

Nature-Integrated Day-Care Spaces: Fostering Early Childhood Growth in Lucknow

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Abstract

The physical environment plays a vital role in shaping early childhood experiences, influencing cognitive, emotional, and social development. However, in rapidly urbanizing cities such as Lucknow, children's exposure to natural environments has become increasingly limited, with most day-care centers confined within enclosed, concrete settings. This study investigates how the integration of natural elements within day-care interiors and outdoor spaces can foster holistic child development and enhance learning outcomes. Emphasizing the principles of biophilic and child-centered design, the research examines how elements such as natural lighting, ventilation, greenery, open play areas, and sensory interaction zones contribute to children's well-being, creativity, and concentration. Employing a qualitative and case study-based methodology, the research involves spatial assessments of selected day-care centers, behavioral observations of children's activities, and structured interviews with parents, teachers, and caregivers. The findings are expected to reveal a strong correlation between nature-integrated spatial design and improvements in children's cognitive engagement, emotional balance, and social interaction. The study further aims to develop a set of design and policy guidelines for sustainable, nature-based child-care environments suited to the urban context of Lucknow. By reimagining day-care spaces as nurturing environments that harmonize nature and built form, this research highlights the potential of design as an active agent in promoting early childhood growth, environmental awareness, and overall well-being.

Keywords: Biophilic design, day-care architecture and interiors, early childhood development, nature-integrated spaces, urban sustainability

INTRODUCTION

Early childhood represents a formative stage in human development, during which the physical environment plays a decisive role in shaping cognitive, emotional, and social growth. The spaces where children spend their early years—particularly day-care centers—serve as the foundation for lifelong learning, behavioral patterns, and well-being [1]. In urban contexts, such as Lucknow, rapid urbanization, population density, and the proliferation of built infrastructure have significantly reduced children's access to nature. As a result, many day-care environments have evolved into enclosed, artificial settings that prioritize functionality over experiential and sensory engagement [2].

A growing body of research in environmental psychology and educational design highlights the restorative and developmental benefits of contact with nature for young children. Exposure to natural light, fresh air, vegetation, water, and organic materials has been shown to enhance concentration, reduce stress, and encourage curiosity, empathy,

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and creativity [3]. Incorporating such elements into day-care spaces through biophilic design principles can, therefore, transform these facilities from purely functional enclosures into dynamic environments that nurture growth and well-being [4].

In the context of Lucknow's evolving urban landscape, the need for sustainable, nature-integrated child-care facilities is both timely and critical (Figure 1). This study seeks to explore how natural elements can be effectively woven into the design of day-care interiors and outdoor play areas to promote holistic child development [5]. By examining existing facilities, user behavior, and stakeholder perspectives, the research aims to establish design and policy guidelines that support healthier, more engaging, and sustainable early learning environments [6]. With urbanization and two-income families the rule in Lucknow, the need for early childhood care centers has grown.

Nevertheless, most centers still are functionally oriented with little attention to the psychological and developmental advantages that could be derived from natural environments. Most centers are open in closed, air-conditioned buildings with little or no visual or physical access to the outdoors [7].

Global and Indian Perspectives

Scandinavian and Japanese models of emphasis on outdoor education and biophilic learning predominate at the global level.

In India, these models exist only in high-end preschools. There is a huge gap in incorporating nature in mainstream, low-cost day-care facilities (Figure 2).



Figure 1. Conceptual overview of nature-integrated day-care spaces in urban environments.



Figure 2. Relationship between natural elements and early childhood development outcomes.

Importance of Early Childhood Environments

Early years (0–6) are crucial for cognitive, emotional, and motor development. Early exposure to nature promotes creativity, empathy, attention, and stress regulation. Day-care areas thus become the key drivers of these outcomes [8].

Research Aim

To suggest design interventions for incorporating nature-based learning in urban day-care centers in Lucknow.

Research Objectives

To study the contribution of natural elements towards child learning, well-being, and behavior.

To assess the current daycare centers in Lucknow and analyze spatial and experience gaps.

To formulate design strategies for incorporating nature both indoors and outdoors in child-care environments.

LITERATURE REVIEW

Theories of Child Development

- *Jean Piaget*: Active exploration leads to cognitive development; nature provides a perfect place for experiential learning.
- *Maria Montessori*: Emphasized sensory involvement and self-motivated activity — both cultivated through natural materials and settings.
- *Reggio Emilia Approach*: Considers the environment as the "third teacher," focusing on natural light, textures, and outdoor activities.

Biophilic Design and Nature-Based Pedagogy

Biophilic design research illustrates that introducing natural elements decreases stress and enhances concentration in educational settings. Nature-based pedagogy studies indicate enhanced cognitive ability and emotional control in children with frequent exposure to nature [9] (Figure 3).

CASE STUDY

Fuji Kindergarten, Tokyo

A notable example of integrating biophilic design in child-centric architecture is the Fuji Kindergarten, designed by Takaharu Tezuka. The circular building layout encourages continuous movement and free exploration, supporting cognitive and physical development as emphasized by Piaget. The open rooftop playground, accessible directly from classrooms, allows children to interact closely with natural elements, such as sunlight, wind, and trees. Large sliding doors blur the boundary between indoor and outdoor spaces, promoting sensory engagement in line with Montessori principles. The presence of existing trees integrated within the structure reinforces a strong connection to nature. The design minimizes rigid classroom boundaries, reflecting the Reggio Emilia approach where the environment acts as an active learning agent. This spatial configuration enhances creativity, social interaction, and emotional well-being among children. Overall, the kindergarten demonstrates how architectural design can effectively support nature-based pedagogy and holistic child development.



Figure 3. Integration of biophilic design principles in child-care spatial environments.



Figure 4. Fuji Kindergarten, Tokyo – circular layout encouraging continuous movement and outdoor play.

Fuji Kindergarten, Tokyo (Tezuka Architects)

Circular Open Plan Encourages Outdoor play (Figure 4).

- Circular / Oval Ring Plan
- The building itself is a single-story oval ring
- World Architecture Community
- This open ring eliminates any dead ends. Children can run along the roof or perimeter without ever having to stop.
- World Architecture Community
- Rooftop Play Deck
- The roof is completely accessible, functioning as a giant play deck and running track.
- The Free Library
- No fixed "play equipment", such as jungle gyms; the roof itself — its shape, slope, trees, edges, etc. — is the playground.
- World Architecture Community
- The Free Library
- Indoor-Outdoor Permeability
- Several of the glazed/sliding doors circling the inner and outer ring are open much of the year (about April to November), creating a porous or even imperceptible boundary between indoors and outdoors [10].
- No permanent internal walls; space is instead generally defined by light boxes, sliding panels, furniture — so kids can move through, look across space, decide where to be.
- Blending with Nature
- Three mature Zelkova trees were preserved and left to grow through the building (courtyards, roof). Kids can climb on them, roof deck has nets around trees.

World Architecture Community

Skylights, open courtyards, water faucets, rain features (water falling through gargoyles into basins) so that children experience natural elements regularly.

Scale & Child-Centric Details

Roof top ceiling heights are minimal (≈ 2.1 m) so it feels like a touch. World Architecture Community

All fixtures, furniture at children's scale. Movements and adjustments in partitions/furniture are within children's ability to manipulate.

Philosophy / Pedagogical Ties

Instructed by montessori ideals: independence, freedom, learning through doing, discovery instead of rote/seated learning.



Figure 5. Indoor–outdoor spatial permeability and natural interaction zones in Fuji Kindergarten.

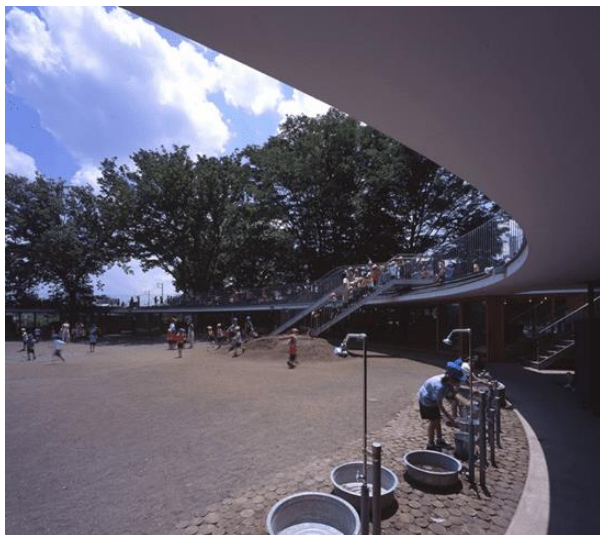


Figure 6. Nature-based learning environment at Korento Nature School, Finland.

Also, the belief that "common sense" / risk / a healthy dose of challenge is good for kids — freedom of movement, some small risk (climbing trees, falling down, getting wet) in a safe setting.

Bach Pan Day-Care, Pune – Uses Courtyards and Skylights to Enhance Sensory Engagement

Bachpan Play Schools / Day-Care centers in Pune have several locations (Hadapsar, Viman Nagar etc.)

Facilities generally list indoor and outdoor play areas, trained instructors, play-based education, etc.

There are pictures in gallery ads, but none positively featuring skylights or large courtyards from the sources discovered (Figure 5–6).

In order to verify if Bachpan Day-Care in Pune utilizes courtyards, skylights, and if so, for specific purposes of sensory stimulation, one truly must:

- Review architectural drawings or design briefs for the particular branch
- Search for good-quality photographs of the building (exteriors and interiors)

Phone the school facility manager and inquire if there are:

- Courtyards (open-to-sky areas) or light-wells
- Skylights / openings in the roof
- How they are utilized (for play, for light, for nature / sensory stimuli) (Figure 7–8)

Terälahti School and Korento Nature School, Tampere

Situated in Rural/Natural Environment

The Nature School (Koren to) accommodates large groups of students and teachers for nature-based learning days. It promotes well-being, phenomenon-based learning, and accountability towards nature [11].



Figure 7. Behavioral mapping of children's activity patterns in day-care spaces.



Figure 8. Research methodology framework showing data collection and analysis methods.



Figure 9. Nature-based classroom setting showing proximity to natural landscapes.



Figure 10. Research methodology framework including qualitative tools and analysis methods.

Learning is not limited to natural science; other subjects are incorporated with nature. For instance, collecting data (through tools like iNaturalist), observation, etc.

ULKOLUOKKA ("Outdoor Classroom") Project

Headed by SYKLI Environmental School of Finland with networks, such as Somen

Latu, LYKE, etc. (Figure 9–10)

Goal: equip teachers to utilize the outdoors as a classroom, increasing outdoor learning frequency from monthly to weekly/daily.

It involves the exchange of lesson plans, materials, and assisting schools in developing their own outdoor learning practice.

Forest Schools / Nature Preschools

Most Finnish outcomes depict children spending considerable amounts of time outdoors, even for pre-school/kindergarten age.

Creative Learning Playschool

Seasonal learning plays a significant role: investigating the forest in winter, spring, summer, and autumn; studying seasonal change, animal life, plant growth, snow, ice, etc [12].

Features / Design & Pedagogical Methods

Here are how the outdoor classrooms are structured, what facilities they commonly employ, and in what ways these contribute to integrated seasonal learning:

- Feature
- Design Element
- How It Works in Practice
- Learning
- Developmental Benefits



Figure 11. Behavioral mapping of children's activities in indoor and outdoor environments.

Proximity to Nature (forest, fields, streams) \Most schools are located so that forest starts at or right at the school edge. Pupils can walk into woods or fields with ease (Figure 11).

Regular contact; spontaneous interaction; minimizes logistical constraints; kids learn about local ecology.

Outdoor Classrooms / Forest Kindergartens

Classes take place outdoors for several hours; "rooms" can be as simple as under trees, shelters, huts, or open log seating.

Rich sensory stimulation (views, scents, noises, textures, weather); facilitates physical movement; strengthens attention, curiosity

Seasonal Curriculum

Learning themes according to seasons: winter snow/ice, spring thaw, summer growth, autumn leaves/migrations. Children see natural cycles.

Creative Learning Playschool

Facilitates concept of time, environment, ecosystems; promotes respect for nature, flexibility; links to climate and sustainability teaching.

Phenomenon-based, Experiential Learning

Instead of memorization, most lessons stem from natural events: learning from a fallen log, watching insect life, measuring snow depth, tracing trails. Utilization of instruments (measuring, collecting data).

Enhances conceptual understanding; combines science, mathematics, art, language; engages students; provides context to the real world.

Well-Being & Social Learning

Outdoor environments lower stress, provide freedom, room to move and rest. Children tend to be calmer, happier (Figure 12).

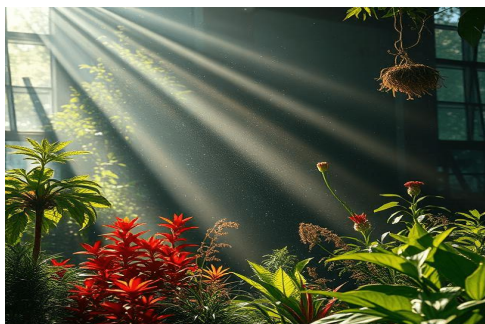


Figure 12. Proposed design strategies for nature-integrated day-care spaces.

Social interactions (working together, looking after one another, being responsible for equipment) are common. Reflection tends to be integrated.

Reduces mental health; enhances social skills; promotes emotional resilience; assists with concentration and motivation.

Training & Institutional Support

Initiatives, such as "Outdoor Classroom / Ulkoluokka" offer resources, professional training, networking for teachers. Finnish curricula are designed to accommodate flexibility so that schools can incorporate outdoor learning. There are policies to support it.

Ensures consistency; facilitates scaling the model; lowers risk that outdoor learning is ad hoc or one-off; enhances teacher confidence and competence.

RESEARCH METHODOLOGY

A qualitative case study approach integrating observation, interviews, and spatial analysis.

Data Collection Methods

- *Surveys/Interviews*: With parents, teachers, and caregivers to explore expectations and perceptions.
- *Observations*: Mapping of children's behavior in current daycare environments (indoor vs. outdoor activity).
- *Site Visits*: To traditional as well as semi-nature-integrated daycare centers in Lucknow.
- *Comparative Analysis*: Conventional enclosed centers versus those having nature elements.
- *Thematic Coding*: Categorizing qualitative responses (comfort, engagement, creativity, safety).
- *Behavioral Mapping*: Monitoring how kids use areas (activity, groupings, attention levels).

Site Context: Lucknow

Lucknow's mixed climate — hot summers, monsoon humidity, and pleasant winters — requires climate-sensitive design. Urban childcare centers are mostly in residential colonies with constrained open space. Challenges are:

- *Spatial Constraints*: Constrained outdoor play spaces.
- *Safety Concerns*: Confining fencing and limited plant diversity.
- *Affordability*: Green materials and design perceived as expensive.
- *Cultural Factors*: Desire for indoor comfort over outdoor play.

The richness of the city's garden tradition — from Mughal gardens to provincial parks — provides contextual inspiration for incorporating greenery even in tight sites.

DESIGN STRATEGIES FOR NATURE-INTEGRATED DAY-CARE

Spatial Planning

- Foster indoor–outdoor continuity using verandas, courtyards, and sliding partitions.
- Develop activity zones for learning, play, resting, and sensory discovery.
- Utilize flexible layouts to accommodate seasonal flexibility.

Biophilic Elements

- *Natural Light & Ventilation*: Skylights, clerestory windows, cross-ventilation.
- *Greenery*: Green walls, rooftop gardens, indoor plants.
- *Textures*: Bamboo, stone, wood used for tactile learning.
- *Water Features*: Mini ponds or mist sprays for sensory peacefulness.

Interactive Natural Features

- *Sensory Gardens*: Scented and colorful plants to explore.
- *Sand & Water Play Areas*: For tactile and collaborative play.
- *Vertical Gardens*: For small spaces.
- *Climbing Plants & Trellises*: Inspire curiosity and shade. Safety & Comfort
- Rounded corners, non-toxic coatings, and anti-slip surfaces.
- Ergonomic, child-sized equipment.
- Climate-responsive shading, ventilation, and insulation.

Technology Integration

- AR-based narrative walls connecting natural events with interactive learning.
- Smart monitoring for safety and comfort (air quality, temperature).

DISCUSSION & FINDINGS

- Early findings and pilot tests suggest that children in nature-infused environments:
- Exhibit longer attention spans and greater creativity.
- Exhibit enhanced social skills and less aggression.
- Teachers observe higher levels of engagement and more efficient classroom management.
- Parents report increased satisfaction with healthier habits and fewer discipline problems.
- Comparative assessment demonstrates that even small nature enhancements (green walls, open courtyards) have a significant effect on mood, activity levels, and child–teacher interactions.

CONCLUSION AND RECOMMENDATIONS

This study confirms that nature-integrated design has a transformative effect on early childhood experience, especially in urban environments, such as Lucknow. The research emphasizes how modern day-care centers, trapped in sealed, artificial space, do not meet the developmental, emotional, and sensory demands of children. Incorporating natural aspects — daylight, green space, water, texture, and open air — enhances the learning environment, stimulating creativity, exploration, and child well-being.

Through an in-depth review of theories by Piaget, Montessori, and Reggio Emilia, and case studies, such as Fuji Kindergarten (Japan) and Korento Nature School (Finland), the research confirms that environments designed in harmony with nature stimulate cognitive growth, emotional stability, and social interaction. Observations and qualitative findings from local daycare analyses further reveal that even minimal nature inclusion —, such as indoor plants, courtyards, or natural ventilation — significantly improves children’s concentration, happiness, and health.

Within the climatic and cultural context of Lucknow, the application of biophilic design principles presents a sustainable route to enhance the early education infrastructure. Day-care facilities incorporated into nature, at a very fundamental level, ensure child development while fostering stronger community relations and environmental sensitivity from an early stage. Hence, infusing nature into child-care architecture is not just aesthetical but mandatory — congruent with both educational and ecological goals.

RECOMMENDATIONS

Design-Level Recommendations

Indoor-Outdoor Continuity: Design continuity between classrooms and outdoor play spaces through courtyards, verandas, and open partitions.

Biophilic Elements: Incorporate natural lighting, ventilation, native plant species, and water elements to encourage multi-sensory interaction.

Material Selection: Utilize sustainable, non-toxic, and tactile materials, such as bamboo, clay, and wood to promote sensory learning and sustainability.

Micro-Nature Spaces: Even within small urban plots, have terrace gardens, planter walls, or little sensory gardens to provide daily exposure to nature.

Safety and Comfort: Provide ergonomic furniture, soft finishes, shaded areas, and climate-sensitive layouts appropriate for Lucknow's composite climate.

Pedagogical and Operational Recommendations

Promote outdoor learning modules with Montessori or Reggio Emilia philosophies.

Train teachers and caregivers in nature-based pedagogy to foster efficient utilization of outdoor and sensory spaces.

Integrate interactive storytelling, AR-based nature games, and activity zones that integrate technology with nature experiences.

Encourage parental engagement through community gardening, nature walks, and outdoor family learning events.

Policy and Planning Recommendations

Lucknow Development Authority and local municipalities ought to implement green design guidelines and incentives for child-care infrastructure.

Urban by-laws should require a minimum open space ratio and promote green roofs or walls for all educational buildings.

Government initiatives like the National Early Childhood Care and Education Policy (2023) must include biophilic principles within their standards for quality.

Support public-private partnerships to finance low-cost, nature-abundant daycare models that can be scaled to low-income areas.

Future Scope

This design framework can be extended to preschools, elementary schools, and community learning centers.

Future studies can consist of quantitative research on the effects of nature-integrated environments for a particular developmental outcome (attention span, emotional regulation, or readiness for school).

A pilot initiative in Lucknow has the potential to illustrate the measurable gains of these interventions and be replicated across Indian cities.

Final Remark

By embracing nature as a core component of day-care architecture, Lucknow can lead the way in child-friendly, sustainable education — one that provides not only smarter but healthier, happier, and greener future generations.

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