

Original Research Article

The Relationship between Nature and Components of Social Interactions in Elementary Schools from Experts' Perspectives*

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Received: 27/04/2026

Accepted: 20/06/2026

Availableonline:23/10/2026

Abstract

Problem statement: In the modern educational system, the school is an open system of formal and informal social interactions, and its physical environment should promote social interaction. Children in their early years need social interactions, and the spatial structure of the environment can facilitate or constrain it. Previous research shows nature positively affects children's social interaction, but the mechanism of this effect and the involved components are not clearly explained.

Research objective: This study aims to identify the components of social interaction based on experts' views that can be created or strengthened by nature in elementary schools.

Research method: A mixed-methods approach was used. First, Components were extracted from the literature, then experts completed a questionnaire, and data were analyzed descriptively.

Conclusion: The findings indicate that, from the experts' perspective, Physical, behavioral-activity, and semantic components show the greatest potential for enhancement through nature; security is less affected. It can be argued that Nature in elementary school design can reinforce multiple social interaction dimensions simultaneously.

Keywords: *Social Interaction, Nature in Schools, Elementary Students, Experts*

Introduction and Problem Statement

The social dimension is a key aspect of human personality (Jafari, 2014). Children, as the most impressionable age group, need social experiences during their formative years of development (Hoseinpourian, 2011).

In most societies, Socialization typically begins at primary school entry, where students first form peer relationships (Amirtash et al., 2006,

Hedayati et al., 2010). Therefore, Elementary school and its related factors significantly influence social development (Rahnama & Elliin, 2006). In this environment, Students interact with other age groups and join collective activities (Heitor, 2005). In modern education, school physical environments should promote social interaction at multiple levels (Sanoff, 2008). Thus, New spaces are needed for new learning methods (Mardomi & Ebrahimi, 2014), allowing diverse activities and small-group work (Sanoff, 2015). Social interactions depend on both the presence of people and spatial characteristics; the physical structure can facilitate or limit interaction. Green

* This article is extracted from "Nafiseh Bagherzadeh Narimani"'s doctoral dissertation, entitled "Exploration of the Biophilic Architecture (Solutions) in Elementary Schools to Increase the student's Social Interaction," which is in progress under the supervision of Dr. "Mahmoud Reza Saghafi" and Dr. "Armin Bahramian" at the Faculty of Architecture and Urban Planning, Art University of Isfahan.

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spaces convey a sense of social place and support social learning (Salehi Fard & Alizadeh, 2008). Nature presence- whether alone or alongside built spaces- increases user presence and enhances social interaction (Kaczynski & Henderson, 2007). Some studies have examined nature's role in children's social interaction, especially among students. Understanding this relationship provides insight into how nature affects children's development during this period. Despite extensive evidence of nature's positive effect on children's social interaction, it remains unclear which components are involved. Thus, the main research question is: through which components does nature most affect children's social interactions? This study addresses this by drawing on experts' perspectives.

Literature Review

• Nature and its effects on children's growth and social interaction

Children are naturally drawn to nature and prefer play areas with natural elements (e.g., trees, flowers, water, animals) (Nogueira, 2017). The dynamism and variability of nature stimulate children's attention and curiosity (Blair, 2009) and encourage them to interact actively with the environment. Hence, nature plays an

important role in children's learning and development (Rigden, 2017).

Researchers consider presence in nature as an effective factor in children's social development and interaction. Munro & Grierson (2017) showed that proximity to nature, through visual connections, influences the way social spaces are used. Table 1 provides a summary of other studies.

So architecture and its landscape can serve as a social space where children play with peers and adults, fostering friendships and reducing social segregation (Ladd, 1999). In other words, Optimal design of natural spaces in schools can thus enhance children's social development."

• Factors influencing the creation of social interactions

Gehl (2011) considers providing spaces for daily activities such as walking and sitting as a foundation for social interactions. On the other hand, according to the architectural and urban design literature, a place has physical, activity-related, semantic, and security aspects, each of which- depending on the use, type of physical characteristics, and activities flowing in the space- affects the formation of social interactions

Table 1. Positive effects of nature on children from a social perspective (in child-specific spaces such as schools). Source: Authors.

Benefits	Sources
Stimulates social interaction & positive peer feelings	Moore (1996), Bixler et al. (2002)
Reduces stress, aggression; increases interaction in natural settings	Wells & Evans (2003)
Improves interpersonal skills & teamwork via outdoor adventure	Rickinson, et al. (2004)
Enhances social, linguistic & communication skills in forest schools	O'Brien & Murray (2007)
Develops participatory individuals	Park & Lee (2019)
Enhances imaginative, constructive, sensory & social play in school grounds	Chawla (2015)
Increases psychological & social well-being in children near nature	Dopko et al. (2019)
Enhances social well-being via green schoolyards/ nature proximity	Chawla et al. (2014), Kelz et al. (2015), Dopko et al. (2019)
Increases physical activity & improves social behaviors	Chawla (2015), Park & Lee (2019), Watchman et al. (2020)
Outdoor environment positively affects social behavior (direct or window views)	Elmaghraby & Kenawy (2016)
Children prefer natural elements; senses, imagination, thinking, planting, group activities, belonging, legibility, accessibility.	Ahmadpour Samani et al. (2019)
Facilitates interaction, encounters & social development via group play in natural spaces	Mozaffar & Mirmoradi (2015)

(Alitajer & Zareihajiabadi, 2016). Fig. 1 illustrates these aspects and their related components.

• The impact of nature on the parameters of social interaction based on the research literature

Numerous studies have shown that natural spaces facilitate children's sense of social connectedness (Fjørtoft, 2004). However, limited research has

directly addressed the influence of nature on the parameters effective in social interactions:

Diversity: The quality of “endless variety” and the “sense of boundlessness” in nature is exciting for children (White & Stoecklin, 1997). Therefore, nature can stimulate children's social behavior through diversity in their environments.

Legibility: Legibility is one of the



Fig. 1. Factors influencing social interaction derived from literature review. Source: Authors based on (1). Altman, 1975/2003; (2). Arghiani & Shakeri, 2021; (3). Behzadpour et al., 2017; (4). Behzadfar & Ghazizadeh, 2011; (5). Pakzad, 2005; (6). Alitajer & Zareihajiabadi, 2016; (7). Mansouriar & Jalalian, 2017; (8). Mousavi Mir Saeed & Zahedian, 2013; (9). Noroozpour & Delshad Siyahkali, 2023; (10). Appleyard, 1980; (11). Bermanian et al., 2016; (12). Churchill, 2014; (13). Gehl, 2011; (14). Kaplan, 1982; (15). Lennard & Lennard, 1998; (16). Lokaitou-Sideris & Banerjee, 1998; (17). Newman, 1972; (18). Peters et al., 2010; (19). Sailer & McCulloh, 2012; (20). Wang & Boubekri, 2019.

preferred factors of the natural environment (Balali Oskui & Zadeh Mahdi, 2018).

Vitality and Sociability: Vitality is one of the drivers of increased social interaction that emerges from the use of natural space (Bemanian et al., 2016).

Creating a Sense of Belonging: Nature is effective in creating a sense of place attachment; the natural environment enhances positive feelings, comfort, and belonging to the environment (Bemanian et al., 2016; Gill, 2014). Additionally, there is a significant relationship between the green space of the school at various levels- including “sensory connection with green space,” “participation in creating green space,” and “education-oriented connection with green space”- and children’s sense of belonging to the school (Siavashpour et al., 2016).

Security: Utilizing green space in the form of place and landscape gives students a sense of being in a secure place (Kateb et al., 2017).

Participation: Green spaces provide a platform for increasing children’s participation in environmental design and decision-making, as well as creating participatory contexts among children and other age groups (Kamelnia & Haghir, 2009).

Reducing Loneliness: Proximity to or living in nature reduces feelings of loneliness and increases connections with others (Houwelingen-Snippe et al., 2020).

Awe: Awe involves positively valenced feelings of wonder and amazement triggered by vast stimuli that transcend current frameworks (Keltner & Haidt, 2003). Among its triggers is encountering nature (e.g., sunsets, mountain ranges, landscapes), and it is often in interaction with “vast” nature that, by shifting focus from self to others, facilitates social connection (Goldy & Piff, 2019; Houwelingen-Snippe et al., 2020).

Perception of Beauty: Individuals prone to perceiving beauty in nature show greater empathy (Diessner et al., 2013) and more social tendencies (Zhang et al., 2014).

Cultural Interaction: Open (green) spaces provide opportunities for cultural interaction

and gathering people from different cultures (Regional Public Health, 2010).

Gardening: Gardening activities in schools including planting potted plants, raised beds or ground-level gardens, habitats, butterfly gardens, etc. (Graham et al., 2004), can lead to improved social relationships (Norwood et al., 2019), increased teamwork, parental and community participation in the school (Blair, 2009), enhanced positive interactions of children with parents, other adults, and even the community, and a sense of belonging to a larger community (Alexander et al., 1995).

Physical Activity: Green spaces attract children to participate in outdoor physical activity with peers, which itself provides opportunities for fostering social behaviors (Putra et al., 2020). The most common pattern of children’s interaction with nature in forest preschools was the extensive use of the body by children; beyond walking, they experienced activities such as running, jumping, crawling, rolling, and sliding (Weiss et al., 2023).

Play: During play, children learn how to establish social relationships with others, solve problems arising from these relationships, and interact with adults (Mardomi & Ebrahimi, 2014). The natural environment is one of the contexts for children’s social interactions through play (Louv, 2008); children become more active and social when engaged in play activities in nature (Dankiw et al., 2020).

Socializing: Nature activities often imply socializing, such as walking together or sitting in a park with friends (Grinde & Patil, 2009).

Walking: Group walking and experiencing nature together have a positive effect on social interaction and lead to temporary companionship or “walking” with others (Houwelingen-Snippe et al., 2020).

Outdoor Nature Education: The natural environment can prepare students for social projects, service learning, and teamwork skills. Service learning also encourages teamwork (North American ..., 2001).

Adventure Activities: Adventure activities (outdoors) have a positive effect on cooperation and interpersonal communication (Hattie et al., 1997).

School Ground/ Community Projects¹: This type of project includes activities such as school ground improvement, greening schemes, gardening in and around the school, outdoor play, and community-based environmental work, which plays an important role in children's social development as well as improving the connection between schools and communities (Rickinson et al., 2004).

Incidental Exposure to the Natural Environment: This can increase attention to others, collective participation, and prosociality (the tendency to care for, help, and assist others) (Goldy & Piff, 2019).

Although evidence supports nature's positive effect on children's social interactions, most literature emphasizes 'existence of effect' rather than 'how it works.' How nature strengthens these interactions through specific domains remains unclear. This gap highlights the need to examine the link between social interaction components and nature. Experts' perspectives in architecture, environmental psychology, and child studies have also been less explored in this regard.

Theoretical Foundations

The theoretical framework draws on environmental psychology, which examines the human-physical environment relationship and explains the built environment as an effective context for shaping experiences and behaviors (Lang, 2009). Realizing social interactions, as a key human behavioral need, requires spatial presence (Jacobs, 1993); if people seek social contact, they create this context anywhere (Lang, 2009). Yet, in some spaces, it arises more readily. In fact, the physical environment offers potential to motivate and support human experiences and behaviors, termed "environmental affordance." One factor affecting these affordances is the physical structure and spatial configuration (Motalebi, 2002). If an environment lacks affordance for a behavior, it cannot occur. Thus, social interactions result from the interplay between human needs/motivations and environmental affordances (Lang, 1987/2009).

This offers a basis for analyzing how natural elements strengthen children's social interactions.

Research Method

This research employed an analytical-critical approach in two qualitative and quantitative steps, and, in terms of objective, given the provision of practical principles for designing child-centered spaces, it is applied research.

In the first step, through a systematic review of the research literature and content analysis, the variables related to social interactions and the role of nature in children's social interaction were extracted. The reviewed sources included articles, dissertations, books, and encyclopedias. These concepts were then categorized through open and axial coding², and the initial theoretical framework was formed.

In the second step, to measure the degree of relationship of each social interaction item with the presence of nature, an attitude survey of experts was conducted as the statistical population. Sampling in this step was initially purposeful, and then continued as snowball sampling until expert saturation. Thirty-two experts were selected from among university faculty members in the fields of architecture, landscape architecture, environmental psychology, child psychology, and social sciences with relevant research experience.

The data collection tool was a structured online questionnaire, in which each expert rated the degree of influence of nature on each item using a Likert scale. Table 2 presents the specifications of the questionnaire.

Before analyzing the items, Cronbach's alpha method in SPSS version 27 was used to assess the reliability of the questionnaire. According to Table 3, the Cronbach's alpha value was 0.945, indicating appropriate reliability.

To identify the items that, from the experts' perspective, have the strongest relationship with "connection to nature," descriptive statistics including mean, standard deviation, and percentage frequency of responses for each item were used. This was because

Table 2. Expert's questionnaire specifications (* Likert scale degrees: 0: No relationship, 1: Very low, 2: Low, 3: Moderate, 4: High, 5: Very high). Source: Authors.

Component	Number of Sub-components	Number of Questions	Questionnaire Type	Question Type	Likert Scale Type (Options)
Physical	29	29	Structured	Closed	6-point*
Behavioral-Activity	12	12	Structured	Closed	6-point
Semantic	10	10	Structured	Closed	6-point
Security	4	4	Structured	Closed	6-point

Table 3. Summary of Expert Questionnaire Items and Reliability Coefficient. Source: Authors.

Cases Processing Summary			Reliability Statistics	
	N.	%	Cronbach's Alpha	N. of Items
Valid	32	100.0	0.954	55
Excluded	0	0		
Total	32	100.0		

the aim was to identify and prioritize items, not to test hypotheses or examine complex relationships among variables or categorize experts.

The descriptive statistical indicators for analyzing the expert questionnaire data, according to the statistical consultant, included the following:

Mean: Calculation of the overall level of relationship of each item with nature from the experts' perspective.
 Standard Deviation: The degree of dispersion and agreement or disagreement among experts' opinions, used to determine the cut-off point.

Cut-off Point: Calculated based on the combination of mean and half of the standard deviation to distinguish items with a "stronger" versus "weaker" relationship with nature:

- Upper threshold = Mean + (0.5 × Standard Deviation)
- Lower threshold = Mean – (0.5 × Standard Deviation)

Percentage Frequency Above or Below the Cut-off Point: To compare the level of agreement among experts, three ratios were calculated for each item:

- Percentage of responses above the upper threshold: Experts rated nature as highly related to that item.
- Percentage of responses below the lower threshold: Experts rated nature as weakly related to that item.
- Percentage of responses between the two thresholds: Representing moderate views.

Finally, the status of each item was determined based on the predominance of one of these three percentages: if the highest percentage belonged to the group above the upper threshold, the item was categorized as "strong"; if the highest percentage fell into the group below the lower threshold, the item was considered "weak"; and if the highest percentage was in the middle range, the item was placed in the "moderate" category.

This quantitative analysis method enabled the validation and selection of social interaction-related items that, based on expert consensus, are influenced by the presence of natural elements.

Research Findings

In this study, factors affecting social interaction were identified in the form of four main components and their subcategories based on the literature review. Table 4 shows the open and axial coding of these four component factors.

In the process of transferring the components from the research literature to the questionnaire, the contextual component (age, gender, culture, and socio-economic status) was excluded due to its extra-spatial nature, because these variables are independent of environmental qualities and merely moderate the way different individuals perceive space.

Table 4. The process of explaining axial and open codes for factors related to social interactions, derived from the systematic literature review. Source: Authors.

Axial Code	Open Codes
Physical	Pedestrian accessibility, Visual accessibility, Proximities, Invitingness, Functional distance, Functional centrality, Social surveillance, Legibility, Integration and spatial continuity, Human scale, Shape and geometry of space, Spatial enclosure, Order and harmony, Appropriate lighting and light, Color, Appropriate collective furniture, Spatial diversity, Flexibility, Shared space, Pause space, Safe and comfortable environment, Tranquility and comfort, Beauty, Varied views and scenery, Appropriate acoustics, Complexity and mystery, Variety and contrast, Privacy, Attachment in space
Behavioral-Activity	Duration of stay in place, Physical activity, Diversity of activities and mix of uses, Outdoor nature education, Adventure activities, Participation, Walking, Gardening, Playing, School ground projects, Exploration, Establishing cultural interaction
Semantic	Symbols and signs, Sense of belonging, sense of place, Increasing commitment, Increasing self-esteem, Social attachment to place, Creating memorable experiences in public spaces, Vitality and sociability, Reducing loneliness, Creating awe
Security	Eliminating inappropriate places, Visual control of space, Ownership surveillance, Safe access and mobility

• Determining items with a strong relationship with nature within the physical component

Among the 29 items of the physical component related to social interaction, based on the descriptive statistics results of the expert questionnaire, 8 items had the highest level of relationship with the presence of nature from the experts' perspective. Table 5 shows the results of the quantitative analysis of these components.

• Determining items with a strong relationship with nature within the behavioral-activity component

Based on the quantitative analysis results shown in Table 6, among the 12 items of the behavioral-activity component related to social interaction, 5 items had the highest level of relationship with the presence of nature.

• Determining items with a strong relationship with nature within the semantic component

Based on the quantitative analysis results shown in Table 7, among the 10 items of the semantic component related to social interaction, 3 items had the highest level of relationship with the presence of nature.

• Determining items with a strong relationship with nature within the security component

Based on the quantitative analysis results shown

in Table 8, none of the four items of the security component had a strong relationship with nature.

Discussion

The findings of this study indicated that from the experts' perspective, nature can strengthen children's social interaction through three main mechanisms: enhancing spatial quality (such as beauty, diversity, invitingness, etc.), facilitating collective and physical activities (such as play, gardening, exploration, and outdoor education), and creating semantic and emotional experiences (such as vitality, awe, and sense of belonging).

Enhancing Spatial Quality (Physical Components Influenced by Nature): Items such as "beauty", "color", "invitingness", "complexity and mystery", "spatial flexibility", "contrast and variety", and "varied views and scenery" were placed in the "Strong" category. This aligns with White & Stoecklin (1998), who highlight nature's 'endless variety' and "sense of boundlessness" as exciting for children. Additionally, the perception of beauty in nature is associated with increased social connectedness (Diessner et al., 2013; Zhang et al., 2014). Creating tranquility and comfort was another strong item, confirming that nature, by reducing stress and providing a calm atmosphere,

Table 5. Descriptive statistics of nature-related items in the physical component in the experts' questionnaire. Source: Authors.

Item	Item Description	Mean	SD	Lower Threshold [Mean-(0.5×SD)]	% Below Lower Threshold	Upper Threshold [Mean+(0.5×SD)]	% Above Upper Threshold	% Between Thresholds	Status
1	Pedestrian accessibility	3.68	1.17	3.10	21.9%	4.28	15.6%	62.5%	Moderate
2	Proximities	3.15	1.13	2.59	12.5%	3.72	37.5%	50%	Moderate
3	Invitingness	3.62	0.83	3.21	40.6%	4.00	60%	0%	Strong
4	Reducing functional distance	3.15	1.48	2.41	25%	3.90	59.3%	15.6%	Moderate
5	Functional centrality	3.18	1.22	2.57	12.5%	3.80	41%	46.9%	Moderate
6	Social surveillance	2.90	1.17	2.32	28.1%	3.50	34.4%	37.5%	Moderate
7	Visual accessibility (visibility)	3.68	0.85	3.25	34.4%	4.11	12.5%	53.1%	Moderate
8	Legibility	4.28	0.77	3.90	12.5%	4.67	43.7%	43.7%	Moderate
9	Integration and spatial continuity	3.71	0.77	3.33	40.6%	4.10	15.6%	43.7%	Moderate
10	Human scale	3.65	0.93	3.19	37.5%	4.13	12.5%	50%	Moderate
11	Shape and geometry of space	3.28	1.02	2.77	12.5%	3.79	34.4%	53.1%	Moderate
12	Spatial enclosure	3.28	0.92	2.82	9.4%	3.74	34.4%	56.2%	Moderate
13	Order, coordination, and harmony	3.65	0.90	3.20	31.2%	4.11	9.3%	59.3%	Moderate
14	Appropriate lighting and light	3.62	1.21	3.01	28.1%	4.23	15.6%	56.2%	Moderate
15	Color	3.43	1.13	2.87	18.7%	4.00	62.5%	18.8%	Strong
16	Creating appropriate furniture in space	3.84	0.88	3.40	18.7%	4.28	15.6%	65.2%	Moderate
17	Spatial diversity	3.80	0.64	3.49	25%	4.13	9.3%	65.2%	Moderate
18	Spatial flexibility	3.37	1.15	2.80	18.7%	3.95	62.5%	18.8%	Strong
19	Creating pause space	3.75	0.91	3.29	28.1%	4.21	15.6%	56.2%	Moderate
20	Creating shared space	3.68	0.96	3.20	31.2%	4.16	15.6%	53.1%	Moderate
21	safe and comfortable environment	3.87	0.94	3.40	21.9%	4.40	21.9%	56.2%	Moderate
22	Creating tranquility and comfort	3.46	1.13	2.90	18.7%	4.05	62.5%	18.8%	Strong
23	Beauty	4.31	0.69	3.97	12.5%	4.66	43.8%	43.7%	Strong
24	Varied views and scenery	3.71	0.68	3.37	34.4%	4.00	65.6%	0%	Strong
25	Appropriate acoustics	3.06	1.04	2.54	18.7%	3.59	25%	56.2%	Moderate
26	Creating complexity and mystery	4.06	1.18	3.47	28.1%	4.66	50%	28.1%	Strong
27	Contrast and variety	3.56	0.80	3.16	37.5%	3.96	62.5%	0%	Strong
28	Possibility of creating privacy	4.09	0.68	3.75	12.5%	4.43	25%	62.5%	Moderate
29	Attachment to place	3.81	0.96	3.32	37.5%	4.29	28.1%	34.4%	Weak

Table 6. Descriptive statistics of nature-related items in the behavioral-activity in the experts' questionnaire. Source: Authors.

Item	Item Description	Mean	SD	Lower Threshold [Mean-(0.5×SD)]	% Below Lower Threshold	Upper Threshold [Mean+(0.5×SD)]	% Above Upper Threshold	% Between Thresholds	Status
1	Increasing physical activity	3.40	1.24	2.78	34.3%	4.02	25%	40.6%	Moderate
2	Playing	3.75	1.32	3.08	37.5%	4.41	43.7%	18.7%	Strong
3	Walking	3.46	1.27	2.83	31.2%	4.10	25%	43.7%	Moderate
4	Engaging in adventure activities	3.43	1.32	2.77	34.3%	4.09	28.1%	37.5%	Moderate
5	Gardening	3.46	1.03	2.95	21.8%	3.98	59.4%	18.8%	Strong
6	Exploration in the environment	3.84	1.09	3.29	37.5%	4.39	37.5%	25%	Strong
7	Participation	2.43	0.93	1.97	9.4%	2.90	37.5%	53.1%	Moderate
8	Diversity of activities and mix of uses	2.40	0.78	2.01	68.8%	2.80	31.2%	0%	Weak
9	Establishing cultural interaction	2.65	0.73	2.28	37.5%	3.02	9.4%	53.1%	Moderate
10	Effect on increasing duration of stay	2.40	0.55	2.13	62.5%	2.68	37.5%	0%	Weak
11	Conducting school ground projects	4.00	1.00	3.50	28.1%	4.50	37.5%	34.4%	Strong
12	Possibility of outdoor nature education	3.87	1.13	3.30	37.5%	4.44	40.6%	21.9%	Strong

Table 7. Descriptive statistics of nature-related items in the semantic component in the experts' questionnaire. Source: Authors.

Item	Item Description	Mean	SD	Lower Threshold [Mean-(0.5×SD)]	% Below Lower Threshold	Upper Threshold [Mean+(0.5×SD)]	% Above Upper Threshold	% Between Thresholds	Status
1	Creating vitality and sociability	4.25	0.75	3.87	18.7%	4.62	43.8%	37.5%	Strong
2	Possibility of forming symbols and signs	3.18	0.84	2.76	18.8%	3.61	37.5%	43.7%	Moderate
3	Creating awe	3.93	0.99	3.44	31.3%	4.43	34.4%	34.3%	Strong
4	Sense of belonging	3.40	0.89	2.96	18.8%	3.85	50%	31.2%	Strong
5	Creating memorable experiences in public spaces	3.47	0.90	3.01	53.1%	3.91	46.9%	0%	Weak
6	Creating sense of place	3.87	0.78	3.48	31.2%	4.26	21.9%	46.9%	Moderate
7	Social attachment to place	4.00	0.86	3.56	18.8%	4.43	28.1%	53.1%	Moderate
8	Increasing self-esteem	2.97	1.13	2.40	37.5%	3.53	34.4%	28.1%	Weak
9	Increasing commitment	3.59	0.86	3.16	40.6%	4.02	12.5%	46.9%	Moderate
10	Reducing loneliness	3.21	0.85	2.79	21.9%	3.64	37.5%	40.6%	Moderate

Table 8. Descriptive statistics of nature-related items in the security component in the experts' questionnaire. Source: Authors.

Item	Item Description	Mean	SD	Lower Threshold [Mean-(0.5×SD)]	% Below Lower Threshold	Upper Threshold [Mean+(0.5×SD)]	% Above Upper Threshold	% Between Thresholds	Status
1	Visual control of space	2.94	1.17	2.35	31.2%	3.52	34.4%	34.4%	Moderate
2	Safe access and mobility	2.78	1.36	2.10	40.6%	3.46	37.5%	21.9%	Weak
3	Ownership surveillance	2.59	1.27	1.96	21.9%	3.23	28.1%	50%	Moderate
4	Eliminating inappropriate places	2.72	1.12	2.15	34.3%	3.28	21.9%	43.8%	Moderate

creates a suitable context for social interaction (Wells & Evans, 2003).

Most items fell into the “Moderate” category, indicating a significant (though not maximal) relationship of these components with nature. This result suggests that physical components generally have good potential for enhancement through nature, but the degree of impact varies across different items. A noteworthy point is the placement of the item “attachment to place” in the “Weak” category. Though seemingly contradictory to studies emphasizing nature’s role in belonging (Gill, 2014; Fjørtoft, 2004), it appears that place attachment depends more on long-term experience, collective memories, and meaningful interactions than on nature’s physical presence alone. Nature itself is insufficient; how it is used and for how long also matter.

Facilitating Collective and Physical Activities (Behavioral-Activity Components Influenced by Nature): Items such as “play”, “gardening”, “exploration”, and “outdoor education” were placed in the “Strong” category. These results are consistent with the findings of Louv (2008) and Dankiw et al. (2020), which show that children engage in more cooperative and active play in natural environments.

Among these items, “gardening” was the strongest item in this component. This finding aligns with previous research (Blair, 2009; Norwood et al., 2019) that has emphasized the role of gardening in increasing teamwork and social participation.

The items “diversity of activities and mix of uses” and “effect on increasing duration of stay” were placed in the “Weak” category. This result indicates that merely diversifying activities or increasing the duration of stay, without the presence of specific natural qualities, cannot be strengthened by nature.

Creating Semantic and Emotional Experiences (Semantic Components Influenced by Nature): Items such as “vitality”, “awe”, and “sense of belonging” were placed in the “Strong” category. Awe as a mechanism through which nature strengthens social connectedness (Goldy & Piff, 2019) and

vitality as a driver of increased social interaction (Bemanian et al., 2016) were confirmed in this study. The item “sense of belonging” was identified as the strongest item. This aligns with studies emphasizing nature’s role in place attachment (such as Gill, 2014; Fjørtoft, 2004; Siavashpour et al., 2016).

The items “creating memorable experiences” and “increasing self-esteem” were placed in the “Weak” category. These qualities depend more on individual, cultural, and social factors than on nature’s physical presence.

Security Components Influenced by Nature: Among the 4 items of the security component, none were placed in the “Strong” category. The items “visual control of space,” “ownership surveillance,” and “eliminating inappropriate places” were classified as “Moderate,” and the item “safe access and mobility” was classified as “Weak.” Therefore, it can be concluded that security components are generally less directly influenced by nature compared to the other three components, and the role of nature in this domain is more limited. This finding is consistent with the nature of the security component; security is more dependent on physical-structural factors (such as lighting, surveillance, fences) than on the presence of natural elements.

According to the results, the behavioral-activity component (5 strong items) is the most influenced by nature, followed by physical (8 strong items) and semantic (3 strong items). Security is least affected.

These findings indicate that in elementary schools, nature primarily affects students’ social interaction through collective and physical activities (play, gardening, exploration, outdoor education). This result aligns with the nature of the school environment, where recess, the schoolyard, and group activities are the main contexts for informal interactions. In sum, nature in schools is not merely aesthetic but also shapes children’s social behaviors and spatial experiences.

Conclusion

This study was conducted with the aim of answering

the question of which components of social interaction nature plays the greatest role in creating or strengthening students' social interactions in elementary schools. Based on the findings from the systematic literature review and the analysis of the perspectives of 32 experts, the physical, behavioral-activity, and semantic components have the highest capacity for enhancement through the presence of nature, while the security component shows less influence. Table 9 presents the items with the strongest relationship with nature in each component. Therefore, considering the objectives of the modern educational system, which addresses both the social interaction dimension and nature in modern schools, the present study can serve as a basis for formulating design principles for elementary schools.

Limitations include reliance on expert views (not children), no differentiation by natural element type, cross-sectional design, and no age/gender analysis. Therefore, Future research could use participatory methods for children's views, study specific natural elements, compare age groups, and conduct longitudinal studies.

Declaration of Conflicting Interests

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Endnotes

1. school grounds/community projects
2. Some factors were excluded based on the study's scope. Nature, though often a physical sub component, was treated as an independent variable and omitted to examine its relations with others. Context specific factors were excluded; only main sub components remained. Overlapping ones were assigned to the semantically closest criterion.

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Table 9. Social interaction items with the strongest relationship with nature from the experts' perspective. Source: Authors.

Components Affecting Social Interaction	Items with a Strong Relationship with Nature According to Experts
Physical (Behavioral Setting)	Varied views and scenery, creating tranquility and comfort, Spatial flexibility, Color, Contrast and variety, Invitingness, Complexity and mystery, Beauty
Behavioral-Activity	Gardening, Outdoor nature education, Playing, Capacity for exploration in the environment, Possibility of conducting school ground projects
Semantic	Sense of belonging, Vitality and sociability, Creating awe

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HOW TO CITE THIS ARTICLE

Bagherzadeh Narimani, N., Saghafi M. R., & Bahramian, A. (2026). The relationship between nature and components of social interactions in elementary schools from experts' perspectives. *Bagh-e Nazar*, 23(161), 73-86.

DOI: [10.22034/bagh.2026.579476.6015](https://doi.org/10.22034/bagh.2026.579476.6015)

URL: https://www.bagh-sj.com/article_247920_en.html

