Collado et al. (2016). Although none of these studies specifically focus on school grounds and their immediate surroundings, similar patterns are evident. *Vegetation*, for example, bushes, trees and flowers, is categorized as the most frequently perceived natural element by young people. This is not surprising and aligns with the findings of, for example, Collado et al. (2016), Gebhard (2020) and Liu and Green (2025). Animal-related natural elements, *water bodies*, *geological materials* and *atmospheric phenomena* are also identified as such. The latter category is supported by the findings of Gebhard (2020) and Liu and Green (2025). In Collado et al. (2016), however, a different methodological approach, based on responses to open questions without providing visual stimuli, may have contributed to the absence of atmospheric phenomena. Furthermore, in our study, participants captured photographs that are classified as *Intensive anthropogenic influence*. On the one hand, these reflect the association of recreational and sports activities with nature. On the other hand, they outline their perceptions of pollution and the presence of infrastructure to draw boundaries between more natural environments and stronger anthropogenic influence. In Collado et al. (2016), the participants also clearly indicate that their understanding of nature is without human influence by describing nature as a quiet place without pollution. These dual associations captured through the categorized photographs raise further questions about the underlying reasons for these perceptions (see Chapter 4.3). The results are discussed in more detail below.

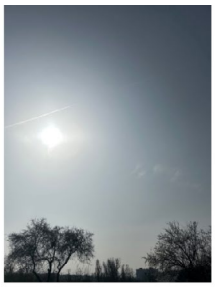
4.1 | Young people's visual perceptions of nature on school grounds and their immediate surroundings

The analysis of the collected photographs reveals an uneven distribution between the two main categories: spatial configurations (65%) and content configurations (35%). The results show that participants with lower scores of general importance of nature collected spatial configurations more frequently. This could be due to the fact that these young people lack an eye for the details of nature. Compared to this study's results, Rathmann et al. (2020) reveal a greater share of content configurations by applying visitor-employed photography. This difference may be explained by the focus of their research since they studied the perception of deadwood, a single distinct natural element compared to the overarching topic of nature (Rathmann et al., 2020).

The results of the quantitative questionnaire, supported by existing literature (e.g. Hartig and Kahn (2016), Lumber et al. (2017) and Gebhard (2020)), highlight the significant role of personal experiences in shaping young people's perceptions and understanding of nature. It is important to note that simple exposure to nature can influence these perceptions and understandings (Keith et al., 2022b; Lumber et al., 2017). However, developing a stronger relationship with nature requires more active participation through activities such as sports and emotional experiences (Lumber et al., 2017). In our study, the importance of personal experiences is reflected in the composition of the various categories identified through the analysis of the collected photographs. The findings of the questionnaire also illustrate that young people's perceptions of nature extend beyond the immediate context of school grounds and their surroundings, as the majority of participants reported regular holidays and weekend trips outside urban environments.

However, over the past decade, researchers have expressed concern about the decreasing possibilities for experiencing and interacting with nature in urban environments (Hartig & Kahn, 2016; van Vliet, 2019). In this context, Soga and Gaston (2016) even coined the term 'extinction of experience'. However, in the underlying study, none of the young people refer to a perceived loss of nature on their school grounds and surroundings. Rather, they perceive nature in relation to the local urban conditions and their previous experiences. Therefore, a more accurate description of the current development could be a 'shift of experiences', as no absence of nature perception is detected. This argument does not intend to trivialize the current situation of urban green spaces disappearing in urban environments, but instead aims to point

FIGURE 6 Examples of how the categories Atmospheric phenomena (1.), Geological materials (4.), Animal related (5.) and Reference to Nature (8.) were documented by this study's participants. One example per subcategory is included (*Source*: by authors).

1.1 Sky	1.2 Sun	1.3 Clouds and fog
		
Photo log entry 17_09: Blue sky	Photo log entry 60_09: The beautiful sun	Photo log entry 6_03: Sun forest clouds
4. Geological materials	**5. Animal related**	**8. Reference to Nature**

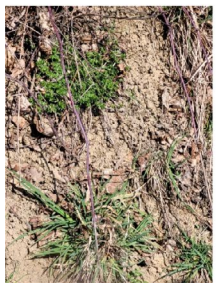



Photo log entry 29_07: Grass sprouts in dry soil	Photo log entry 5_14: Blackbird	Photo log entry 63_05: The beauty of nature

out the present possibilities for experiencing nature through activities, emotions and contact (Lumber et al., 2017) within urban environments and even within school grounds and their immediate surroundings. Particularly because it is essential not only to provide access to nature, as shown by our study's results, but also to encourage activities in these natural environments to establish relationships with nature beyond solely perceiving (Keith et al., 2022b; Lumber et al., 2017; Price et al., 2022).

4.2 | Nature on school grounds and their immediate surroundings

Today, school grounds and the surrounding formal green spaces, such as parks and urban forests, are deliberately planned by landscape architects, urban planners and designers to meet the demand of local users, for example, in terms of sports, well-being and recreation (Barron et al., 2021; Hartig et al., 2014; Jansson et al., 2018). This study's results indicate that young people also perceive anthropogenically managed and maintained natural environments as nature. Payne (2014) also shows that the children participating in his study perceive human-made objects and infrastructure as nature. This perception may be linked to the 'person-environment relations' represented by such infrastructure, as it often provides a medium through which recreational activities are performed, closely associated with nature. Entries in the photo logs of similar or even the same settings reveal that the degree of perceived human intervention in nature varies, as introduced in Chapter 3.3.

That young people are not coherent in their identification of nature is also depicted in the example of the identified category *Flowers and blossoms*. It could also be seen as two distinct categories. However, the participants are not consistent in identifying blossoms as blossoms and not flowers, and therefore, they are joined into one category. The seasonal cycle of nature comes with numerous visual variances that affect the perceptions of nature (To & Grierson, 2024). Particularly in spring, the visual appearance of flowers and blossoms due to their colourful appearance might be perceived as similar. The reason could also be the lacking skill to recognize or observe plants in one's personal environment, scientifically described as 'plant blindness' (Wandersee & Schussler, 1999). The latter is also observed by Akoumianaki-Ioannidou and Tachou (2016), as only 25% of the young people participating in their study manage to identify the plant species present on the respective school ground. However, 80% are eager to learn more about the present species. This interest, for example, is also reflected in the underlying study in the photo log entries that belong to the description of the male blossoms of the hazel (*C. avellana*) described as 'Sausages on trees'. This shows that an eye for detail is developed, but the knowledge to name is missing. Therefore, these findings imply that incorporating the present plant species on school grounds into education, for example,

through direct contact with plants, can foster young people's specific understanding of plant species, their effects and synergies. This implication aligns with Akoumianaki-Ioannidou and Tachou's (2016) results, who emphasize the need to also provide teachers with the skills and resources necessary to integrate local plant species into their education.

4.3 | Social aspects and recreation on school grounds

Although the studied environments have little in common with untouched nature, they retain natural elements and functions and serve as recreational environments that support well-being, stress relief and enhance physical fitness (Akpinar, 2016; Chawla et al., 2014; Li & Sullivan, 2016). These aspects are appreciated and visually documented by the participating young people, as they reveal a strong association with sports and social activities. This is reflected in the survey findings in the photographs collected. The predominately named activities, that is, team sports, going for a walk and social interaction with friends, stress the importance of the social aspect during leisure time activities or breaks in between lessons. Having access to green spaces for these activities additionally enhances well-being (Chawla et al., 2014) and allows the use of these environments as playgrounds and to establish social bonds (Del Pérez Pulgar et al., 2020; Tunstall et al., 2004). Similar findings refer to the main motives for visiting nature, that is, spending time with family or friends. These results are comparable to the data of Hegetschweiler et al. (2022), who explore how and why young people use urban forests. This trend is also recognizable in the collected photographs, because, besides walking paths and other recreational infrastructure, football fields and basketball courts were also captured. Although the latter represent more degraded natural environments, they are still associated with nature.

Thus, it is particularly important to provide a suitable and multifunctional infrastructure that meets the needs of the variety of preferred outdoor activities while also giving young people the opportunity to spend school breaks in natural environments. This implication is supported by Keith et al. (2022b), who underscore the need for nature-focused and outdoor activities to strengthen young people's relationship to nature. To and Grierson (2020) go a step further by incorporating the five senses, alongside the local vegetation and architecture, into their evaluation tool to measure the sensory experiences of nature on primary school grounds, arguing that sensory experiences can strongly influence the perception of these environments. According to Jansson et al. (2018), a well-balanced design that includes vegetation, seating possibilities in the shade and free-accessible sports facilities (e.g. basketball courts) can support young people to overcome their barriers, as social interactions and spending time in nature should not be contradictory. Nevertheless, Michaelson et al. (2023) highlight the urgency that adults should encourage opportunities for nature experiences for young people. An example of such an opportunity can be provided in school outdoor learning settings, where time is available and peers are present. This implication is further supported by Keith et al. (2021), who emphasize the need to adapt environmental education curricula to incorporate emotional and sensory stimulation tailored to the needs of local young people. Similarly, Lumber et al. (2017) underscore the importance of activities, emotional engagement and direct contact with nature.

4.4 | Delimitations to nature

Although ecologically degraded areas, such as sports fields, are associated with nature by young people, they also draw clear boundaries about what they do not consider to be part of nature. This finding coincides with the perceptions revealed in Collado et al. (2016). Although this was not explicitly addressed in this study's task, some participants made it clear that pollution, litter, industrial plants and transportation infrastructure fall outside their perception of nature by indicating it in their photo log entries. This implies that young people are aware of the negative impacts, for example, pollution has on natural environments, as illustrated in photo log entry 64_03: 'Lots of plastic in a beautiful landscape'. They view littering as disruptive and detrimental to natural settings, a perception that aligns with findings from de Veer et al. (2022) and corresponds to Aminpour's (2021) results, who reveal that young people are sensitive to the natural attributes of school grounds and prefer them to be well maintained.

Some participants took photographs capturing instances where nature reclaimed human-made objects: for example, moss and/or lichen on a fire hydrant (see Figure 1; photograph 20_08), on a traffic sign (see Supporting Information S1; photograph 5_10) or a bridge pillar (see Supporting Information S1; photograph 58_07). In the literature, areas reclaimed by nature are generally viewed negatively, often associated with abandoned places (Escolà-Gascón et al., 2024). Reclaimed areas are often a result of social issues (Abdullah & Rahman, 2012) and migration (Dubeaux & Cunningham Sabot, 2018). No specific data on young people's perceptions of this topic were found, and this study's data do not allow for conclusions about how young people feel about reclaimed objects. Although their corresponding photo log entries suggest a neutral attitude, it needs to be noted that the documented reclaimed objects are relatively small and are located within managed and maintained urban green spaces. These photographs give evidence of young people's mindful awareness of nature in urban environments.

4.5 | Limitations and future research

The visual perception of nature on school grounds and in their immediate surroundings varied across the collected data. Thus, getting personal insights into their choice of natural elements and scenes documented beyond the photo log entries would have been of value. Conducting follow-up focus group interviews could be implemented

in future research and would provide valuable additional information. Due to personal and data privacy considerations, participants were not allowed to take photographs of each other or third parties. This limited the ability to analyse the role of humans, who can be perceived as part of nature (Gebhard, 2020), and direct social interactions in their perception of nature on school grounds and their immediate surroundings. Furthermore, this study was performed in spring, which has influenced the type of natural elements observed and thus affected the frequency of blossom and flower photographs. Additionally, seasonal characters (e.g. weather conditions and outdoor temperatures) trigger different visual and other sensory stimuli due to, for example, colour variety, odours of plants, movement of rivers and rustling of wind (To & Grierson, 2024). Seasonal differences, including increased insect activity or more visible animal presence in summer, may reveal further variations in perception and warrant future exploration. Finally, this research was conducted in the participants' familiar environments. Future studies in more climate change-impacted environments, where young people are not in their familiar surroundings, would support a better understanding of young people's perception of nature in times of crises (e.g. climate change, biodiversity loss).

5 | CONCLUSION

This study contributes to the understanding of young people's visual perception of nature on school grounds and in their immediate surroundings in urban environments by using visitor-employed photography. While reaffirming previous research (e.g. the high value of vegetation and recreation in young people's perception of nature), it also offers new insights facilitated by the participatory visual research method. This enables a refined exploration of how young people perceive and understand nature beyond written and oral responses.

Drawing on Kaplan and Kaplan's (1989) theory that supports the data analysis process, the results demonstrate that young people's perceptions range from detailed observations of specific elements, such as blossoms and flowers, to broader scenes featuring multiple natural elements. Participants also documented anthropogenic influences, both negative (e.g. pollution, infrastructure) and positive (e.g. spaces for recreation and sports), reflecting their awareness of human impacts and understanding the opportunities school grounds and their surroundings provide for recreation and social interaction.

Importantly, this study shows that, despite concerns about a declining connection to nature in urban areas, young people continue to perceive accessible natural elements on their school grounds and surroundings, suggesting a 'shift of experiences' rather than an 'extinction of experience'. This highlights the potential of school grounds and surroundings to fulfill the complex role of providing easily accessible space to natural environments that meet the multifunctional needs of their users to foster everyday nature experiences that support well-being, social interaction and environmental awareness. By integrating present natural elements into formal education, these environments can foster the development and deepening of young people's understanding of nature and strengthen the eye for its details on school grounds, within urban environments and beyond.

AUTHOR CONTRIBUTIONS

Johanna Trummer and Lucas Weinberg were responsible for the conceptualization of the manuscript, collecting the data and performing the data analysis. Johanna Trummer led the writing of the manuscript. Lucas Weinberg, Jerylee Wilkes-Allemann, Karin Oberauer and Lars Keller contributed critically to the drafts. All authors gave their final approval for publication.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

Data supporting the findings of this study are available on Zenodo: https://doi.org/10.5281/zenodo.17305677. (Trummer & Weinberg, 2025).

STATEMENT ON INCLUSION

Our study brings together authors from two different countries, including scientists based in the country where the study was carried out. All authors were engaged early in the research and study design to ensure that the diverse perspectives they represent were considered throughout both designing and implementing the research. A key goal of the study was to include young people as local stakeholders, a group that is often underrepresented in research. The study aims to give them a voice and, in this case, also a visual representation through the chosen research method. Additionally, the authors made a deliberate effort to cite relevant literature from scientists in the region whenever applicable.

ORCID

Johanna Trummer https://orcid.org/0009-0002-3124-4908

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Data S1. Visual examples of participants' photographs for each of the coded categories.

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