A systematic review of the cognitive functioning of natural environments

Satyajeet Nanda\textsuperscript{a,b,e} | Omkar Bagaria\textsuperscript{b} | Poonam Sharma\textsuperscript{a} | Kshipra Jain\textsuperscript{d}

\textsuperscript{a}SAIN (Deemed-to-be University), Bangalore, Karnataka, India, Associate Professor, Department of OB & HRM.
\textsuperscript{b}Vivekananda Global University, Jaipur, India, Assistant Professor, Department of Management Studies.
\textsuperscript{c}Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India, Professor, College of Nursing.
\textsuperscript{d}ATLASSkillTech University, Mumbai, Maharashtra, India, Faculty, Department of ISME.

Abstract The impact of nature on youngsters and school children cognitive functioning is a field of research and study that looks at how exposure to natural environments can impact the cognitive abilities and development of youngsters. There has been a recent uptick in curiosity on the ways in which natural settings in educational ones influence the process of learning. This study demonstrates how nature has the ability to lessen cognitive overload, relieve stress and improve general well-being, thereby fostering an environment conducive to effective learning. It does this by using a PRISMA guided systematic approach to evaluate the impact of nature treatments on the cognitive performance of young people. There were found to be 560 different journal papers. First, the papers were screened based on their titles, which totaled 250 and the remaining articles were evaluated based on their abstracts, which totaled 35. Due to the title-abstract screening technique, 35 publications progressed to the next phase of full-article assessment. After deleting duplicates, ten articles were selected for a comprehensive review. The research investigates the effect of nature exposure on cognitive capabilities in children and emphasizing the potential advantages for children of abilities. It examines whether socioeconomic position influences the connection between nature and cognitive performance, highlighting the significance of access to natural surroundings for people of the socioeconomic backgrounds. The review focuses on nature’s potential beneficial effect on cognitive domains and the methods by which nature-based experiences might improve cognitive development in children. The findings of the systematic review propose that cultivating a stronger bond between young individuals and the natural environment in educational contexts can lead to enhanced cognitive abilities. Educational institutions in a prime position can provide nature-infused educational experiences that not only alleviate cognitive strain and stress but also foster overall well-being and facilitate improved learning outcomes.

Keywords: nature, school children, socioeconomic status (SES), youngsters

1. Introduction

Individuals with cognitive functions are mental talents that make it possible to evaluate and handle information about the surrounding world. These skills are distributed from normal cognitive functioning at one end of the continuum to dementia at the other. Dementia incidence is at the end of the range (Woods et al 2023). To complete the most basic activities of daily life as well as the most difficult endeavors, proper cognitive functioning is needed. A multitude of factors might be involved in the physiological decline in cognitive abilities generally or specifically related to age (Fisher et al 2017). The impact that natural environments have on the cognitive development and overall well-being of younger generations has garnered a significant amount of attention from researchers and educators alike (Izquierdo et al 2021). The main emphasis of this attention has been on how natural settings affect school-age children’s and young people’s cognitive performance (Oswald et al 2020). The intricate relationship between cognitive functioning and natural environments illuminates how nature supports children and young people and improves learning, creativity and general cognitive performance (Berti et al 2019). The rapid pace of modern life, marked by technological advancements, towering infrastructure, congested roads and environmental pollution, has introduced a detrimental influence on society (Casado et al 2020). These societal shifts have minimized opportunities for nature engagement and fostered an accelerated lifestyle, contributing to heightened mental strain and challenges (Zhao et al 2022). Young people are receptive to amazement and resourcefulness in approaching learning with an attitude of wonder and curiosity fostered by interactions with natural components (Laycraft 2019). In addition, the impact of nature on cognitive performance has major repercussions for individuals in the areas of emotional well-being and for reducing stress (De Pue et al 2021). Children and young people who participate in nature-based activities, such as outdoor play and educational programs in the natural
world, have high emotional resilience and psychological thriving (Moula et al 2022). Engaging with the natural world helps to build a feeling of dynamic connectivity and instills a deep appreciation for the inherent beauty of the environment (Day 2022). This, in turn, mitigates the negative effects of stress and promotes a sense of holistic well-being (Laycraft 2019). There is a rising push to include nature-based therapies and outdoor learning in school curricula as educators and policymakers realize nature’s importance in cognitive development (MacIntyre 2019). Educational institutions can foster a symbiotic relationship between cognitive functioning and natural environments to foster students’ holistic development yet instill a lifelong reverence for the natural world as well as its transformative effects on cognitive growth and well-being (Tomasi et al 2020). This study aims to provide important insights into how nature supports early cognitive development by thoroughly evaluating the impact of natural surroundings on school-age children as well as young people’s cognitive capacities and academic achievement (Casadó et al 2020).

1.1. Key contributions

- The report includes a systematic review led by the PRISMA database, which indicates a rigorous and comprehensive method to evaluate the current research on the impact of nature on young people’s cognitive abilities.
- After evaluating 560 relevant journal papers, the authors selected 10 for extensive evaluation. This procedure ensures that the review is based on relevant and reputable material.
- Nature exposure affects children’s cognition, according to a study. Nature-based activities can improve cognitive development in young people through all abilities, according to the report.

2. Systematic Review Process

A protocol created beforehand was registered with PROSPERO with the registration number CRD42021214826 (Tawfik et al 2020). The PRISMA checklist was used to guide the process of conducting a systematic review. A total of 560 journal articles were discovered, as shown in Figure 1. The review procedure went beyond the scope of typical database searches to ensure that all relevant publications, such as dissertations and works that are available to the public and are not officially published, were considered. This included an ancestry search, which included reviewing the reference lists of important publications, as well as a painstaking manual search of relevant journals and less well-known literature. It included a search engine. This strategy was chosen to guarantee a thorough examination of the relevant previous research on the subject matter that has been compiled (Booth et al 2020). Key article references were reviewed to identify ten additional investigations (Vrontis et al 2021). After removing the duplicates, only 310 outcomes remained. Irrelevant articles were first eliminated as part of the screening procedure. First, titles (n = 250) were used to weed out articles, and abstracts (n = 35) were used to filter the remaining papers. The title-abstract screening process resulted in 35 publications remaining to the next phase of the full-text assessment. Based on the exclusion and inclusion criteria, both authors assessed the whole texts of the remaining papers. Ten patients were chosen for the comprehensive analysis. Figure 1 shows the PRISMA flowchart with the reasons for the exclusions.

3. Review of cognitive functioning in school children and youngsters

The word cognition refers to the group of higher-order brain functions that support information processing (Badcock et al 2019). In real life, most cognitive skills are deduced from behavior and influenced by a broad range of neurological, educational, social and environmental factors. The cognitive functioning of schoolchildren is a broad concept that involves a variety of mental functions, including memory, attention, problem solving and decision-making (Gkintoni et al 2021). Children’s cognitive capacities increase and improve as they progress through the school year, which has an impact on their overall academic performance and learning outcomes (Egger et al 2019). A child’s cognitive functioning is fundamentally important because of her capacity to learn language, which is the primary means by which humans communicate. The primary objective of cognitive education in school is for children to perform thorough ability-to-speak assessments and filter out children’s language problems as soon as feasible (Ellis 2019). When fostering the healthy growth of children’s cognitive abilities, the ultimate objective is to provide additional intervention education on children’s cognition, which is determined by the results of assessments (Peng et al 2020). When the basis of cognitive functioning starts to take shape, individuals continue to expand and mature throughout puberty (Li and Bates 2019). Children can concentrate on pertinent stimuli and block distractions to attention, a basic cognitive mechanism that helps them participate in class activities and learn new material (Nagaraj et al 2020). Children’s cognitive flexibility is crucial as they traverse the academic environment because it enables them to modify their behavior and way of thinking in response to different tasks and obstacles (Demirtaş 2020). Emotional well-being and cognitive functioning increase because children who have greater cognitive functioning are able to control their emotions and handle stress, which creates a favorable atmosphere for learning and socialization (Ma 2019). For educators and caregivers to implement specialized instructional strategies and
interventions that support children's holistic development, academic achievement and general well-being, they must have a thorough understanding of the nuances of cognitive functioning in school-aged children (Blewitt et al. 2020).

![Figure 1 Flow diagram of PRISMA.](https://www.malque.pub/ojs/index.php/mr)

### 3.2. Youngsters

The cognitive capacity of young people is critical to their development as a whole as well as their success in school. The cognitive skills of children expand as they age, which enables them to acquire a better understanding of the world around them (Danovitch 2019). Acquiring cognitive abilities, including language, problem solving, attention and memory, is essential for individuals to absorb information and adjust in changing circumstances (Purba et al. 2020). The children and young people of this age group are thinking more sophisticatedly (Casado et al. 2020). This kind of reasoning is known as a formal logical procedure and includes the following abilities:

- To think in an abstract manner is considered an alternative.
- To develop unique ideas or questions by deriving logic from previously accepted ideas.
- Several perspectives are examined to contrast or discuss concepts or viewpoints.

As children grow into young adults, cognitive functions become complicated and include higher-order thinking, abstract reasoning and the capacity for planning and decision-making (Stadskleiv 2020). The development of the prefrontal cortex, which controls decision-making functions and working memory, is related to these developments (Garcia-Alvarez et al. 2019). The cognitive functions of young people are affected by a variety of elements, such as young people, the stimulation they receive from their surroundings, and their relationships with other people (Fueyo et al. 2022). Negative situations, such as neglect or trauma, can impair cognitive development and lead to possible long-term effects. Positive social connections and a stimulating environment can stimulate cognitive growth (Strathearn et al. 2020). This is because it enables the adoption of targeted treatments and educational practices that promote optimum cognitive development and overall well-being in young people (Heaton 2021).

### 3.3. Efficacy of Nature's Interruption

The cognitive development of infants, toddlers and school-aged children improves when they spend time outside (Vazou et al. 2019). Studies have shown that spending time in natural settings such as parks and green spaces improves cognitive capacities (Jimenez et al. 2021). Students in natural environments report feeling less stressed, happier and more creative. Better academic achievement and the development of analytical and evaluation of reasoning abilities are two additional benefits of frequent contact with the natural world (White et al. 2019). Participating in outdoor activities encourages feelings of awe and wonder, paving the way for more well-rounded education that considers both cognitive and affective dimensions. Therefore,
it is clear that educating students in natural settings can aid in the development of well-rounded, intelligent and emotionally stable people.

4. Summary of review findings

4.1. Cognitive skills of children

The average cognitive score of socioeconomic status (SES) is determined by a range of distinct metrics that are shown in Figure 2 and Table 1 for four sets of children aged two to ten years. As anticipated, children belonging to the high-ability and low-ability groups demonstrated test scores that positioned them at the opposite ends of the percentage rankings. Notably, the learning trajectory of a group with high abilities and low SES differs from that of a group with low abilities but high socioeconomic status. This was an unexpected summary that implied that children with superior SES would perform better at learning more time when there are two low-ability young people. In middle school, young people with less skill but more resources start to outperform those with more talent but less wealth. It seems that a child’s social condition has a greater influence on her growth than her natural capacity for education.

4.2. Visual Attention

Visual attention is the mental process of anticipating, selecting and sustaining a focus on various parts of a visual image or mental image. The young children outperformed the school children, and the high-functioning group outperformed the low-functioning group, confirming the pattern of group differences. Significant retest gains were observed for linear and quadratic tendencies, but no interactions were found to be reliable. We further examined whether the degree of cognitive functioning represented an individual variation in plasticity, independent of the individual’s educational attainment. The percentage ranking for cognitive function showed a favorable correlation with education level. The degree of cognitive functioning, on the other hand, showed a strong correlation with both retest increases in the reasoning area. The prior studies, which included education level as a covariate, produced similar patterns. In summary, our assessment of cognitive functioning was a more accurate indicator of the interindividual variations in plasticity with respect to educational background. Figure 3 and Table 2 depict visual attention.

4.3. Reasoning

For school-age children and young people, cognitive functioning is essential for academic and psychological growth. Their cognitive skills, such as critical thinking, problem solving, attention and memory, have an enormous impact on how students can learn new material and perform academically as they progress through different educational stages. Comprehending the complexities of cognitive growth throughout these development stages can assist educators and parents in customizing successful teaching strategies and interventions to meet the requirements and learning preferences of each student. Additionally, developing cognitive ability at a young age can enable children to become self-directed learners and provide a solid basis for their future success and intellectual progress. Figure 4 and Table 3 depict the comparisons of reasoning.
learning capacities, a complete strategy incorporating mental evaluations, customized learning methodologies and a supportive environment are necessary.

Table 1 Outcomes of Average Distribution Position.

<table>
<thead>
<tr>
<th>Children age</th>
<th>High ability, (high SES)</th>
<th>High ability, (low SES)</th>
<th>Low ability, (high SES)</th>
<th>Low ability, (low SES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>88</td>
<td>87</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>26</td>
<td>86</td>
<td>82</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>30</td>
<td>84</td>
<td>78</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>34</td>
<td>80</td>
<td>74</td>
<td>30</td>
<td>14</td>
</tr>
<tr>
<td>38</td>
<td>76</td>
<td>70</td>
<td>35</td>
<td>16</td>
</tr>
<tr>
<td>42</td>
<td>72</td>
<td>66</td>
<td>40</td>
<td>18</td>
</tr>
<tr>
<td>46</td>
<td>70</td>
<td>62</td>
<td>42</td>
<td>20</td>
</tr>
<tr>
<td>50</td>
<td>70</td>
<td>63</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>54</td>
<td>69</td>
<td>62</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td>58</td>
<td>68</td>
<td>61</td>
<td>45</td>
<td>25</td>
</tr>
<tr>
<td>62</td>
<td>69</td>
<td>59</td>
<td>47</td>
<td>26</td>
</tr>
<tr>
<td>66</td>
<td>69</td>
<td>57</td>
<td>49</td>
<td>25</td>
</tr>
<tr>
<td>70</td>
<td>69</td>
<td>55</td>
<td>50</td>
<td>23</td>
</tr>
<tr>
<td>74</td>
<td>69</td>
<td>53</td>
<td>52</td>
<td>23</td>
</tr>
<tr>
<td>78</td>
<td>69</td>
<td>52</td>
<td>53</td>
<td>23</td>
</tr>
<tr>
<td>82</td>
<td>69</td>
<td>49</td>
<td>54</td>
<td>23</td>
</tr>
<tr>
<td>86</td>
<td>69</td>
<td>48</td>
<td>55</td>
<td>23</td>
</tr>
<tr>
<td>90</td>
<td>69</td>
<td>47</td>
<td>56</td>
<td>23</td>
</tr>
<tr>
<td>94</td>
<td>69</td>
<td>46</td>
<td>57</td>
<td>23</td>
</tr>
<tr>
<td>98</td>
<td>69</td>
<td>45</td>
<td>58</td>
<td>23</td>
</tr>
<tr>
<td>102</td>
<td>69</td>
<td>44</td>
<td>59</td>
<td>23</td>
</tr>
<tr>
<td>106</td>
<td>69</td>
<td>43</td>
<td>60</td>
<td>23</td>
</tr>
<tr>
<td>110</td>
<td>69</td>
<td>42</td>
<td>61</td>
<td>23</td>
</tr>
<tr>
<td>116</td>
<td>70</td>
<td>41</td>
<td>62</td>
<td>23</td>
</tr>
</tbody>
</table>

Figure 3 Comparison of visual attention between schoolchildren and young people.

Table 2 Outcomes of Visual Attention.

<table>
<thead>
<tr>
<th>Visual Attention</th>
<th>Cognitive function levels</th>
<th>High cognition</th>
<th>Low cognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Children</td>
<td>2.8</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Youngsters</td>
<td>2.4</td>
<td>1.9</td>
<td></td>
</tr>
</tbody>
</table>
Figure 4 Comparison of reasoning between schoolchildren and young people.

Table 3 Outcomes of reasoning.

<table>
<thead>
<tr>
<th>Cognitive function levels</th>
<th>High cognition</th>
<th>Low cognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Children</td>
<td>2.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Youngsters</td>
<td>2.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

4.4. Perceptual-Motor speed

The overall performance levels were greater for the schoolchildren than for the younger children, and they were a larger group with high levels of functioning than they were for the group with low levels of functioning. This pattern was also observed in the reasoning area. Significant improvements were observed in linear and quadratic trends when the retest was conducted. Once again, learning rates were shown to be greater in the younger age group than in the school-aged children. Figure 5 and Table 4 depict the comparisons of perceptual-motor speed.

Figure 5 Comparison of perceptual-motor speed between schoolchildren and youngsters.
Table 4 Outcomes of perceptual-motor speed.

<table>
<thead>
<tr>
<th>Cognitive function levels</th>
<th>High cognition</th>
<th>Low cognition</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Children</td>
<td>3.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Youngsters</td>
<td>2.5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

5. Final considerations

This systematic study demonstrated that exposure to natural environments can significantly influence the cognitive function of younger people. The PRISMA principles were used throughout the research project, identifying a considerable body of literature. The results revealed that 560 individual pieces were condensed into ten personal papers that covered the topic.

The study demonstrated that children’s exposure to natural environments has a beneficial effect on their cognitive capacities, emphasizing that children from different socioeconomic situations can reap the advantages of this exposure. Access to nature is associated with improved cognitive function, stressing the need for nature among individuals in all socioeconomic situations. According to the results, encouraging a connection with nature, particularly in academic settings, can result in considerable increases in cognitive functioning, which promotes overall welfare and learning outcomes for young people. This research highlights the necessity of incorporating natural components into educational settings to maximize children’s cognitive development and to assist their overall growth and development as whole people.

Ethical Considerations

Not Applicable.

Conflict of Interest

The authors declare no conflict of interest.

Funding

The current review did not receive any financial support.

References


Li Y, & Bates TC (2019) you can’t change your basic ability, but you work at things, and that’s how we get hard things done: Perspect. Doi:https://doi.org/10.1037/age0000669


Zhao W, Chen J, Hai T, Mohammed M N, Yaseen Z M, Yang X & Xu Q (2022) Design of low-energy buildings in densely populated urban areas based on IoT. *Energy Reports, 8*, 4822-4833. Doi: 10.1016/j.egyr.2022.03.139