

Contextual design guidelines of a Sensory Garden for Children with Autism Spectrum Disorder (ASD) in Bangladesh

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ARTICLE INFORMATION

Received: 17.09.2022
Revised: 14.11.2022
Accepted: 06.12.2022
Published online: 10.02.2023

Keywords:

Autism spectrum disorder (ASD),
Sensory difficulty,
Sensory Garden design,
Withdrawal space

ABSTRACT

Bangladesh's number of children with autism spectrum disorder (ASD) rises daily. Evidence shows that issues in sensory integration have a significant impact on the behavior of a child with ASD. Due to sensory integration, children with ASD face difficulties detecting, comprehending, and organizing sensory information from the body and surrounding environment, resulting in hyper and hypo-sensitive reactions. This paper aims to generate guidelines for designing a sensory garden to help sensory integration for children with ASD in Bangladesh to lessen their struggles. First, the authors reviewed the literature on children's behavior with ASD, their problems, and how a sensory garden can help them reduce their problems. Then, they conducted informal interviews with two therapists who work with autistic children daily and 12 caregivers from four organizations to gain insight into the most significant physical impediments children with ASD face in Bangladesh. These interviews helped to generate a checklist for evaluating case studies. Then, two case studies are done on foreign sensory gardens to understand the landscape architects' considerations in creating a multisensory garden. Finally, the authors provide recommendations for designing a sensory garden for children with ASD using qualitative analysis to meet their unique needs and improve their daily lives.

1. Introduction

Autism spectrum disorder (ASD) is a developmental disorder in children. Children with ASD face problems in social communication, restrictive, repetitive, or stimming behaviors, atypical responses to sensory stimuli, and behavioral challenges [1]. Its range of developmental disabilities is a lifelong disorder that has no known cure and treatment [2]. Even ASD has no marker and no test for diagnosis. Parents' reports and clinical observations are the main criteria for diagnosing ASD [3].

Worldwide the number of children with ASD is increasing significantly day by day. Research shows that 1 in 88 children has been diagnosed with an autism spectrum disorder [4]. According to talk about caring for autism

(2012), autism is the fastest-growing developmental disability in the USA [5]. The number of children diagnosed with autism will be more than AIDS, diabetes, and cancer combined [5], [6]. Autism is a concern for the whole world. Developed countries like Canada, Switzerland, Japan, and South Korea face a similar problem. Table 01 shows the autism prevalence in developed countries [7]:

In Bangladesh, around 300,000 children have this disorder. According to the Autistic Children's Welfare foundation Bangladesh, 1 in every 94 boys and 1 in 150 girls are affected by autism [8]. Although autism is a developmental disability, many children with ASD have average to above-average IQ levels [9]. Being tolerant to them and providing them a physical environment considering their needs may lead to better cognitive and intellectual

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This article is published with open access at www.seu.edu.bd/seuja

ISSN No. 2789-2999 (Print), ISSN No. 2789-3006 (Online)

development results. Even providing a suitable physical environment may help those with an intellectual disability. Children with ASD face problems in sensory integration, which may be the reason for ASD in many children [4]. Sensory integration is the power to process and interpret visual, acoustic, vestibular, tactile, and proprioception information from the environment by the brain. However, children with ASD face difficulties in receiving, processing, and organizing sensory information [10]. Currently, multisensory rooms are designed worldwide for therapy.

Country	Number of children diagnosed with ASD	
Canada	106 in 10,000	1 in 94
Switzerland	145 in 10,000	1 in 69
Japan	181 in 10,000	1 in 55
USA	185 in 10,000	1 in 54
South Korea	263 in 10,000	1 in 38
Hong Kong	372 in 10,000	1 in 27

Table 01. Autism prevalence in the countries Canada, Switzerland, Japan, South Korea, Hong Kong

However, a multisensory garden can be designed as nature has a vital healing capacity that can help. In this work, first, the authors will present a literature review conducted in two phases. The literature review in the first phase will help understand the nature of autism and the sensory issues children face in their everyday lives. In contrast, the second phase will discuss the impact of nature on sensory integration by reducing stress or stimulating children with ASD. Then, the authors develop some hypotheses that will be examined through interviews with experts in the field (doctors, therapists) and the caregivers of children with ASD in Bangladesh. children with ASD improve their sensory integration impairments. Unfortunately, little research has been done to design a proper sensory garden worldwide. For example, no research has been done in Bangladesh on designing a sensory garden for children with ASD. Therefore, this study aims to find out the relation between the sensory needs of autistic children and the principles of landscape design to create guidelines for a landscape designer to design an effective and therapeutic sensory garden for children with ASD in Bangladesh.

2.0 Objective

The aim of the paper is to generate some guidelines for designing sensory gardens so that children with ASD can

overcome problems related to sensory issues and improve their lives.

3.0 Methodology

In this work, first, the authors will present a literature review conducted in two phases. The literature review in the first phase will help understand the nature of autism and the sensory issues children face in their everyday lives. In contrast, the second phase will discuss the impact of nature on sensory integration by reducing stress or stimulating children with ASD. Then, the authors develop some hypotheses that will be examined through interviews with experts in the field (doctors, therapists) and the caregivers of children with ASD in Bangladesh.

Finally, the authors will also explore foreign case studies to analyze how landscape architects have designed successful sensory gardens and determine their design considerations. The findings from the interviews and case studies will be examined to generate the guidelines for designing a multisensory garden for children with an autism spectrum disorder in Bangladesh.

4.0 Phase 01: Literature Review

A. Nature of autism

Autism spectrum can be defined as a neurological and behavioral disorder that affects the execution of the brain in the part of communication skills and impacts social interaction [11]. Children with ASD show specific behaviors such as:

1. Weakness in social interaction: the inability to use eye contact, facial expression, and impairment in social interaction.
2. Communication impairment: impairment in language, the deficit in commencing, or continuing and sustaining a conversation.
3. Repetitive and restrictive behavior: an obsessive desire for repetition, intense preoccupation with one activity or subject, distress over change, repetitive movement, persistence in routine, and rituals without any purpose.

B. Problems that the children with ASD face

Children with ASD face issues with processing information or stimuli demonstrated by a visual, vestibular, acoustic, or tactile hypersensitivity or hyposensitivity. The prefix 'hyper' indicates oversensitivity to stimuli. This brain obtains more information from the surrounding environment than necessary and becomes overwhelmed while processing that information [12]. Therefore, too much information might agitate a child with ASD. Conversely, according to Sanchez et al., an environment with minimum details helps children with ASD more [13].

The prefix 'hypo' means the brain cannot interpret information and it (the information) becomes lost in the brain resulting in little or no reaction [12]. Researchers have found no predictable pattern of which stimuli will

induce a 'hyper' or 'hypo' reaction in a child with ASD [14]. For example, a texture may create hypersensitivity in some children with ASD, whereas some may not even sense a rough-textured surface and hurt themselves by touching it. That means some children may be hypo-sensitive to pain and cannot protect themselves from hurting [15]. Children with ASD face difficulty orienting in an environment while moving from one place to another. [16]. In addition, barriers or screens might make them nervous as they cannot comprehend what might be there next to the barrier. According to Vazques and Torres, this happens due to the limited capacity of imagination [16]. Therefore, architects and designers have much scope of work to make a physical environment more comprehensible.

Autistic children struggle to communicate with their surroundings. Sometimes they need color coding and pictures of objects to support them visually. Social interaction is an issue for a child with ASD. They might become overwhelmed in a crowd and forced to participate in social interaction [16]. An overwhelmed person might need a space to overcome his/ her anxiety. For social anxiety, considerations should be taken to design different proxemics.

Children with ASD face problems in-play experience due to their difficulties with social interaction. Inability to relate to other children hampers their play experience [17]. According to Susanna Miller, "Play is the child's method of exploring and coming to terms with the world and learning physical coordination; the use of symbols and fantasy." [18]. That is why increasing play opportunities have become crucial for the betterment of developmental issues.

C. Therapies for the problems

As Autism spectrum disorder exhibits a large spectrum of impairments, countless forms of therapies have emerged in recent years. Communication therapy, behavior therapy, play therapy, occupational therapy, physical therapy, pet therapy, and sensory therapy are the most common therapies. In most cases, a combination of therapies is more effective than a single therapy.

D. Nature as a therapy

As Autism spectrum disorder exhibits a large spectrum of impairments, countless forms of therapies have emerged in recent years. Communication therapy, behavior therapy, play therapy, occupational therapy, physical therapy, pet therapy, and sensory therapy are the most common therapies. In most cases, a combination of therapies is more effective than a single therapy. Nature has a vital capacity for healing. According to Moore, the sound of running water, wildflowers, pastures, and the life of the entire neighborhood dramatically affects the students' social and psychological behaviors. Likewise, birds' and butterflies' beautiful sounds and colors affect the children positively [19]. Furthermore, nature helps children develop

creativity and observation power [20]. Likewise, playing in a natural environment strengthens collaborative skills and language development [21]. In addition, nature helps develop imagination and a sense of wonder [22]. These are considered to be significant issues for life-long learning. Finally, nature helps children decrease stress and help them deal with life with strength [23], [24].

Children with the attention-deficit disorder can benefit a lot after walking in an outdoor space. For example, an experiment organized by Frances Kuo and Andrea Faber Taylor found that children who have attention-deficit/hyperactivity disorder (ADHD) could concentrate better after walking in a park and reduced the difference between children with ADHD and without ADHD [25] [26]. Using nature as therapy for children with ASD has created new hope. Designing nature and integrating sensory therapy has become a new study area for researchers that might help improve the impairments of children with ASD.

E. Sensory Garden for the children with ASD

Sensory gardens are parks designed to stimulate and engage the five basic senses. According to H. Hussein (2011), these are parks or gardens where all landscape, texture, and color components are carefully designed to provide the highest sensory stimulation [27]. Sensory gardens provide aesthetic enjoyments and work as a therapeutic tool for stimulating and enhancing all five basic human senses of hearing, vision, touch, smell, and taste [28]. A study conducted by Hazreena Hussein (2014) found that, in a sensory garden, children with special needs can play and explore outside through physical mobility. In addition, a sensory garden can provide space for them for social skills and sensory stimulation [29]. Another study by Blakes, Rikinsoon, and Dillon (2013) argued that seven outdoor activities are beneficial for children with ASD, including gardening and horticulture activities, landscape design, physical exercise, summer camps, farm experience, live experience through environment and animal therapy [30]. Blakesley and Payne suggested in their previous study that learning through the natural environment enhances better understanding. This learning process provides a direct experience for children with ASD [31].

Furthermore, a study on the need for sensory gardens done in 2014 demonstrates positive behavior changes for individuals with sensory disorders in hypersensitive and hyposensitive autism children. Hypersensitive therapies are provided for children who become too active to be at ease. While hypo-sensitive therapy parks are provided to stimulate children to be active, challenging, and have adequate play space [30]. Another study shows that structure of the garden, the preparation of hardscape and softscape material, and physical shape can influence the behavior between hyposensitivity and hypersensitivity [32]. Monika Trojanowska conducted research on sensory

garden design for visually impaired people in Poland. However, the study found a necessity for specialized design in sensory garden design that complies with safety standards for multisensory stimulation for all special school children [33]. This study was also supported by the research conducted by R. Nikraves and S. M. Tabaeian (2016). According to their research, sensory garden designs need to consider the environment, access to various activities, green garden space, different colors of space, individual activities and groups, active participation, social interaction, observation and understanding, and finally, safety level [34].

In conclusion, a sensory garden helps children with ASD in sensory integration, enhances social interaction, and helps to focus on learning. Therefore, while designing a natural space as a sensory garden with many elements, including texture and colors, careful consideration is necessary to stimulate children's senses.

F. Hypothesis

Like Indoor, the outdoor space has considerable scope for development for children with ASD. These scopes can be brought through different landscape design aspects in the field of a sensory garden. Here, landscape architects have a more significant role with different design features. Some valued structures have been discussed below:

1. Plant is one of the most significant parts of the whole organization of the sensory garden. Its colors, textures, and smells are not only inspiring but also relaxing. Hence, to support the bond between humans and nature, landscape architects can incorporate sensory integration by considering color, texture, sound, and smell through diverse plants in their design.
2. Designers can create an easily predictable and simple environment by designing patterns, circulation, and pathways with proper zoning and can help in improved social interaction by careful space fragmentation.
3. A secluded expedient space can be sheltered with different natural elements to create a withdrawal space for releasing the stress and anxiety of the patients.

4.1 Phase 02: Interview

Experts in this field and caregivers were considered for an interview to understand Bangladesh's present situation and facilities. Only a few government and non-government organizations related to autism are running in Bangladesh. Most of the organizations are in Dhaka and were established in the last two decades. For this research, Experts and caregivers from four of these organizations- 'Beautiful Mind,' 'Proyash,' 'Orchestra,' and 'Inner Circle' shared their thoughts.

A. Participants 01: Experts in the field

Two therapists had responded to a basic questionnaire about how the kids deal with problems in their physical surroundings. The interview was carried out in two parts- formal and informal on the zoom platform due to the pandemic in 2020. First, based on the literature review, some questions were selected covering problems related to autism and the physical environment. Then, after getting the feedback from experts, a further informal discussion was carried out.

B. Participants 02: Caregivers

The interview was conducted as a thematic interview. The themes were sensory difficulties, imagination, communication, and social interaction. At least three Supporting staff of the mentioned organizations and the parents of the kids were given an introduction to each theme, and some general questions were asked on how they encountered the issues. A layout of the query was prepared before the interview, but some questions were not predetermined. At the end of each theme, how the topic was addressed in the literature was discussed. The intention behind this was to find the broader scenario. The goal of this participant group is to identify the most significant physical impediments that an autistic kid has in his or her environment, mainly when they remain outside of their house. All their answers were summarized to create a checklist for evaluating a sensory garden.

C. Findings

Almost every component like light, shade, sound, sight, texture, furniture, orientation, and color of outdoor spaces could provoke an intense reaction in individuals with ASD. For example, some may be disturbed by music, while others love it. Some may prefer calm and quiet spaces, while others like interacting and socializing with other people. However, more or less, all the respondents agreed that with the proper environment, facilities, practice, and therapy, this group could get better.

Nature can play a vital role in their improvement. As a result, all concerns should be considered while creating recommendations.

4.2 Phase 03: Sensory Garden: Case-Study

A. Sensory Garden Evaluation Criteria

Based on the literature review and interviews of experts in the field (doctors, therapists) and caregivers (parents, teachers of children with ASD), a checklist has been prepared [table 2] to evaluate case-study gardens to understand the scope of landscape architects' intervention areas for designing a sensory garden for the children with ASD.

In Bangladesh, there is no designed sensory garden for children with ASD. However, some schools and organizations are recently taking initiatives to create sensory gardens. For the study, two foreign case studies were chosen that were solely designed to aid children with ASD.

A. Case Study 01: The Sensory Arts Garden at Els Center of Excellence, Jupiter, Florida, USA [35]

In 2017, a new garden was opened in Florida to help individuals with ASD along with the community. Landscape architect David Kamp, with a team of experts, including music therapists, special educators, and researchers, design the center for leading positive, productive, and rewarding lives. The multidisciplinary collaboration is a nuanced response to the people with ASD.

Case Study

	Site & Surrounding	Spatial Configuration	Wayfinding	Escape/Withdrawal space	Sensory Integration		
					Texture	Color	Furniture
Name of Garden/ School	Location of the garden	Garden layout	Ease of circulation	Space for solitude	Rough	Bright/ muted	Types of furniture
Surrounding noise level	Remarks	Zoning	Remarks	Sensory evocation	Smooth	Environmental stimuli/ visual distraction	Impact on proprioception and vestibulation
		Remarks		Remarks	Remarks	Remarks	Remarks

Table 2: Checklist for evaluation a sensory garden

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Case Study 01: The Sensory Arts Garden at Els Center of Excellence, Jupiter, Florida, USA [35]

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Site & Surroundings: The center has a natural flatwood area, limestone Creek Park, a water channel from the Loxahatchee River, and a vibrant neighborhood nearby. The center's structures reduce the noise level in the neighborhood and open up nature as an essential partner in health and wellness.

Spatial Configuration: The overall layout offers a large outdoor space with repeated clusters with unique character, understandable circulation, diverse settings, and understandable destinations. Using simple geometry to create semi-enclosed small gardens with specific plants invites the users. The virtual pauses offer unobstructed views and reduce the anxiety from the unseen with the potential for continuous discovery and sovereignty. Designers have divided the garden into different zones to facilitate both hypersensitive and hyposensitive children. They have created sensory zones with colorful flowers and small quiet spaces with less exciting elements so that hypersensitive children can reduce their stresses.

Way Finding: Designers have considered wayfinding in their design. Different grass and ground covering have been designed like a ring pallet to orient oneself within the garden and design circulation so that nobody gets lost and finds their destination. Thus, students can enjoy the garden and focus on enhancing feelings of serenity and tranquility.



Fig. 1, Fig. 2. Clarity and simplicity are reflected in the overall design, details, and material selections. [35]



Fig. 3, Fig. 4: Different scales of spaces can meet different needs resulting in improved social skills.[35]

Fig. 5, 6, 7. Plants, furniture, and features discretely target the five senses. [35]

[Fig 1-7] Photo credits: Dirt works, PC. Website: <https://dirtworks.us/contact-us/>

Withdrawal Space: Successions of reduced and integrated sensory areas, or "places away," are designed

along the garden perimeter. These places provide relaxing counterpoints for individuals who may be hypersensitive or seek a moment of rest and sanctuary. In contrast, some vicinity has been designed for socialization with other students, visitors, or caregivers.

Sensory integration: Texture, color, smell, and material of garden furniture are purposefully selected and located to balance hyper and hypo-sensitive activity. The play of visual and physical interaction and separation is sensibly designed here. Muted colors are preferred during wall, furniture, and pave selection. Surfaces that are smooth or stiff provide a variety of tactile experiences like smooth pebble seats or rough water spheres, natural plants, or wooden furniture. Structured, upper body supporting, straight-backed benches provide stability, while "pebble" seats offer playful alternatives and varying proprioceptive and vestibular experiences [35]. A primary base plane unites the room, but color or material changes at crucial places signify a transition, a new experience, or draw attention to the body and senses. Smooth-edged furniture is preferred to reduce accidents and adverse reactions.

Plants are meticulously selected for this garden. Size, shape, color, smell, visibility, privacy, and personalization have ensured the assortment of plants like repetitive foxtail palms structure the visual and bring comfort to the students and guests. A fertile rhythmic edge canopy relieves the visitors from the sun. Gumbo limbo and bay rum trees were chosen for their structural properties, form, shade capacity, visual, olfactory, and tactile characteristics, and semi-permeability. Metal chimes on opposite sides of a planter offer the opportunity for musical interaction and active the space with sound. The planting palette is intentionally subdued to create emotions of calm and tranquility.

The overall design, details, and material decisions represent safety and security and work as a bridge for individuals with ASD and general people. Still, the project faced some problems initially while including different age group. There is a lack of large gathering space for occasional gatherings. Some features became very popular, like swing or lemon verbena plants that became very difficult to maintain.

Case Study 02: Kingwood College, London, UK [36]

In collaboration with The Kingwood Trust, the Helen Hamlyn Centre for Design sought to enhance homes for individuals with autism spectrum disorder (ASD).

The design team concentrated on social interaction, communication, particular interests, and sensory preferences while considering the fundamental needs. They conducted numerous conversations with autistic adults to enhance the garden experience and foster a sense of community. No one influences the sensory quality of the external environment, such as the sun, wind, weather,

animals, etc. So, the design decisions were vital while designing outdoor spaces.

Site & Surroundings: The site has been designed and developed on the existing area of a residential service. The area is calm and quiet and devoid of unnecessary noises.

Spatial Configuration: They have created different outdoor spaces to cater to the varying needs and interests of an autistic adult. Overall, space organization is clear and simple, with seven 'green spaces' offering unique possibilities and opportunities. These seven zones are escaping area (withdrawal space), exercise area, gardening area, area for sensory integration, social activities, transitional spaces, and wilderness. The beginning of every zone was kept simple and advancing to more exciting social and activity areas. The most enthralling sensory and animal zones are found along the perimeter. Two mature trees are remained untouched, which grants an obvious choice for the wilderness. A barbecue space along with a summer-house is placed centrally for socialization. Finally, a veranda works as a transition space allowing individuals to flow from the interiors to the outside.

Way Finding: People with autism may have impaired depth perception, influencing navigation, distance assessment, and maneuvering around objects and other people. As a result, Paths and visual markers are offered to improve their perception and predictability in outdoor areas. Desired locations are freely accessible, whereas less desirable regions can be easily avoidable. Many characteristics of autism may be beneficial in maintaining a garden: regularity, pattern, repetition, and attention to detail are desirable attributes in a gardener. Clear indications are designed to explore the sensory environment that appeals to them and avoid those that do not.

Withdrawal Space: Three "escape" places are incorporated into a separate part of the garden. Two natural canopies given by large trees and a man-made canopy with seating offered these escapes.

Sensory integration: The study team considers certain senses while designing the 'rooms' that cater to each sensation, allowing individuals to concentrate on one at a time. The garden is filled with visual phenomena that move and changes their color, form, shape, and shade over time, the weather and the seasons. Visual consistency, repeated pattern, and same color tone plants are used while secrete pollen trees are avoided. Some spaces have the option to play with light, shade, or glare, while some are kept flat. A hypersensitive person may wish to touch and feel everything around them, but another may want to avoid touching anything. So, in this garden, plants are grouped about their tactile quality; grass covering is provided for those who like to sit or lay on, and the walkway has options like sand, crushed gravel, or stone slabs. The garden produces a variety of sounds with varying rhythms, tones,

and pitches. Some are artificial, while others are natural. Quiet zones are designed away from social spaces for hypersensitive persons. Space that allows rain, birds, or other sound sources are separated.



Fig. 8



Fig. 9, 10

Fig. 8, Fig. 9, Fig. 10: Small spaces with unique setups to satisfy the different demands of the users [37].

[Fig 8-10] Photo credits:

Website: <https://www.kingwood.org.uk/what-we-offer/horticulture-diy/>

The smell is also significant as it can bring back childhood memories and give a sense of taste. Thus, garden scents from herbs, plants, flowers, vegetables, raked gravel, a mown lawn, and fresh soil after the rain are considered in the design. Plants grouping, mildly scented plants, or the plants that produce scent after rubbing are used here. Some places are designed so those who smell hypersensitive adults will be comfortable there. The garden may be a demanding and fascinating setting for adult people to learn how their bodies move in space. For their joints and muscles, various persons require varying levels of proprioceptive input like mowing the lawn, soil digging, water lifting, stretching up to reach a tree branch, etc., offered to adults with autism. These activities also calm their nervous system, keep them busy and help them learn.

The landscape is planned with up-downs and slopes in some places, walkways are designed with smooth surfaces, and small and large open spaces are intended to create options for the interested ones. The garden environment also provides

a choice for vestibular input that promotes awareness of balance and coordination. A one-person bird's nest swing is also incorporated to stimulate vestibular input.

Finally, it must be mentioned that this project shows the potential of garden settings that influence individuals with autism in significant ways. The project clearly states that no prescriptive set of green spaces will meet the needs of every adult with autism. The key is to consider individuals and elements that could feature in their wish list and negotiate spaces that offer the best fit for different needs. It is a pilot project for learning more about the integration process.

Case Study Findings

The Sensory Arts Garden at Els Center of Excellence, Jupiter, Florida, USA' and 'Kingwood College, London, UK' are very successful sensory gardens that help children and adults with ASD. They are helping individuals with ASD to lead positive, productive, and rewarding lives by taking aid from nature and making it an essential part of health and wellness. These two gardens provide crucial information about how to design a sensory garden. However, applying the exact idea in Bangladesh might be challenging. Some of the main factors that vary in our context are behavior, habit, and cultural difference. Nevertheless, several activities can be included while designing a sensory garden. In that case, a designer must be aware of his context, user profile, culture, and resources like soil quality, plant type, and environment.

Again, it is better to remember that our two case study gardens have been designed recently (within 5 to 10 years). They are working successfully for the time being. Nevertheless, only time and post-occupancy evaluation can show their long-run impact on children with ASD.

5.0 Design guidelines

This publication aims to generate guidelines on designing a sensory garden that will help cater to the varying needs and interests of children with ASD. From the literature review, interviews, and foreign case studies, recommendations have been generated that might help to reduce the problem faced by children with ASD in their physical environment.

A. Site

Locate the sensory garden in a noise and environmental hazard-free area. The garden should be fully enclosed on all

four sides. Children with ASD may become curious and wander through an open gate. This walled enclosure also prevents unwanted intrusions from passersby. Entry to the garden should feel like a celebration. However, at the same time, measures should be taken so that children with hypersensitivity do not become overwhelmed.

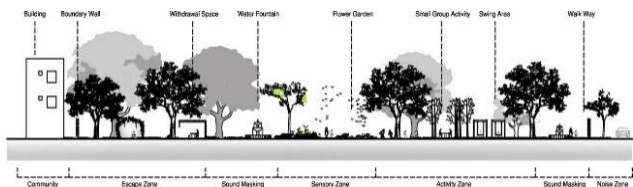
Layout- A successful sensory garden for children with ASD must have a simple layout with a clear, logical organization. The design should be devoid of ambiguity and extraneous elements. That might create anxiety in a child with ASD and make him/ her frustrated. The design elements should aid the child by giving visual messages to determine the destination and reach there easily. For a child with ASD who experiences hypersensitivity, space should be introduced in a low stimulus manner. He/ she must enter a cleanly designed space with a gradual increment of environmental stimuli in a predictable way further into the garden. A landscape architect can use five elements (path, place, landmarks, edges, and nodes) of Kevin Lynch to create a visual map.

Distribution of space- distribution of space is a critical aspect of designing a sensory garden for children with ASD. Too big activity space or too small both might trigger hypersensitivity in a child with ASD. That is why careful consideration of space organization and progression of space is necessary.

B. Spatial configuration

In a broader sense, space should be designed for solitude and socialization to aid hypersensitivity and hyposensitivity. To enhance socialization, landscape architects should consider organizing a combination of Fig. 11: defining and designing boundaries can make a sensory garden successful (drawn by authors) small and large spaces. A person with ASD may feel uncomfortable in large open spaces; smaller spaces will help them interact in smaller groups. He/ she may not want to participate in social activities immediately. They may appreciate providing sitting options a little apart from the main activity space. Adjacencies of those spaces have to be designed carefully [Fig.11]. Too many noisy places might need some innovative considerations. For example, water

Fig. 11: defining and designing boundaries can make a sensory



garden successful (drawn by authors)

can be used for sound masking. Sometimes, visual barriers might help control sensory input and avoid sensory overload, which is extremely important for children with ASD. Vegetations and other screening elements can help

reduce or eliminate stress by minimizing excessive visual or auditory stimuli.

Position social spaces in ways that have several approaches and exits enabling children to come and leave the place independently. To facilitate a variety of issues of autism, the designer should accommodate a wide variety of therapeutic activities. Spaces should be designed to incorporate sensory integration activities, physical activities, gross and fine motor skills, self-help activities, directed and free play activities. If there is space or budget constraint, it may not be possible to allocate separate spaces for all of these activities. Careful programming and scheduling the use of the space might help. Space distribution around activities- space distribution around an activity should be carefully considered. Safety is crucially related to this.

C. Way finding

A sensory garden should be designed in a way where maximum comprehension is preferred. To amplify the comprehension, the use of signage would be a big help for children with ASD. If a screen of vegetation and other barriers is provided, locating some signage might help them in their limited capacity of imagination and ability to understand what might be located next to the barriers. Using pictograms and picture exchange communication system can ensure better comprehension. Picture Exchange Communication System involves showing photographs and finding objects using touch, hearing, smell and sight in the sensory garden. This exercise is useful for way finding and identifying significant features. A child with ASD is a visual thinker. That is why it would be beneficial for them to provide information through visual cues. "The image of the city" by Kevin Lynch identifies five elements that can help an individual cognitively organize the city. Kevin Lynch's book was mentioned as a reference in the literature on healing gardens for Alzheimer's patients. These five elements, paths, places, landmarks, nodes, and edges, help outdoor design environments for people with Alzheimer's

Fig. 12: Winding paths for circulation for the sensory garden can



help in additional comfort. (Drawn by authors)

diseases. These organizing elements can help with wayfinding resulting in improved well-being [38]. Landscape architects can use these elements while designing a sensory garden for children with ASD to help them orient in a space and make sense of their world.

Designing winding paths for circulation for the sensory garden can help in additional comfort, bringing a sense of calm [Fig 12]. They create a flow that fosters calm progress through space. Include curves and slopes to design the transitions between two spaces. Gentle slopes are good alternatives to steps on angular paths.

D. Escape or withdrawal space

Children with ASD face difficulty in communication and social interaction. Provide escape wherever possible to withdraw their stress, relax and contemplate. It is better to provide several withdrawal spaces throughout the garden. Some might be located near the activity area, and some might be in the quiet part of the garden.

Allow some transparency while designing an escape near the activity area so that children can see through and be aware of their surroundings. Plants can be used to act as a screen. Bamboo and long grasses can make an excellent screen. Place them around a seated area for additional privacy. Sheds and arbors can become withdrawal spaces too. Once plants have grown over them, they can be both beautiful and functional for relieving stress for a hypersensitive child [Fig 13].

E. Designing for sensory integration

Designing for sensory integration is a very crucial part. Designers have to be extra careful as no predictable pattern might make a child with ASD hyper or hypo. Instead, it is better to create a series of 'sensory rooms' that serve to each sense aiding children to focus upon one particular sense. In this case, children even can choose the sensory space that appeal to them.

Designing for sensory integration must consider color texture, sound, smell, and furniture while designing a sensory garden [Fig 14].

Color

Color helps to evoke certain moods. A careful decision is required to select and use color so that the space becomes inviting but not over stimulating. The muted color palette is more suitable as bright colors may induce hypersensitivity to some children with ASD.

Texture

The use of harmonious plants with similar textures can create a calming mood. To stimulate hypo-sensitive children with ASD, use a contrasting combination, such as plants with large and small leaves or plants with shiny and matt leaves.



Fig. 13(a)

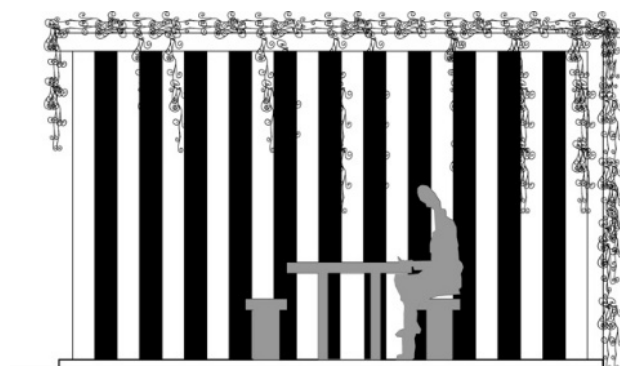


Fig. 13(b)

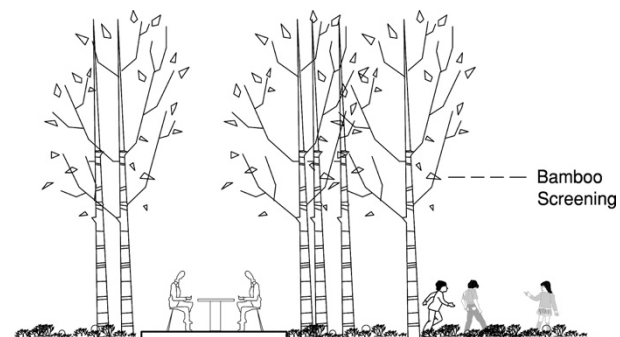


Fig. 13(c)

Fig. 13 (a), Fig. 13(b), Fig. 13(c) . Showing the Withdrawal or escape space. (Drawn by authors)



Fig. 14. Designing for sensory integration must be considered [39].

A textured wall might be created with a wide variety of plants or mosses. A study by Hazreena Hussein showed that students like to feel the mosses by touching them [36]. Even a table/ area can be dedicated to exploring by touching various cuttings from the garden.

Sound

External noise or sound from neighboring activities can be reduced through sound masking. Landscape architects can use water features, swishing grasses, bird songs, and wind chimes to mask external noises. While working with sound and smell, positioning sensory spaces are critical as they may 'leak' into other places. Placing them away from escape or withdrawal spaces would be a good idea.

Smell

Children love the floral scent of a garden. However, this aspect has to be carefully considered as some children might find it overwhelming. In addition, the temperature can exaggerate the effect of the scent. For example, a rose produces a much subtler scent during a cold morning than the scent it creates in a warm mid-afternoon breeze. Therefore, consider placing scented flower beds based on general wind direction so that the summer breeze does not exaggerate the situation.

Proprioceptive and vestibular senses

Designing activities that incorporate climbing, lifting, pulling, or pushing helps in improving proprioception. Weeding, pruning, and picking fruits can help in coordination skills. Providing space with safe, soft flooring to spin attracts children with ASD. The rotational movement of spinning is very captivating for children with ASD. Using objects like spinning plates or balance beam help to build a sense of proprioception and vestibulation.

Even introducing contours and slopes can improve these senses.

Furniture can be designed to improve the sense of proprioception and vestibulation. For example, straight-backed benches with armrests provide support in key areas of the body and help to strengthen upper body postural muscles and the abdominal muscles. Pebble seats work as a playful alternative. They offer varying levels of proprioceptive and vestibular experience.

6.0 Conclusion

Designing a sensory garden for children with ASD might help them reduce their problems and allow them to be part of the community. With this objective, this study assisted in generating guidelines to design sensory gardens for children with ASD in Bangladesh.

However, it must be noted that this study has some caveats:

- This study involved a small number of experts and caregivers under consideration.
- It involved no child with ASD or did not take data directly from them to generate more accurate data.
- A rigorous behavior observation would have been needed to clarify and detail the findings.

It would have helped produce more detailed design guidelines despite being time-consuming.

In this regard, the following techniques should be included for further research in this particular field.

-While only two people were available for this research, more experts are necessary for gathering information for both landscape and children with ASD.

-The lack of helpful information about our context makes us rely on the case studies from other developed countries. For this reason, creating a model is necessary for researching both the patients and professionals in outdoor spaces following the context of this continent. At the same time, close observation of children with ASD will bring more significant benefits. In addition, proper documentation should be prepared for future investigations.

However, this research would build a foundation for designing sensory gardens considering all these limitations for children with ASD in Bangladesh.

7.0 Acknowledgment

We want to thank Sakina Sultana, Founder and Head, Prochesta Somaj Kallan Songstha, and Mahabubur Rahman, Senior Occupational Therapist. Dhaka Proyash for supporting this research with their valuable time and experience during the pandemic in 2020. They gave insight and knowledge that considerably aided the research.

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