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Beyond Sight: Designing Inclusive Kindergarten Outdoor Spaces for Visually Impaired Children

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Abstract Outdoor spaces, which are often designed with a focus on visual perception, have their barriers towards certain people with different capabilities, especially the visually impaired, who find it difficult to deal in such visually biased spaces. Addressing the visually impaired at an early age can help them face struggles and spatial barriers to be able to integrate normally into the society. Kindergarten outdoor spaces are important as they provide these children with concrete experiences from which they can learn about the world. They need to go beyond focusing on visual sense by being inclusively designed using the multi-sensory approach, which is used to increase spaces' experiential values, allowing children to use them freely and independently. The study seeks to shed light on the importance of incorporating multi-sensory approach in developing kindergarten outdoor spaces for visually impaired children. The proposed methodology involved analyzing and linking aspects, such as visual bias in architecture, kindergarten outdoor space design, visually impaired children's perceptions and difficulties and multi-sensory approach, to better understand inclusive design concepts. A rubric was then compiled from these theoretical aspects to link outdoor space elements with the five human senses. Hence, exploring the Case Study of "Hazelwood School for the Blind", using the rubric, was made to examine how its elements were utilized to create optimum sensory outdoor spaces experienced through all senses. Results showed that it is extremely important to utilize multi-sensory approach to help architects develop optimal design strategies for inclusive kindergarten outdoor spaces. The resulting holistic spaces, designed specially to address visually impaired children, can act as great means of introducing them to richer experiences. They additionally help them overcome their barriers and difficulties, and enhance their senses, spatial perceptions, navigation and cognitive mapping processes.

Keywords Kindergarten, Outdoor Spaces, Visually Impaired Children, Multi-Sensory Approach, Inclusive Design

1. Introduction

Architecture cannot be considered only as a visual tool, but rather a multi-sensory tool that helps users feel, understand, perceive and experience spaces by all senses. Although visual design approach helped shape contemporary architecture, the incorporation of a multi-sensory design can increase the experiential value of spaces, enhancing users' experiences. As users get a total impression of a space based on a sensory image formed into their minds, architects have to be conscious of how important users' experiences are as they form space impressions. They should have intuitive feelings to use different elements wisely to create livable usable spaces that are significant beyond their functionality. Incorporating multi-sensory design is what gives identity

to a space, creating a spirit of place, triggering senses and invigorating the overall experience. Built environments, especially outdoor spaces, have their barriers towards certain communities, especially the visually impaired who face struggles as they interact in a visually biased environment.

According to the World Health Organization, visual impairment is the condition of a person who is lacking or has lost vision [1]. 285 million are visually impaired worldwide, 19 million of them are children below 15 years old. In Egypt, there are 2.2 million visually impaired, 1.4 million of whom are below 15 years old. Addressing the visually impaired at an early age helps them integrate normally into the society. Visually impaired children prefer to spend most of their time in outdoor spaces, as they provide them with concrete experiences, so they need interesting safe spaces that they can use independently. Understanding their perceptions can help in designing engaging multi-sensorial environments that facilitate their orientation and cognitive mapping. These special spaces can introduce them to richer experiences and holistic ways of learning about their surroundings. To help design inclusive outdoor spaces for visually impaired children, the research will tackle and link three main domains: Kindergarten Outdoor Spaces, Visually Impaired Children, and Multi-sensory Approach, (Figure 1).

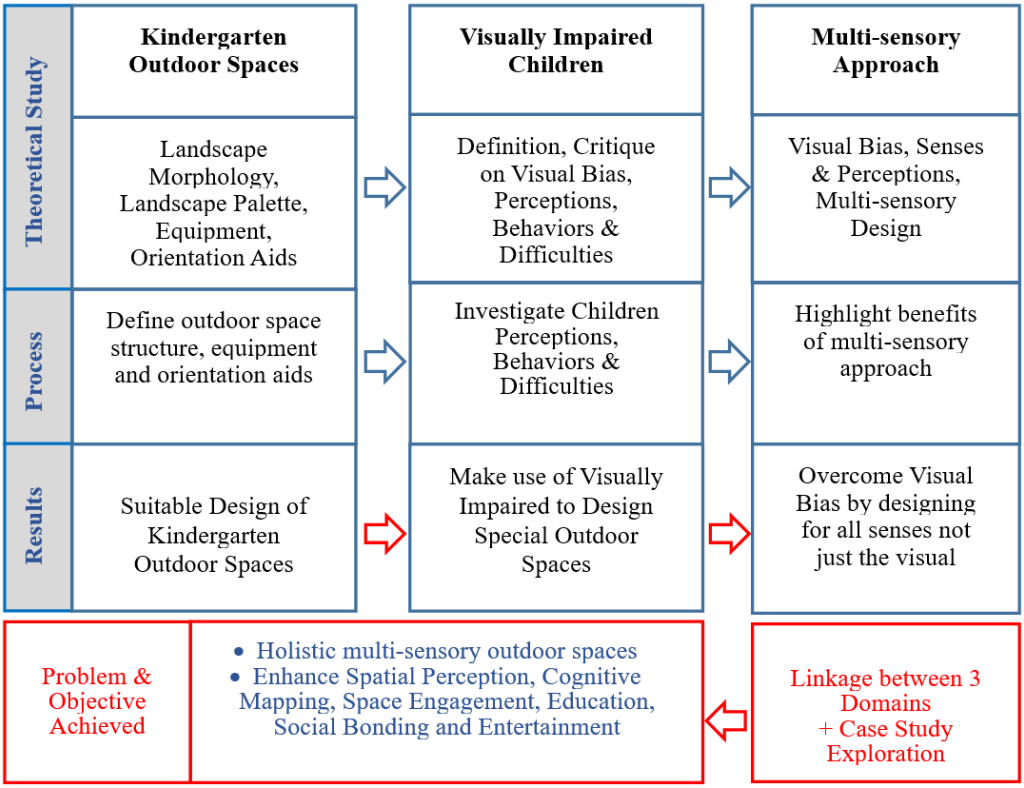


Figure 1. Research Structure

2. Problem

Kindergarten outdoor play is an important part of children's lives as it provides them with concrete experiences, while qualifies them for school. Kindergarten outdoor spaces are not designed inclusively to be used by some children, especially the visually impaired. Architects are mainly focusing on designing spaces using visual aspects, neglecting all other sensory aspects, which creates an architecture visual bias. Visually impaired children can have a hard experience as they struggle to engage within these spaces. They rely upon information obtained through senses, other than the visual, to be processed cognitively to understand and perceive spaces. Therefore, they need specially designed inclusive spaces that they can use comfortably and independently. Considering the multi-sensory approach is necessary to create holistic outdoor spaces that can enhance visually impaired children's spatial perception and cognitive mapping.

3. Objectives

The main objective is to shed light on the importance of incorporating multi-sensory approach in developing kindergarten outdoor spaces for visually impaired children.

4. Methodology

To provide a comprehensive data source for analysis, the methodology involved analyzing information gathered from existing body of knowledge in books, journals and articles. Investigating architecture visual bias, kindergarten outdoor space design, visually impaired children's perceptions and difficulties, and multi-sensory approach, helped in linking these aspects to better understand inclusive design concepts. A rubric was then compiled from these theoretical aspects to link outdoor space elements with the five human senses. Hence, exploring the case study of "Hazelwood School for the Blind", using the rubric, was made to examine how its elements were utilized to create optimum sensory outdoor spaces.

5. Kindergarten Outdoor Spaces

In her book, Doing Thinking Feeling Being, Jessica Mullen states that the space where children spend most of their time is their school ground. Being outdoors is a chance for understanding, exploring and learning about the world. This is where children mainly experience motor skills and perform manipulative skills [2]. It has to be a place for doing (physical activity), thinking (intellectual stimulation), feeling (internal emotions) and being (recognizing individuality) [3]. Any outdoor space should provide a creative place for all these activities, where children can develop their skills, confidence levels, learning, exploration, spatial perception, independent orientation, and cognitive mapping [4].

Unfortunately, when thinking about accessibility in outdoor spaces, it is common that only healthy children are thought of, while visually impaired children are forgotten. Their needs are not necessarily considered, since in many countries the disabled are mainly associated with wheelchairs. As a result, visually impaired children face difficulties and do not fully benefit from outdoor space activities [5]. They are forced to interact in a visually biased world dedicated to healthy people, although they do not have the ability to perceive the world by observation through eyes. According to Universal Design principles, spaces should respect the needs of all categories, regardless their disabilities [6]. There is a need to change the stereotypical point of view that limits solutions to Braille inscriptions by providing visually impaired children with different ways of learning about the world through all senses [5].

Outdoor spaces should have the ability to be understood by all senses to help visually impaired children use these spaces easily. They need various opportunities to touch, hear and smell the elements that they are not able to see. This sense compensation can calm disability effects by reducing social security personality disorders and bullying behavior [2]. Designing stimulating outdoor environments can impact children's future lives positively by developing their skills, increasing their sense efficiency, and providing them with pleasure. As a result, children learn to live normally in the society (Figure 2).

Along with considering children's perspectives and behaviors, the main physical structure of outdoor spaces, landscape morphology and palette, equipment and orientation aids need to be taken into account to help design inclusive outdoor environments for visually impaired children (Figure 3).

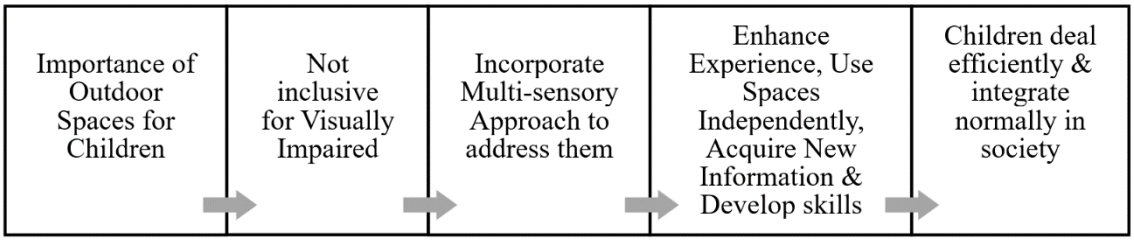


Figure 2. Designing Special Kindergarten Outdoor Spaces

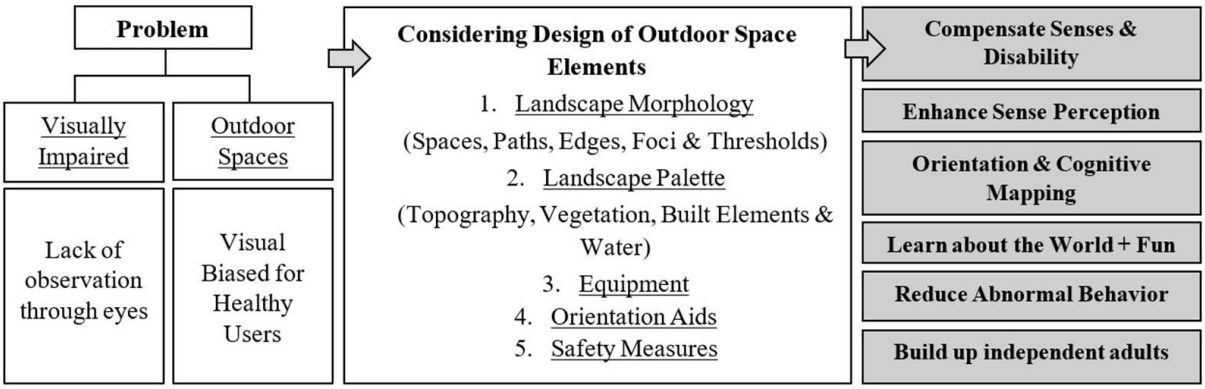


Figure 3. Creating Holistic Outdoor Spaces

5.1. Landscape Morphology

Landscape architecture is the organization of outdoor spaces to meet users' needs by enhancing natural environments for richer experiences. The physical composition of landscape consists of fabric, the integrated structure of whole landscapes, and form, the parts that make up the fabric. Both create a landscape morphology considered as the main landscape structure [7]. Landscape morphology is comprised of five elements: spaces, paths, edges, foci and thresholds (Figure 4). Spaces define land areas for different activities. Paths connect spaces, edges enclose and separate spaces, foci create emphasis in spaces, while thresholds create transitions between spaces. These five elements, which identify landscape forms, should be specially organized as integrated wholes in kindergarten outdoor spaces to provide for different experiences [8].

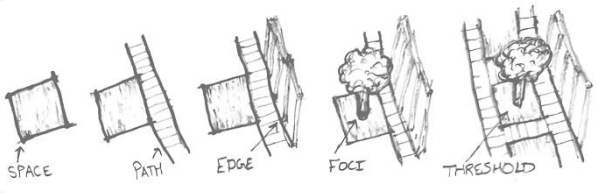


Figure 4. Landscape Morphology Elements

5.2. Landscape Palette

The main elements that are used to form landscape morphology include topography, vegetation, built elements (ground, vertical and overhead planes) and water. These four elements, known as the landscape palette, can be arranged to create a variety of themes and forms in outdoor spaces (Figure 5–8). For example, topography can be utilized to create topographic spaces, paths, edges, foci, and thresholds. When integrated with landscape morphology, landscape palette can be used to provide a functional, appealing, comfortable outdoor setting with enjoyable experiences [9].

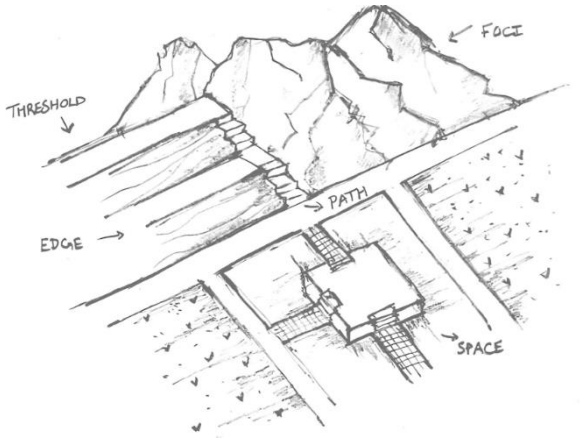


Figure 5. Topographic Space, Path, Edge, Foci, Threshold

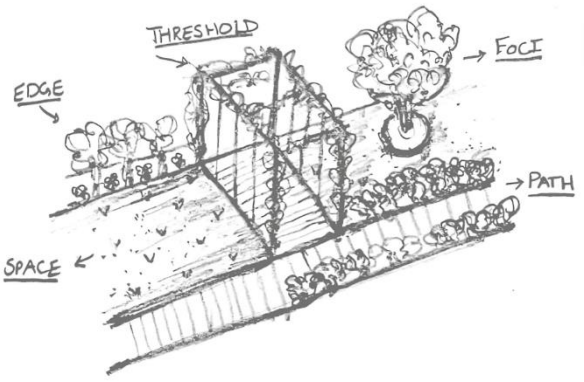


Figure 6. Vegetation Space, Path, Edge, Foci and Threshold

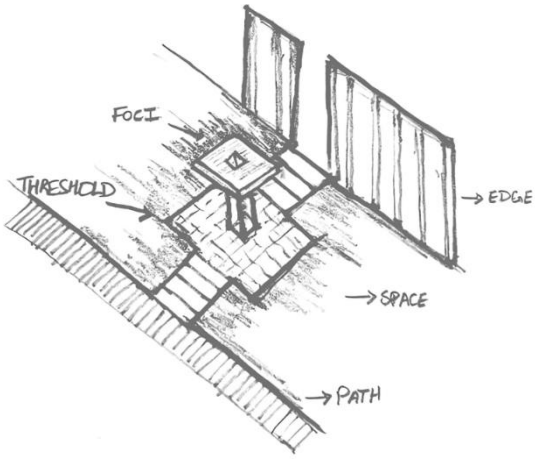


Figure 7. Built Space, Path, Edge, Foci and Threshold

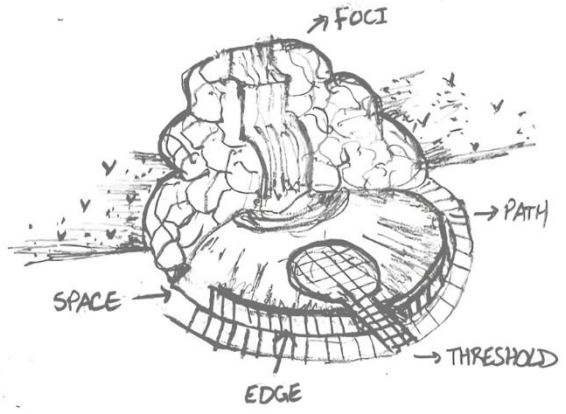


Figure 8. Water Space, Path, Edge, Foci and Threshold

5.3. Equipment

Visually impaired children need specialized equipment that provides opportunities for enjoyable activities with different challenges. Incorporating interactive sensory equipment, such as specially designed swings, slides, tactile handrails, multi-seat seesaws, spring rockers, wading pools, net walkways, bridges and game stations, helps develop children's sense coordination and skills, enhancing their experiences. For example, incorporating musical equipment can improve their hearing skills to help them recognize distances and sizes for enhanced orientation and cognitive mapping. As interactive equipment promotes the concept of learning while having fun, architects have to work on integrating them to provide children with inclusive experiences [10].

5.4. Orientation Aids

Architects must consider adding sensory cues, signage, bumps, grooves, air vents, braille and beepers, in pathways, step edges, ramps, platforms and guardrails. These aids help children mark distances and identify spaces and equipment easily, avoiding freestanding objects and hazards. Incorporating contrasting colors and informative textures to mark flooring, walls and level change, can create a sense of clarity when children feel them using hand, feet or cane. Outlining space edges with colored or textured fences, curbs, etc. can provide children with easy orientation. Moreover, adding signage with verbal descriptions can enhance perceptions, identification and mapping processes. These orientation aids help in creating safe, accessible spaces [10].

5.5. Safety Measures

The safety measures for each incorporated element should be considered to provide a safe outdoor environment for children to use freely and independently. Spaces should be free of obstruction with sufficient maneuvering, wide ramps, clear steps and identifiable platforms to facilitate comfortable moving [2]. Space elements have to be designed upon children's sizes, heights and eye levels, and maintained regularly. It is important to provide ground planes with stable, non-slippery, tactile surfaces, such as rubber and grass, for safe walking. Adding different surfaces with informative textures, that produce sounds when felt with feet or cane, can help guide children through the outdoor space. Materials should be of low reflectivity to avoid glare that harms sensitive eyes of low vision or legally blind children. Path networks must be clear and barrier free [5]. In order not to mislead users, vertical planes have to be straight, without unnecessary projections. Overhead Planes should be designed to provide protection from rain and sunlight. It is necessary to add orientation aids to mark/outline space elements (ground, vertical and overhead planes, topography, foci, thresholds, water features, vegetation, equipment, etc.) and indicate hazards around them. Aids have to be designed with contrasting textures, colors and materials to help children easily identify space elements [10]. When incorporating vegetation, it is important to use plants without thorns. As for the equipment, it should be placed on flat grounds at sufficient distances for clear maneuvering. It must be made up of durable, rust resistant, ecological, shock-absorbent materials, such as wood or plastic. It is also necessary to design it free of sharp corners or nails [11].

6. Visually Impaired Children

Visual impairment is a term used to describe any vision loss, partial or complete, that cannot be corrected with glasses or lenses. Partial blindness is having a very limited view with a sense of light, while complete blindness is having no view at all. Visual impairment is sometimes misunderstood as people believe that the visually impaired do not see anything but blackness; this is not true as there is a wide range of visual impairments [12]. Visual impairment is divided into three categories: Low Vision, Legal Blindness, and Total Blindness. Low vision is

diagnosed when a person has a measurable vision with difficulty in accomplishing tasks when prescribed glasses or lenses. Legal Blindness is diagnosed when a person has trouble in seeing the focal point of what he/she is attempting to focus on or difficulty in viewing the peripheral information around that focal point. Total blindness is diagnosed when a person cannot see anything, as his/her eyes have no light perception [1].

Although the visually impaired perceive spaces using the rest of their senses, they are forced to deal in a visually biased environment. They mainly rely on a combination of sensory inputs to produce an understanding of space. Understanding their behaviors and perceptions can help in designing special outdoor spaces that can help them acquire information, satisfy their curiosity, develop their skills and perceptions, facilitate their orientation and cognitive mapping, and boost their confidence [2]. Addressing the visually impaired, especially children, is essential to help them integrate into the society (Figure 9). These children can have a hard experience as their disability isolates them from social interactions. They are involved in passive activities, struggling to engage and have fun. This can affect their adult lives, causing personality disorders and lack in physical development. If they are taken into consideration, they can learn to communicate, develop their skills, explore their creativity, and build up their characters [13].

7. Multi-Sensory Approach

During the modern era, architecture was based on functionalist thinking: formal design principles and technological advancements. Human bodily interaction was neglected and sensory perception was bypassed, as modern buildings were designed for visual perception, which led to a visual bias in architecture. Architects often address design aspects, such as context, environment, culture, user behavior, and function. The emphasis on these principles overcame sensory necessity. Controlling architecture's visual bias requires exchanging an objectified architecture with one based on experiential qualities for the whole body and its senses [14]. The thinking process needs to be reconsidered to balance technological advancements and sensual qualities. This should play an essential role in the influence of architecture to come up with inclusive multi-sensory designs. The concept of multi-sensory design does not exclude visual phenomenon, but includes full sensory attention, making spaces understandable by all senses [15].

There is a necessity for incorporating the concept of multi-sensory design within the built environment to impact all human senses (Figure 10). Three other concepts related to perception, hapticity, kinesthesia, and synesthesia, need to be incorporated to reformulate senses into active systems that directly impact experience. The haptic system uses skin to explore spaces through direct touch, kinesthesia uses muscles to explore spaces through movement and synaesthesia uses the neurological system to explore spaces through past memories. Taking these systems into consideration allows architects to come up with an inclusive multi-sensory design, increasing experiential values of spaces [10]. The challenge lies in creating a balance between functional and aesthetic qualities to impact overall experience. Defining outdoor elements and considerations, describing qualities that senses react to, understanding children senses, behaviors and perceptions, utilizing universal design principles, and incorporating multi-sensory approach can help architects transform functional ideas into engaging spaces. Outdoor spaces then transform into special places through which children can fully interact.

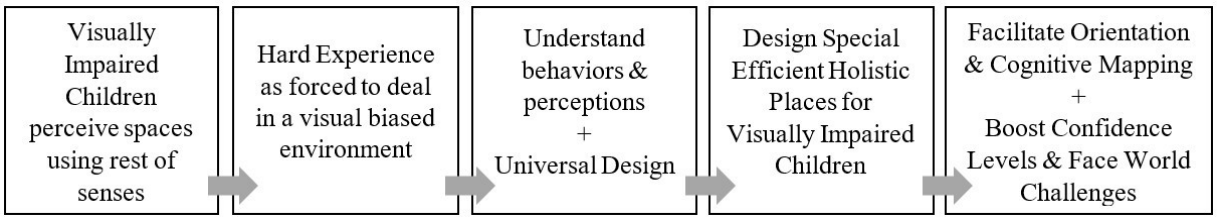


Figure 9. Addressing Visually Impaired Children

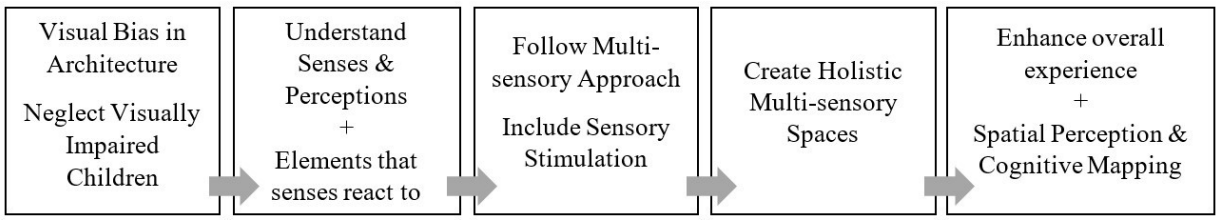


Figure 10. Utilizing Multi-Sensory Approach

8. Rubric: Theoretical Study Conclusion

The following rubric (Table 1) was compiled from the theoretical aspects to link landscape morphology elements, landscape palette materials, equipment and orientation aids with the five human senses. It additionally comprises the safety measures taken when designing and incorporating any of these elements. The rubric will be used in evaluating the case study of Hazelwood School for the Blind to investigate whether its outdoor space was designed to follow the rubric's elements or not. Moreover, to understand how these elements were utilized and arranged as integrated wholes to create efficient holistic sensory outdoor spaces, enhancing visually impaired children's senses, spatial perceptions, cognitive mapping, and overall experiences.

9. Case Study: Hazelwood School for the Blind

The case study of "Hazelwood School for the Blind" was chosen for analysis to act as a frame of reference that can give insight about optimum sensory design incorporated in outdoor spaces for visually impaired children. It was chosen based on information availability, recognition for design and attribute varieties, acknowledgement in competitions, completeness, functionality, and indoor-outdoor relation. "Hazelwood School" is an international award-winning school in Glasgow, Scotland at the edge of Bella Houston Park in one of the districts with a large number of visually impaired (Figure 11, 12). The school was completed in the year 2007 by Gordon Murray and Alan Dunlop Architects. It serves the needs of 60 children, aged 2 to 18, with visual and hearing limitations, cognitive issues, physical limitations or combinations [16].

Table 1. Rubric showing relation of Landscape Structure, Equipment and Orientation Aids to Senses

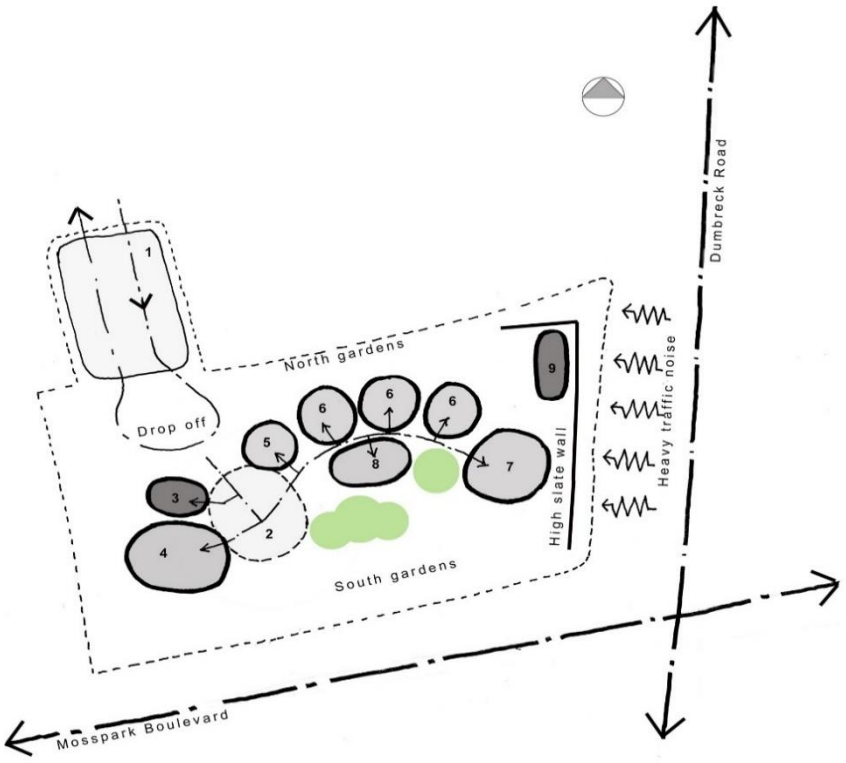
Landscape Structure			Senses					Safety Measures
Landscape Morphology	Landscape Palette		Touch	Hearing	Smell	Taste	Vision (For Low Vision & Legally Blind)	
Spaces, Paths, Edges, Foci & Thresholds	Topography							
	Vegetation							
	Built Elements	Ground Planes						
		Vertical Planes						
		Overhead Planes						
	Water							
Equipment								
Orientation Aids								

Figure 11. Hazelwood School's Aerial View [17]

Figure 12. Hazelwood School's Exterior [16]

The school creates a rich inclusive environment that addresses the educational and developmental needs of impaired children with different age groups. It provides an interesting safe space, that is not extremely easy to navigate, in order to help students learn to face obstacles independently, enhance their life skills and satisfy their curious senses [18]. The design eliminates conventional institutional aspects by incorporating multi-sensory spaces with visual, auditory, olfactory and haptic cues. The building consists of eleven classrooms (junior, middle, and senior), nursery spaces, a gym, hydrotherapy pools, therapy rooms, shared classrooms (art, music, play & cooking rooms), administration, staff rooms, dining rooms, multi-purpose halls, stores, changing areas, toilets and kitchens (Figure 13, 14). A separate adjacent residential unit, Life Skills House, is provided to accommodate children and teach them basic life skills. A central curved spine or "street", that distributes children to their classrooms, acts as the main circulation space for wayfinding throughout the building. It is a large cork-clad wall provided with tactile aids, braille signage, contrasting colors and materials, trail rails, pictures and moon (system of lines, curves and letters in simplified form) to enable safe independent navigation [19].

The school was designed to respond to the surroundings by meandering through the natural environment; the use of natural materials further enhanced integration with context. The building curves around parkland's existing mature lime and beech trees to create intimate garden spaces, with sensory cues, for interesting outdoor learning. These specially designed spaces are used to stimulate senses by providing opportunities to smell, feel and hear what nature offers [16]. The five elements of landscape morphology, the four landscape palette materials, and the incorporated equipment and orientation aids will be discussed and examined in the school's outdoor space. Moreover, the rubric will be used in evaluating the outdoor space to investigate how its elements were arranged as integrated wholes to create inclusive sensory spaces, enhancing visually impaired children's experiences.



1. Carpark & Drop-off
2. Entrance & Multi-purpose Spaces
3. Administration
4. Hydrotherapy Pools & Gym
5. Nursery
6. Junior & Middle Classrooms
7. Senior Classrooms
8. Shared Classrooms
9. Life Skills House

Figure 13. Hazelwood School's Space Zoning [16]

Figure 14. Hazelwood School's Plan [16]

9.1. Spaces

The outdoor space acts as an external classroom that allows children to learn and play freely. It consists of a car park, entrance drop-off, small learning spaces, play areas, resting spaces with seating, and green areas (Figure 15). Spaces are readable, unobstructed, uncluttered, and easily accessible, while the orientation is simple. Learning spaces, adjacent to indoor classrooms, are oriented towards the site's northern edge to avoid noise and direct sunlight. These spaces are extroverted to the north where the climate is preferable. Activity spaces, that do not require focus, are oriented towards the southern noisy edge. These spaces are more enclosed to reduce exposure to harsh sun [20].

9.1.1. Topographic Spaces

The entire outdoor space is flat without any level change.

9.1.2. Vegetation Spaces

They are designed to act as rest spaces between northern learning zones (Figure 16). Some act as large spaces with existing trees to buffer southern noise. Hedge and herb enclosures, such as shrubs and trees, along with the externally built fence enclose the outdoor space vertically.

9.1.3. Built Spaces

Activity spaces are defined by ground planes of different surfaces, such as sand, gravel, rubber, grass, reinforced floor or stone pavers, to enhance experiences when felt with foot or canes (Figure 17, 18). They are enclosed vertically with the building's slate wall, the freestanding walls, and the permeable external fence. The building's projected roofing slates act as overhead planes that define and shade most of the outdoor space, creating pleasant atmospheres.

9.1.4. Water Spaces

Water is not incorporated to create different water spaces.

Figure 15. Spaces in School's Outdoors [16]

Figure 16. Vegetation Space [19]

Figure 17. Music Activity Space [16]

Figure 18. Activity Space with Specialized Equipment [21]

9.2. Paths

A network of tactile paths, that vary in floor finishes, from gravel to bound rubber and timber, connect outdoor spaces (Figure 19). A main one-way path is provided for direct circulation and easy navigation. Vegetation paths, on the site's edge, are enclosed by trees and shrubs for different experiences. Shadows are casted by the building's structural timber frame over these paths' flooring to create clear patterns that aid children in orientation.

9.2.1. Topographic Paths

Topography is not fully utilized for topographic paths. Two ramps and one stepped path are provided for functional purposes to connect paths on different levels.

9.2.2. Vegetation Paths

Vegetation paths, located on the east and south site edges, are defined on the ground plane with tactile flooring textures. They are enclosed vertically by large lime trees and shrubs that additionally create vegetation canopies to define these paths on the overhead plane (Figure 20).

9.2.3. Built Paths

Built paths are provided with contrasting ground plane textures. They are defined vertically by the building's large slate walls, while defined in the overhead plane by the projected roof slates. Walls and slates create shaded walks that enhance climate (Figure 21, 22).

9.2.4. Water Paths

Water is not incorporated in the outdoor space.

Figure 19. Spaces and Paths in School's Outdoors [16]

Figure 20. Bound Gravel path separates between greenery [21]

Figure 21. Recycled Bound Rubber path separates between grass and sand [16]

Figure 22. Timber Decking in main entrance flooring [16]

9.3. Edges

The externally built fence, large lime trees and small shrubs, that surround the site, create an edge that defines the whole outdoor space and form a buffer from surrounding streets, buildings and parks. The building's slate and freestanding walls also act as edges that define landscape spaces, to separate between their different functions, and buffer them from external traffic noise (Figure 23). Walls create visual and physical enclosure within the outdoor space.

9.3.1. Topographic Edges

Topography is not utilized to create edges.

9.3.2. Vegetation Edges

Along with the external fence, lime trees and shrubs create dense hedge edges that separate the school's outdoor space from external streets and buildings (Figure 24). These edges create sensory richness as they act as habitats for wildlife.

9.3.3. Built Edges

Along with vegetation edges, the externally built fence encloses overall landscape for physical separation. The building's thick walls and freestanding walls act as edges that enclose activity spaces, separate zones, and create buffer from external noise (Figure 25, 26). Paths also act as edges that separate activity and vegetation spaces, and create a buffer between the building and these spaces.

9.3.4. Water Edges

Water is not incorporated in the landscape.

Figure 23. Spaces, Paths and Edges in School's Outdoors [16]

Figure 24. The school's fence as vegetation edges [17]

Figure 25. The school's building as a built edge [16]

Figure 26. Freestanding Walls as a built edges [21]

9.4. Foci

Single or grouped trees act as focal forms that provide vertical emphasis and contrast horizontal ground planes (Figure 27). They draw user attention to their special characters, locations and aesthetics. Moreover, they act as guides that help children mark landscape elements, enhancing their orientation and navigation. They have recreational uses, such as being focal shaded activity places.

9.4.1. Topographic Foci

Topography was not taken into consideration.

9.4.2. Vegetation Foci

Two lime trees, located in the southern space, act as landscape foci. Moreover, two groups of large trees act as focal forms within the outdoor space: a group of large beech trees in the south and a group of two lime trees in the north (Figure 28, 29, 30).

9.4.3. Built Foci

No special built foci are incorporated in the outdoor space.

9.4.4. Water Foci

Water is not used to create water spaces in the outdoor space.

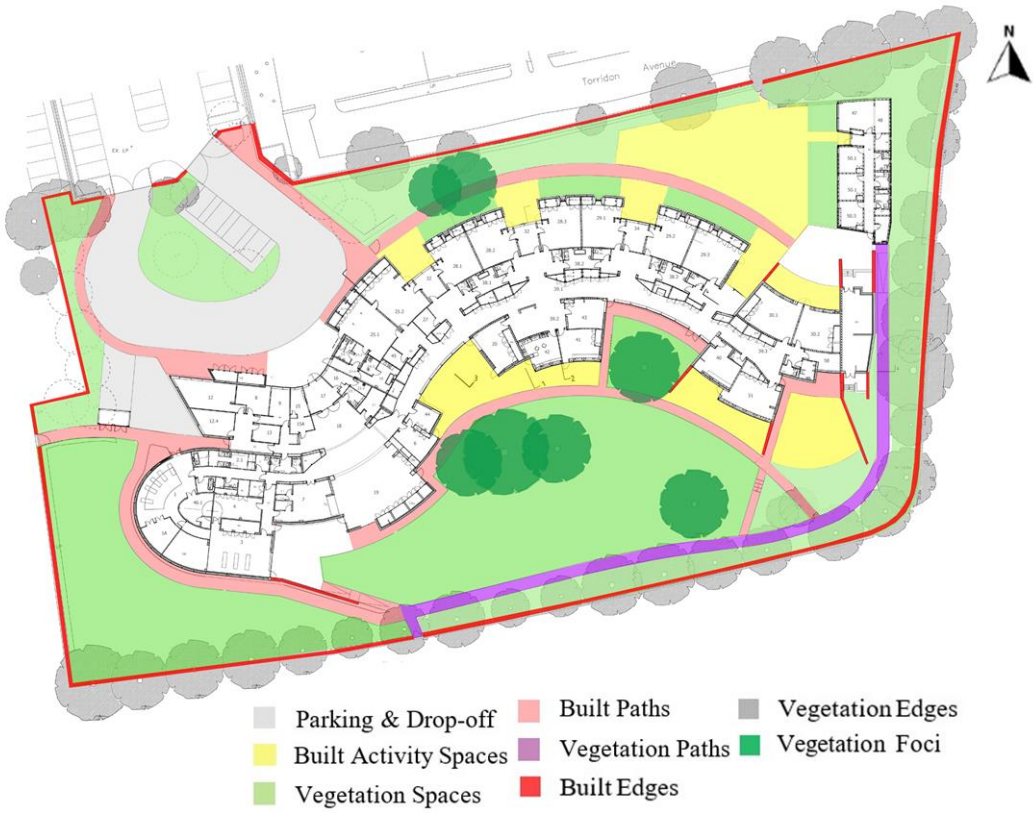


Figure 27. Spaces, Paths, Edges and Foci in School's Outdoors [16]

Figure 28. A mature lime tree as vegetation foci [17]

Figure 29. Group of beech trees as vegetation foci [21]

Figure 30. A lime tree and a beech tree as vegetation foci [16]

9.5. Thresholds

Thresholds are used to create contrast with adjacent spaces and paths, allowing for an enhanced experience. Entrance thresholds are emphasized with staircases and landings to play roles in integrating interior and exterior spaces. Moreover, some green areas are incorporated in the outdoor space to act as contrasting thresholds that separate activity zones (Figure 31).

9.5.1. Topographic Thresholds

Topography is not fully utilized to create topographic thresholds. Only two staircases with landings are provided for functional purposes to mark entrances.

9.5.2. Vegetation Thresholds

Green spaces, located between northern activity zones, act as contrasting vegetation thresholds (Figure 32). A large green space, with a focal lime tree, acts as a vegetation threshold that marks the southern entrance and separates southern activity spaces.

9.5.3. Built Thresholds

Two built thresholds, designed to mark entrance spaces, are defined in the ground plane with contrasting flooring textures (Figure 33, 34). They are vertically enclosed by the building's exterior walls, while defined in the overhead plane by the building's extended roof. A contrasting built threshold is provided in the north as a transitional space between paths and activity spaces. Paths act as contrasting built thresholds that separate between spaces and buffer the building from these spaces.

9.5.4. Water Thresholds

Water is not incorporated to create water thresholds in the outdoor space.

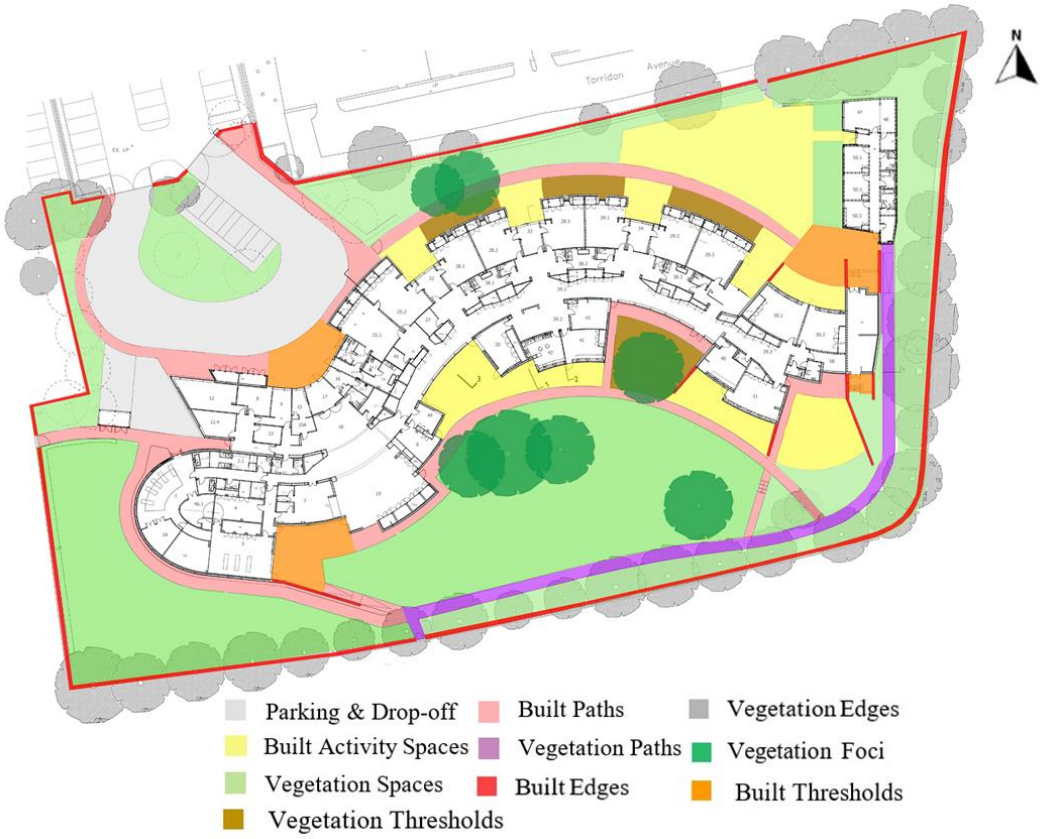


Figure 31. Spaces, Paths, Edges, Foci and Thresholds in School's Outdoors [16]

Figure 32. Vegetation Threshold [19]

Figure 33. Entrance Threshold [16]

Figure 34. Entrance Threshold Aerial View [21]

9.6. Equipment and Orientation Aids

Equipment, such as slides, swings, seesaws, bridges and musical equipment, are designed with special specifications, durable materials and contrasting colors to fulfill children needs. Seatings are provided for rest and nature enjoyment. Variety of equipment creates opportunities that engage children in enjoyable activities (Figure 35). Orientation aids, such as contrasting flooring textures, help children easily navigate using feet or cane. Walls act as heat sources, providing tactile guides for orientation. Natural materials with different textures and contrasting colors, such as, timber cladding, slate tiles, brick and glass, create a landscape extension for enhanced experience. These cues aid children in identifying outdoor elements and equipment.

Hazelwood School was developed as prototype for development of similar schools. Although it did not fully integrate topography, water, foci, and smell and taste stimulants, it proved to be an inclusive environment that incorporates multi-sensory design to create stimulating experiences for visually impaired children (Table 2–7). Engaging children in different experiences helps them develop their senses and skills to eventually become independent enough to face life difficulties successfully. Considering outdoor space structure, special equipment and orientation aids help create an understandable enjoyable multi-sensory setting. Hazelwood School successfully integrated these elements to create efficient stimulating outdoors. It proved to be an inclusive multi-sensory environment with simple circulation, space variety, integration with nature and different stimulating experiences (Table 8).

Figure 35. Hazelwood School's Equipment: (a) Specialized Swing; (b) Music Equipment; (c) A Suspension Bridge and Specialized Swings; (d) Swing Chair and Seating; (e) Seatings; (f) Seatings [16, 19, 21]

Table 2. Hazelwood School's Spaces Rubric

Landscape Morphology	Landscape Palette		Senses					Safety Measures
			Touch	Hearing	Smell	Taste	Vision	
Spaces	Topography							
	Vegetation		√	√	√	√	√	√
	Built Elements	Ground Planes	√	√	√		√	√
		Vertical Planes	√	√	√	√	√	√
		Overhead Planes	√	√	√	√	√	√
	Water							

The rubric shows how topography and water were not used in the school's outdoor space, and how ground planes are not designed to enhance taste sense

Table 3. Hazelwood School's Paths Rubric

Landscape Morphology	Landscape Palette		Senses					Safety Measures
			Touch	Hearing	Smell	Taste	Vision	
Paths	Topography		√	√	√		√	√
	Vegetation		√	√	√	√	√	√
	Built Elements	Ground Planes	√	√	√		√	√
		Vertical Planes	√	√	√	√	√	√
		Overhead Planes	√	√	√	√	√	√
	Water							

The rubric shows how water was not used to create water paths, and how topography and ground planes were not designed to enhance taste sense

Table 4. Hazelwood School's Edges Rubric

Landscape Morphology	Landscape Palette		Senses					Safety Measures
			Touch	Hearing	Smell	Taste	Vision	
Edges	Topography							
	Vegetation		√	√	√	√	√	√
	Built Elements	Ground Planes	√	√	√		√	√
		Vertical Planes	√	√	√	√	√	√
		Overhead Planes	√	√	√	√	√	√
	Water							

The rubric shows how topography and water were not utilized to create edges, and how ground planes were not designed to enhance taste sense

Table 5. Hazelwood School's Foci Rubric

Landscape Morphology	Landscape Palette		Senses					Safety Measures
			Touch	Hearing	Smell	Taste	Vision	
Foci	Topography							
	Vegetation		√	√	√	√	√	√
	Built Elements	Ground Planes						
		Vertical Planes						
		Overhead Planes						
	Water							

The rubric shows how topography, built elements and water were not integrated to create foci

Table 6. Hazelwood School's Thresholds Rubric

Landscape Morphology	Landscape Palette		Senses					Safety Measures
			Touch	Hearing	Smell	Taste	Vision	
Thresholds	Topography		√	√			√	√
	Vegetation		√	√	√	√	√	√
	Built Elements	Ground Planes	√	√	√		√	√
		Vertical Planes	√	√			√	√
		Overhead Planes	√				√	√
	Water							

The rubric shows how water was not used to create thresholds, how overhead planes were not utilized to enhance hearing, smell and taste senses, how topography and vertical planes were not used to enhance smell and taste senses, and how ground planes were not used to enhance taste sense

Table 7. Hazelwood School's Equipment and Orientation Aids Rubric

Equipment and Orientation Aids	Senses					Safety Measures
	Touch	Hearing	Smell	Taste	Vision	
Equipment	√	√			√	√
Orientation Aids	√	√			√	√

The rubric shows how Equipment and Orientation Aids were not designed to enhance smell and taste senses

Table 8. Hazelwood School's Successful Design Factors

Inclusive Design	Using landscape morphology elements, utilizing landscape palette materials, especially vegetation and built elements, and including different sensory equipment and orientation aids helped create efficient multi-sensory outdoor environments.
Simple Circulation	Designing a main direct route, with relation to buildings, to create a clear flow that can be easily recorded in users' cognitive maps. This simple circulation allows for a better sense of movement and memory.
Variety of Spaces	Creating extroverted or introverted activity and vegetation spaces with different scales and functions. This enriched children's spatial experiences by involving them in communal or individual spaces with different interesting activities.
Integration with Nature	Considering relation between the building and its surroundings allows it to integrate with nature, creating rich outdoor experiences. Using natural materials, such as wood cladding enhances aesthetic, functional, and environmental aspects.
Different Experiences	Creating different space moods using sensory stimulants, such as contrasting colors, natural materials, tactile textures, sensory cues, vegetation, etc., to trigger children's senses, enhance their experiences, and facilitate their movement.

10. Results and Discussion

The study was conducted due to the fact that kindergarten outdoor spaces are not designed inclusively to address visually impaired children, as their designs focus mainly on visual stimulation. Children struggle to interact within these conventional spaces, which prevents engagement in sensory play, discourages exploration and self-directed activity, and decreases development. Children may also face physical obstacles, such as dealing in wide spaces with unclear paths, navigating on unsafe floors, tripping over or hitting freestanding objects or level changes, disorienting due to a lack of sensory cues, playing unsafe equipment with hazardous materials or unnecessary projections. These difficulties need to be addressed by designing inclusive outdoor spaces to fulfill children's needs. The study's main objective is to shed light on the importance of incorporating multi-sensory approach in developing kindergarten outdoor spaces for visually impaired children. The proposed methodology involved analyzing relatable theoretical aspects, creating a rubric to link these aspects, and exploring an international case study using the rubric. This was made to provide optimum guidance to develop kindergarten outdoor spaces for visually impaired children using multi-sensory approach (Figure 36).

By analyzing the theoretical aspects, it was proved that considering landscape structure, morphology and palette,

adding special equipment and orientation aids, while implementing safety measures for each incorporated element, helps create a holistic outdoor environment that enhances visually impaired children's experiences. Organizing landscape morphology elements (spaces, paths, edges, foci, and thresholds) as integrated wholes, while utilizing landscape palette materials (topography, vegetation, built elements, and water) can help create various outdoor themes and forms for different stimulating experiences. Adding specialized interactive sensory equipment, such as tactile game stations, swings, musical equipment, slides, net walkways, etc., provides enjoyable activities that promote the concept of learning while having fun. Incorporating orientation aids, such as sensory cues, signage, braille, beepers, etc., in landscape structure and equipment, can help children identify these elements, mark distances between them, and avoid their potential hazards. In addition, considering the safety measures, for each incorporated element, helps create easily accessible safe spaces. These measures include creating wide organized spaces with adequate maneuvering and clear stable paths, designing planes with different textures, adding special safe equipment, and incorporating sensory cues and protective barriers to define/mark space elements and indicate hazards, while avoiding plants with thorns.

Along with considering all previous elements, the concept of multi-sensory approach must be implemented to help overcome architecture visual bias, enhancing outdoor space design. The approach includes full sensory attention, making spaces equally understandable by all senses. Sensory tools can be used to engage children in stimulating activities that build their characters to be able to deal efficiently and navigate independently within spaces. Auditory tools include textures that produce sound when felt with hands, feet or cane, auditory cues, signage with speakers, musical equipment, water features, and bell balls. Tactile tools include tactile flooring, cues, and maps, containers with textured objects, braille signage, protective barriers, textured plants, and water features. Olfactory and gustatory tools include boxes with objects of different scents and flavors, and fruitful scented plants. Visual tools, for low visioned children, include signage with large prints, contrasting materials and colors, colored plants, and magnification devices.

To link landscape morphology elements, landscape palette materials, equipment and orientation aids to the five human senses, a rubric was created. It was used in evaluating the case study of "Hazelwood School for the Blind" to investigate whether its outdoor space was designed to follow the rubric's elements or not. Moreover, to understand how these elements were utilized and arranged to create optimum sensory outdoor spaces, enhancing visually impaired children's senses, spatial perceptions, cognitive mapping, and overall experiences. Hazelwood School's outdoor space design acted as an optimum frame of reference for development of similar facilities. It showed a variety in utilizing landscape morphology elements, landscape palette materials, sensory equipment, and orientation aids to help create a special multi-sensory environment. The most successful design factors were the inclusive design, simple circulation, variety of spaces, integration with nature and different experiences.

Results of this study (Figure 37) showed that it is extremely important to incorporate multi-sensory approach in the design of kindergarten outdoor spaces for visually impaired children. To develop an optimum inclusive multi-sensory outdoor space, there is a need to achieve a well-designed landscape structure (morphology and palette) and incorporate specialized equipment and orientation aids using all safety measures. This allows spaces to offer a wide range of opportunities that help transform and enhance children's behaviors, personalities, skills, senses, imagination, experiences, mental and physical health, perceptions, while facilitating their orientation and cognitive mapping to easily identify/memorize space elements. In this way, children can be fully familiar with these specially designed spaces to deal efficiently and navigate independently.

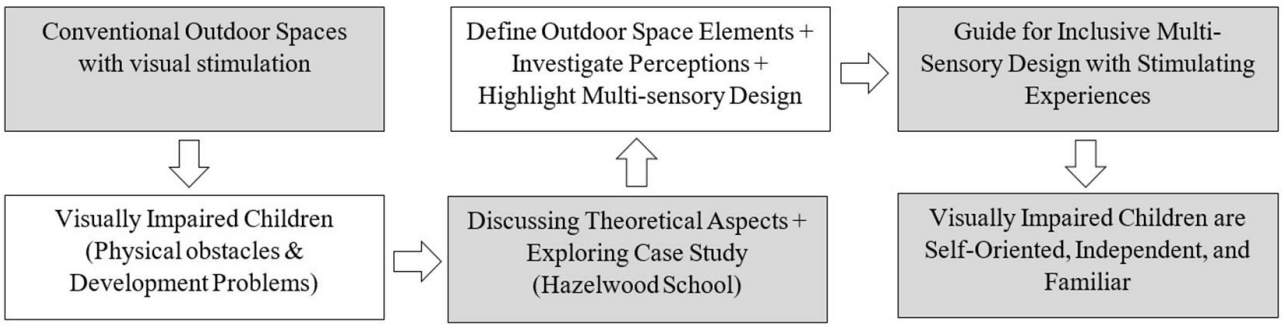


Figure 36. Research Process

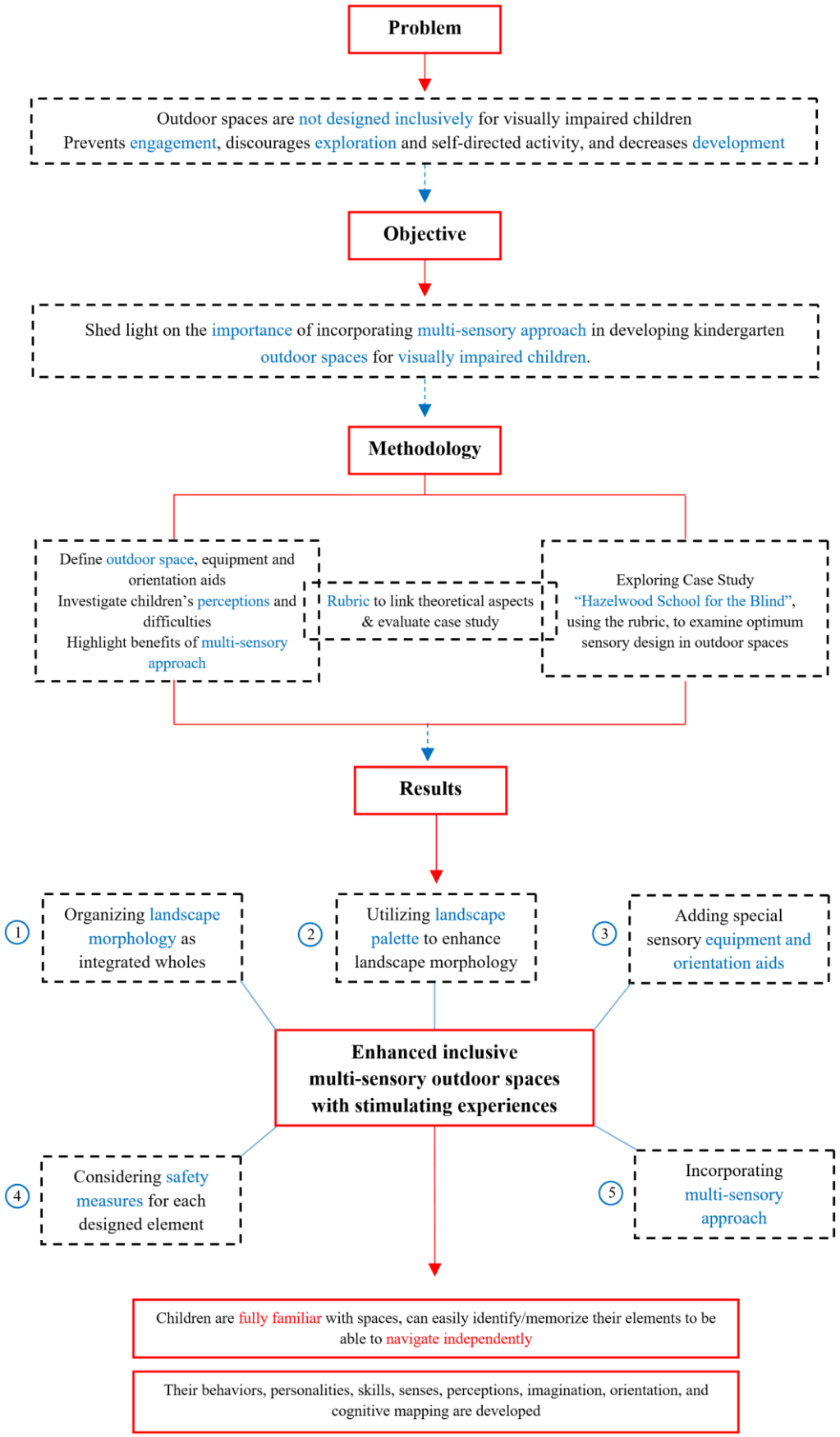


Figure 37. Research Structure

11. Conclusions

Although architecture depends mainly on visual experience in common practice, it has to be inclusive, addressing people with different capabilities, especially visually impaired children, who find it difficult to deal in visually biased spaces. Their perceptions are different than those of sighted children; therefore, understanding their behaviors can be useful in fulfilling their needs. Addressing these children at an early age helps them grow independently, integrating normally into the society. Kindergarten outdoor spaces are important parts of these children's lives as they provide them with concrete experiences. They have a crucial role in supporting children's educational and developmental process. Their designs need to go beyond focusing on the visual sense and neglecting all other senses. The study's main aim was to shed light on the importance of incorporating multi-sensory approach in developing kindergarten outdoor spaces for visually impaired children. Analyzing and linking various aspects, such as architecture visual bias, kindergarten outdoor space design, visually impaired children's perceptions and difficulties, and multi-sensory approach, was made to better understand inclusive concepts. Creating a rubric, that links these aspects, was beneficial in evaluating the case study of "Hazelwood School for the Blind", which acted as an optimum reference on sensory concepts in kindergarten outdoor spaces for visually impaired children. Results showed that it is extremely important to incorporate multi-sensory approach in the design of kindergarten outdoor spaces for visually impaired children. To create inclusive sensory outdoor environments, landscape morphology elements, landscape palette materials, equipment and orientation aids should be utilized to their best use to enhance space design. The safety measures for all elements need to be taken into account to help children use spaces easily without facing any obstacles. Moreover, the concept of multi-sensory approach must be implemented to further enhance outdoor space design. The resulting well-designed spaces offer a wide range of multi-sensory activities, introducing children to richer experiences and holistic learning ways. Eventually children's senses, perceptions, orientation and cognitive mapping are enhanced. They additionally overcome their learning difficulties and social fears, develop their characters, gain self-confidence, and become familiar with spaces to be able to navigate independently without assistance. In this way, children can be able to deal normally in the society just like sighted children.

12. Recommendations

The study suggests recommendations to help develop kindergarten outdoor space design:

- Raising awareness, among architects and architecture students, by conducting seminars, advertising campaigns, etc. with specialists in the field of visual impairments to help keep them updated about the special needs of the visually impaired to design inclusive universal spaces.
- Involving visually impaired users, caregivers and specialists in the planning, designing and executing processes. Participatory design is an opportunity to fully understand requirements, potentials and restraints to help create an inclusive design that fulfill children's needs.
- Cooperating with specialized entities that address the visually impaired, such as Model Center for Care and Guidance of the Blind, American Foundation for the Blind, etc.
- Collaborating with governments to improve visually impaired outdoor space facilities.
- Adding separate standards for the visually impaired, to the Code of Architectural Requirements for People with Special Needs, without associating them with wheelchair users.
- Conducting more studies, researches and surveys to better understand the visually impaired's psychology to improve outdoor tools for inclusive multi-sensory outdoor environments.
- Utilizing international expertise to link new technologies with architecture. This creates new opportunities to enhance children's use and experience within outdoor spaces.
- Conducting an experimental study on visually impaired children by observing them in a regular outdoor space then in a modified one with sensory tools. Results could help architects know the effect of these tools on enhancing children's behaviors, senses, orientation and experiences.
- Raising awareness among teachers and parents to prepare them with sufficient knowledge about sensory design to highly benefit visually impaired children.

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