

Introducing Several Approaches to Upgrade the Interior of Visually Impaired Children's Preschool Focusing on Effective Communication. Case Study: Narjes Girls' Blind Pre-school

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Abstract

The needs of visually impaired people are among the abandoned issues in architecture and urban planning in Iran. For example, visually impaired children's schools are not in line with their objectives, and no specific regulations have been provided for their physical design. However, the importance of the quality of these children's learning environment, especially at a young age, is evident for everyone because there is the first social environment they enter, preparing to present in a society without any suitable infrastructure for the visually impaired people. Narjes girls' blind preschool in this research has been chosen as a case study to investigate the children's educational issues and their interaction with the current environment. This study was done through in-depth desk studies, interviews, and observation of children's classes. Finally, according to the conditions caused by visual impairments, learning needs, and Children's behavior observation, in addition to providing solutions for redesigning the studied place, some general approaches are classified to help any designer or interior architect during the design process of similar environments to achieve a design that fits better with the needs of these children.

Keywords: Children, visual impairment, senses, preschool, education, Interior, Communication

1. Introduction

Although most visually impaired people are adults over 50 (WHO, 2019), children with this impairment are also a part of this community, suffering from its problems from an early age. These problems are different from adults' and cannot be faced or addressed with the same approach. This impairment at young ages affects many aspects of life, such as physical and psychological development, needs, and even the formation of a person's social relationships in the current and future life (Chadha & Subramanian, 2011; Rahi & Cable, 2003). In this regard, educating these children in the early years is vital because early intervention, in addition to improvement in their current and future performance, provides a basis to have similar experiences to sighted children, involving meaningful games and interactions with people and objects around them, which usually do not happen due to lack of skills or motivation (Wilson, 2003; Guralnick, 2000).

The process of teaching and learning takes place in various environments and conditions such as home, park, and school. However, as one of the influential factors in this process, the role of schools and learning environments is undeniable. By a proper design that adapts to these children's particular conditions and needs, many of their problems during the learning process could be mitigated, and their presence, participation, health, and motivation could be preserved (Ala *et al.*, 2012). However, one of the challenges in these places' design process is the visual dominance of the designer's mentality, which downplays the other senses.

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Since visually impaired people rely on other senses, such as touch or hearing, their perceived spatial qualities are different from what architects have considered (Herssens & Heylighen, 2008). In other words, the environment's qualitative characteristics and the human perceptual system capabilities are not used consciously to establish effective communication between them.

Given the above, although they have an influential role in the quality of visually impaired people's lives (Goldsmith, 1997), Architects' mere reliance on personal experiences and knowledge does not lead to an architecture tailored to their needs. (Bernardo, 1970). As a result, to overcome the challenges of this specific design case, the designers are also tasked with obtaining a correct understanding of the visual impairment, its effects on children's growth and development, learning needs as well as their perception of the environment (Wilson, 2003), just like other involved people like parents, teachers, and planners.

2. Literature Review

2.1. Visual impairment and children

The World Health Organization (WHO) uses the term "visual impairment," referring to a wide range of vision problems, usually classified into two groups: low vision and blindness (WHO, 2010). However, this classification does not provide a clear picture of the conditions and needs of children with this impairment. Children's visual impairments occur due to various causes, conditions, and ages (before and after birth) and affect their vision in several ways (Halas, 2006). Also, its impact on the children's development and progress is an issue, being difficult to generalize because of the unique conditions of each child (Arter, 1997). In this regard, various needs and conditions have to be met generally.

2.2. Visually impaired children's education in the early years

One of the visual impairment consequences in childhood is its effect on children's education and development (Rahi & Cable, 2003). For example, unlike most sighted children becoming familiar with concepts such as the dimension, color, form, structure, and function of the objects around them at home before entering school, visually impaired children need special training to learn similar concepts (Arter, 1997). However, some believe that with proper and early intervention and education, these children can progress at the same time as other sighted children in the future (Norris et al., 1957).

Most preschool educational resources for visually impaired children are formed based on general areas of Montessori's learning philosophy. Maria Montessori (1870–1952), an Italian physician and educator, was one of the founders of early intervention and preschool special education programs. Emphasizing the development of independence, responsibility, and efficiency of children with disabilities, she defined the following three aspects:

- Practical life experiences: including personal hygiene and doing personal routines, improving physical condition, and having responsibility towards their surrounded area
- Sense training: focusing on the child's senses development (touch, sight, hearing)
- Academic education: introducing mathematics, science, and language to the child through appropriate child's preferred activities, done independently (Wilson, 2003).

2.3. Architecture for visually impaired people

Unlike Vaughn, who believes that specific designs for visually impaired people are unnecessary and they can adapt quickly to each environment, Royal National Institute for the Blind (RNIB) research proves the opposite. Because public spaces are designed and organized for sighted people, many visually impaired people are isolated in their homes as adaptation is not possible for them (Vaughn, 1993; Barker *et al.*, 1995).

In this case, Universal Design is an approach that considers all people's needs in its instruction, especially disabled people and their circumstances, to provide an accessible environment for their independent presence in society (Dischinger, 2000). While this approach considers the efficiency aspects of design (Ahmer, 2014), some experts also emphasize the importance of considering user perception and the environmental quality they experience (Cheryl Davis & Lifchez, 1987).

People perceive and experience their surrounding environment through their senses, and good architecture can involve all of them (Walden, 2008). However, considering sight as the main perception channel, architects put most of their emphasis on the environment's visual aesthetic attributes.

Sighted people know the environment's auditory, olfactory, and tactile aspects as small details, that have little meaning as they typically understand the whole space and then consider the details. This process is different for visually impaired people as their received visual information is partially or entirely cut off. So it is non-visual details and features that are primarily considered by them, being put together and define the space totality for the person, details such as changing the flooring materials, the ceiling height, or corridors' width (Dischinger, 2000; Vermeersch et al., 2009; Bernardo, 1970; NorgesBlindforbund, 2004). In this regard, using senses as a source of inspiration during the design process and intensifying people's senses leads to understandable and accessible environments for everyone (NorgesBlindforbund, 2004). As perceptual tools, especially for visually impaired people, four senses are involved in interacting with the environment (Walden, 2008):

Vision: 80% of VI people can distinguish between light, shadow, and darkness, using this limited visual information to interact with their surroundings (Sakaguchi *et al.*, 2000). Although their vision may work differently in various conditions (Kelley, 1981), some design factors optimize residual ability. These factors consist of: adjustable light to meet their needs and avoid any glare and strong light contrast (Barker et al., 1995), the proper use of objects' color, size, shape, and arrangement next to each other to facilitate their orientation (Dischinger, 2000), and the colors and lights' tones and the contrast between them which help them to distinguish the surrounding and its objects' shape (NorgesBlindforbund, 2004 & 2013).

Hearing is an efficient communication channel for VI people to perceive sounds. Due to its multidirectional nature, sound carries information about the environment's activities, defines directions, and helps perceive the objects' nature and their relationship by its reflection and absorption (Dischinger, 2000; Cheryl Davis & Lifchez, 1987). Besides, the various environment acoustic qualities due to the surfaces' material, shape, and form (flat, bent, or diagonal) or the ceiling height lead to a different atmosphere, helping to environment identification and orientation (Brodey, 1965).

Touch, gathering information through receptors in the skin, is much slower than vision or hearing because it takes time for the person to put all the received information (lines, forms, and textures) together, perceiving totality (McLinden & McCall, 2002). Compared to the others, its applicability within a person's arms radius is to identify a person's exact position and is not effective at long distances. Changing surfaces' material, defining different edges or prominent stripes, and generally, tactile environment design leads to a richer environment experience and better perception by VI and sighted people (Walden, 2008).

Smell, as a complementary sense along with the others, be stimulated by different perfumes and fragrances of various material (wood) and environments (Cafe, Bakery), help VI people to identify their surroundings and orientation.

3. Designing and redesigning VI children's preschool environment in Iran

3.1. Current situation

Providing a safe and usable environment for VI children seems to be very important. However, since they are learning to deal with the ordinary world, people like Walden believe that they need an environment, not fully adapted to their conditions and needs. They should learn to manage critical situations as an essential part of their development at this age (Walden, 2008; CEUD). Unfortunately, it seems that Iran's VI children's educational system exaggeratedly and unconsciously follows this viewpoint.

Generally, urban design's consideration for disabled people in Iran is limited to some universal design instructions which are not implemented correctly due to mismanagement, underestimation of the problems, and even incorrect perception of these instructions (Fig.1).



<Figure 1 > Poor implementation of universal design instructions for VI people in Iran

VI children's educational environments encounter the same problems. During this study, a critical observation of two VI children's schools in Tehran indicates their poor conditions, not matching their needs. In other words, they are built just similar to regular public schools with no specific regulations, except for a few instructions such as yellow handrails, sharp edges covered with foam, or yellow stripes on the stairs' edges (Fig.2).



<Figure 2 > Solutions to make the environment of Narjes blind school safer

One of the reasons for negligence in this field is the lack of sufficient information. According to the school counselor, the only need of these schools is to be eliminated from any dangers such as slippery surfaces or sharp edges to be safe for students. Such a viewpoint is a school without any defined and planned sensory stimulus, resulting in a better environment orientation or perception for students or any motivation to explore their surroundings and learn.

3.2. The importance of research on the quality of VI children's Preschools

The learning environment's quality, along with other factors such as learning resources, teachers' ability, and curricula, has a significant effect on student performance (Ala et al., 2012). In other words, as much as a person's abilities can improve through training and rehabilitation activities, many problems would be reduced through proper environment design, according to their conditions and ergonomic (Fredericksen. et al., 1991). In addition, the adaptation of the learning environment to the educational approach is also essential and helpful (Ala et al., 2012).

Based mentioned above, VI children's preschool environments are no exception. The users are children whose sight has been impaired at young ages before entering school. Considering the importance of this period for their development, this place is the first social environment they experience after the safe environment of their home. A suitably designed environment brings a proper condition for these children to learn, develop and reduce their intellectual and personality development distance with their sighted peers, prepare themselves as active citizens in a society without infrastructure for them, and have a chance to educate in regular schools in the future. Its importance became apparent after the authors observed a four years VI child making a detailed dough snake just by touching a plastic snake for the first time (Fig. 3). In this regard, a suitable environment can provide rich experiences for these children and even play a teaching role instead of isolating them due to limitations caused by the surrounding environment.



<Figure 3 > Playing with dough and shaping it based on the child's experience of touching objects

Given the above, the targeted environment should be able to meet the following needs:

- Creating a sense of security and safety in the child,
- Meeting the learning needs of VI child,
- Activating and stimulating the child's senses during the day,
- Encouraging the child to participate in individual and group activities,
- Providing conditions for the child to experience the world similar to sighted children.

In this way, the environment of VI preschool could be an influential factor in creating a sense of confidence and motivation for children to explore their surroundings and gain experience and enjoyment during school hours.

3.3. Research method

The lack of sufficient and documented studies and regulations on VI school's physical quality in Iran was one of the difficulties of this research's literary Studies. In this regard, besides a general review of current studies, field studies were conducted through interviews and observation in two VI children's schools in Tehran in 2015. The frequent visits of schools and interviews with teachers, school counselors, therapists, and older students were done to benefit from their experiences and get familiar with the schools' current situation, teaching system, and students' problems. Finally, Narjes Blind Girls' Pre-school was selected as the main case study for critical observation to be provided with solutions to enrich and improve its environment's quality.

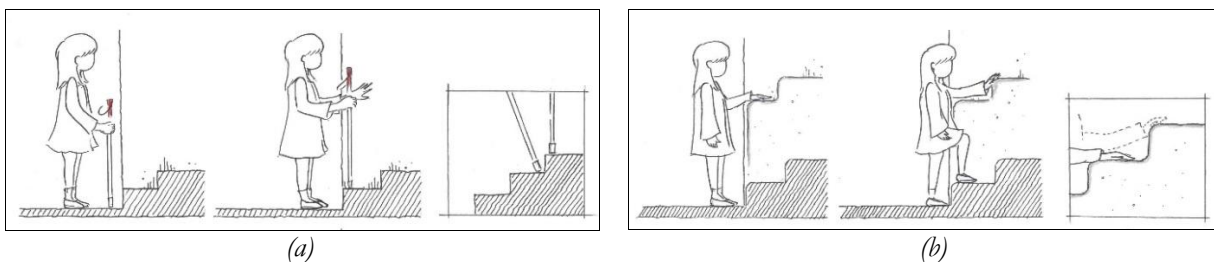
Children's young age made it impossible to use a questionnaire form in Braille to ask about their interests, needs, and how they think about their classes. Besides, the poor communication due to their deep distrust of strangers made the author attend classes as a teacher assistant to observe and spend time with children without making them uneasy in a regular daily routine. In this way, the author observed children's behaviors and interactions with the current environment during playing and education times and individual and group activities. Also, from an interior architect's point of view, it was tried to identify children's problems with adaptation to the current environment and suggest feasible solutions to upgrade the quality of the preschool environment.

3.4. Results and Discussion

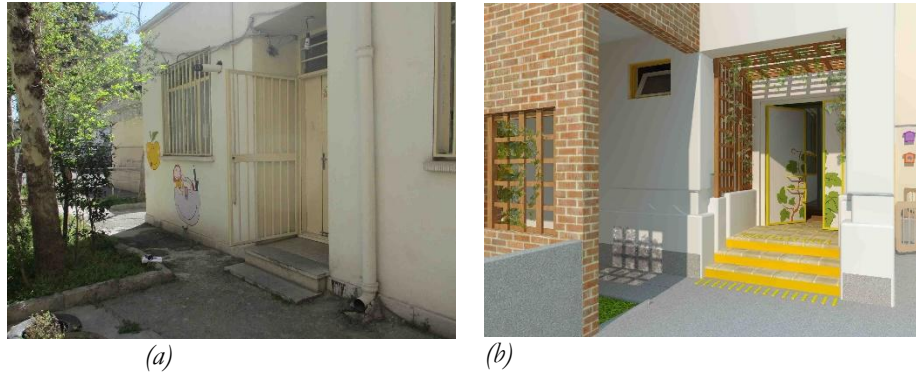
Generally, about 15 children, mostly between three and seven years old, with different visual impairment types, are present between 7 am-12 pm in this place. According to its staff, in addition to daycare, the main reason for children's presence is to learn necessary skills and develop their current abilities. However, this place's unsuitable physical quality does not answer these goals. Besides not answering their educational needs, its conditions do not meet safety standards correctly, and it is the teacher's responsibility to deal with all the deficiencies. How these children spend their time in preschool and its quality can affect their future activities. So it is essential to plan their experiences during these few hours a day, from simple things like using personal shelves to issues that directly affect their education.

Sensory stimulation, the human's perceptual tool to understand and get involved with the surrounding, could be one of the first ways to establish effective communication between children and the environment, applied in various situations and forms. Unlike its current situation Fig. (5-a), the children's first and last experience of this place during the day, the entrance can be an excellent example of this.

The Children's resistance to learning and using their white cane due to feeling embarrassed is one of the staff's concerns as their age needs to learn to use it correctly in various situations such as climbing stairs. Due to their vision, the sighted people notice the depth and height of the stairs and take steps accordingly, while VI people do it with their cane, holding it upright and hitting forward (Fig. 4-a). As it is not wise to force small children to use their cane until they are mentally ready, this problem could be solved by placing a handrail along the stairs, simulating its dimension. When the child grabs the handrail and climbs the stairs (the hand on the handrail moves in front of the foot), he/she can recognize the location of the next stair and its height in advance (Fig. 4-b, 5-b). This could effectively help to synchronize the child's sense of touch, hand and feet movement, and mind and prepare the child to use the cane. Furthermore, encouraging children to touch the handrail or other surfaces in exterior spaces built of different materials is a way to engage their touch to experience the same materials in different weathers or different times of the day.



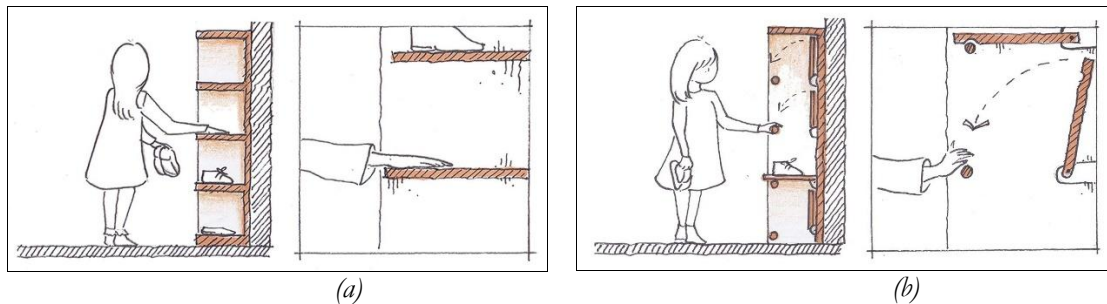
<Figure 4 > a) Using a cane for stairs climbing, b) Replacing the cane with a sense of touch for stairs climbing



(a) (b)
 <Figure 5 > a) The entrance's Current situation, b) The proposed design

Including the educational approach with the environment's design and answering learning needs, is another way to enrich the environment, leading to children's more effective communication with it. For example, aligning self-help skills education with the learning environment design and making it a daily life routine could benefit their learning process (Stone, 1997).

Being barefoot indoors is a many Eastern countries' tradition, including Iran. So, usually, anterooms for wearing and taking off shoes are considered at entrances. Unlike its current situation in this building, making children depend on their teachers, this place could help children to learn wearing shoes independently. First of all, the area of the anteroom has to accommodate several children simultaneously, as VI children need more time for wearing or taking off their shoes, leading the place to be crowded. Besides, the shoe rack has to be accessible and informs the child of its fullness or emptiness without touching its contaminated surface to find an empty spot (Fig. 6-a).



(a) (b)
 <Figure 6 > a) Finding an empty spot by touching the contaminated surfaces, b) proposed flipping shelves

The proposed design (Figs 6-b, 7) consists of flipping shelves. The knobs under their surfaces define the shelf's position, among others, and the shelves' front bar can be used to signify whether a shelf is full or empty. Based on the teacher's opinion, each shelf could be assigned to one child or be chosen daily by children using their touch to strengthen their memory, accuracy, responsibility towards belongings, and getting familiar with row and column concepts (Fig. 8).



<Figure 7 > The proposed shoe rack design with flipping shelves



<Figure 8 >The proposed anteroom design

Wearing clothes, hanging, or distinguishing them is another self-help skill children are taught in this area. Usually, they are encouraged to use their sense of touch and smell to find them, but sometimes heaped clothes in the wardrobe make it hard. By classifying and labeling each part differently, using sharp colors or punched surfaces, the heaping of clothes is prevented, and Children can find their clothes by remembering the section and getting help with the sense of touch (Fig. 9 10).

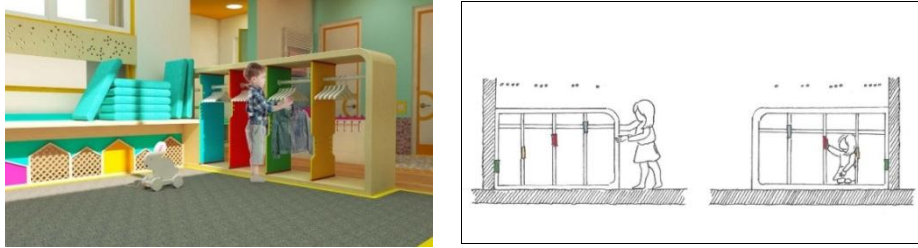


<Figure 9 > a) Current situation, b) Using senses of touch and smell to identify clothes, c) Heaped clothes and child's confusion, d) Classification and labeling wardrobe



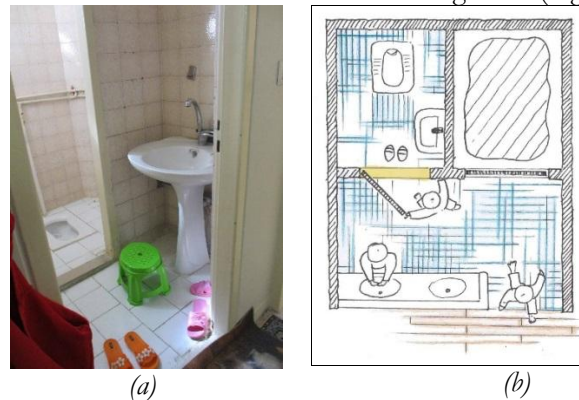
<Figure 10 > Classification and labeling wardrobe using sharp colors and punched surfaces

Other concepts such as left and right or symmetry, with a bit of creativity like the double-sided design of the wardrobe, can be indirectly introduced in this or similar spaces too (Fig. 11).

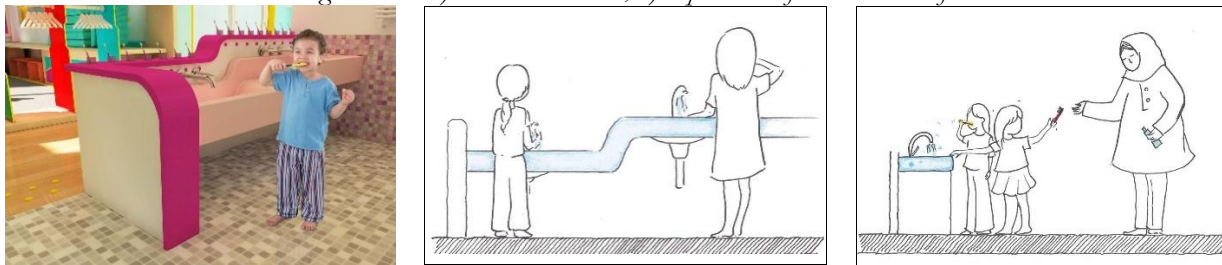


<Figure 11 > Two-sided design of wardrobe, introducing children to basic concepts such as symmetry, left and right

Another way to establish effective communication between the child and this environment is to facilitate using it, requiring the child's problem recognition in dealing with the current situation. The best example is the toilet, where children often need to use it during the day. However, the main reason preventing them from using it independently is fear of slipping and falling into the squat toilets. Also, the current small area does not allow the presence of several children same time to learn personal hygiene like brushing teeth or washing hands. Therefore, an appropriate solution is allocating space to these matters, separated from the toilet, allowing children to move freely. On the other hand, removing the squat toilet and replacing it with a sitting toilet seems safer for VI children. However, considering the point of this area, preparing children for the real world outside their safe circle, the squat toilets should be placed beside a sitting toilet, and some measures are taken to facilitate using them (Figs. 12, 13).

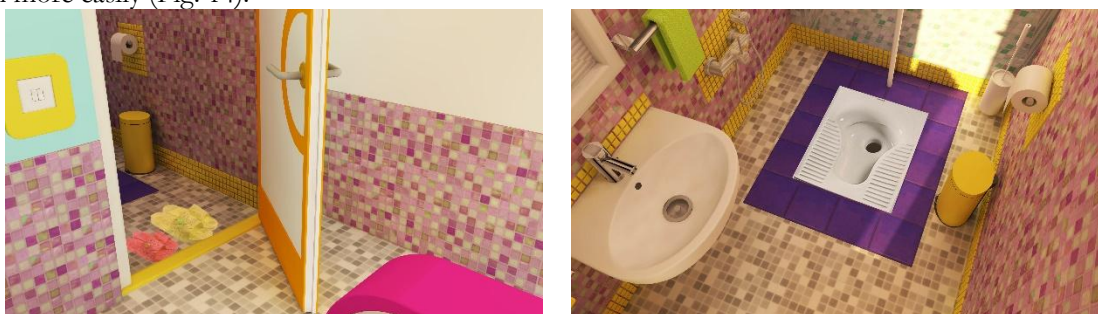


<Figure 12 > a) Current situation, b) Separation of the washroom from the toilet



<Figure 13 > Independent washroom, allowing the presence of several children to learn personal hygiene

These measures can include using non-slip tiles for flooring, using completely different textures and colors in the margin of the toilets, and toilet components like washing tab and soap container to help the low vision child recognize them more easily (Fig. 14).



<Figure 14 > Using different materials in the margin of the toilet and behind toilet components

What helps the child distinguish the washroom area from other adjacent spaces are clues defined by the designer in different ways. Their repetition in similar situations conveys lots of information and concepts to the child, including the environment's use, its experience's quality, or even warnings of possible dangers. Using qualitative features of environments' elements such as flooring materials gives clues by their sound reflection, texture, temperature, or the color and differences between them in different areas. For example, using small tiles in slippery flooring environments such as washrooms, pantries, or pottery workshops and its repetition warns the child of the poured water or other liquids on the ground (Fig. 15).



<Figure 15 > Using the same flooring material in environments with the same features to give clues to the child

Using parquet in all indoor movement paths is another example of helping the child orient the space and be assured that these paths are free of obstacles or dangers to move freely (Fig. 16).



<Figure 16 > Using the same flooring material for indoor movement paths to make them clear for the child

Their freely moving is of great importance because it is a significant disadvantage of this impairment (Koestler, 1976). Due to this inability, their experiences are limited to people's explanations which affect their progress in speaking, understanding concepts, and social skills. Motivating them to explore their surroundings at older ages is even becoming harder. In this regard, preparing appropriate conditions to encourage them to explore and move in their surroundings at an early age will help them deal with the challenges they will face in the future and have an independent life. One way is to help them feel more secure in their environment (Warren, 1984; Stone, 1997). According to school officials, in addition to risk factors elimination, the children's secure feeling will be obtained through their familiarity with the environment, which is kept stable and memorable.

In the current situation, invisible and familiar places are formed during the time in children's minds, and teachers try to keep them unchangeable; for example, around the main furniture with a fixed location such as circular or rectangular tables which children gather around them to make handicrafts, gas heater with its warm surroundings or areas near the windows, gathering most children with low vision due to its brighter side in training time (Fig. 17). Due to their limited vision, offered solutions to define different areas' qualities in the preschool environment should be tangible by their senses, such as the location of opening and heating and cooling systems, the carpets' place, and their texture or furniture forms.



<Figure 17 >invisible places formed in children’s minds

In addition to the stability, this environment’s flexibility is also necessary. The learning activities are performed as individual and group activities, following variable daily processes. In addition, as mentioned, each child’s vision is different from the others leading to various needs. So, the learning environment should also have the flexibility to adapt based on different situations, and furniture can play a significant role in this case. Furniture, just like the fixed elements such as walls, floors, and ceiling, helps in defining the interior. However, it has the potential to provide the desired flexibility. A fixed wooden desk around the room with wooden benches under them is considered in the proposed design. The benches can be pulled out and used for group activities in the center of this area or individual activities next to the fixed desk around the room. As a result, the learning space with its fixed structure provides the possibility of minor changes according to the needs of the teacher and children (Fig. 18, 19).



<Figure 18 > a) The Fixed desk and movable benches, b) Flexibility in using benches



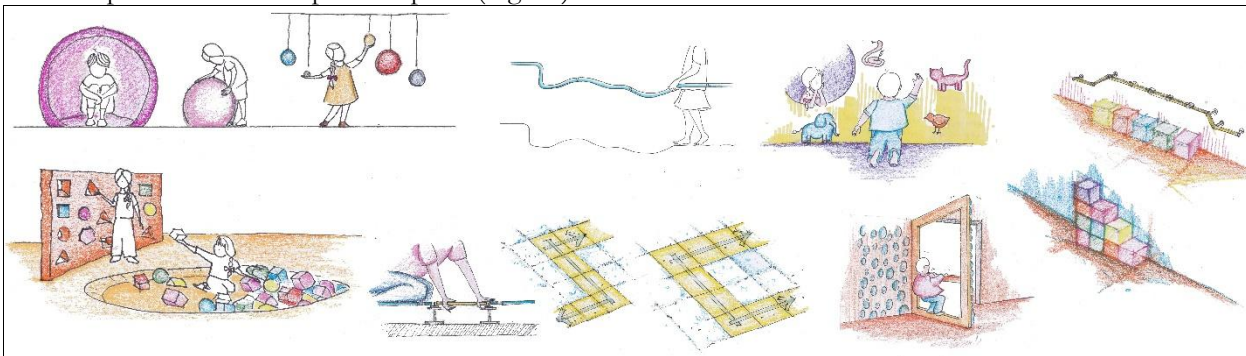
<Figure 19 > Stability and flexibility of learning space in using furniture

Increasing the environment's attraction by considering children's interests in the design process is another solution to improve its relationship with them. In this preschool, one of the children's enjoyable activities relates to the occupational therapy class, done as a complementary program to develop children's abilities to use their residual vision, make optimal use of other senses such as the sense of touch to do delicate tasks, strengthen child's muscles, coordination between body and mind, besides balance and orientation training. The negative point of this program is the faraway place dedicated to it from the preschool area and the limited hours each child could spend separately in it. The related specialist believes this sector's combination with the preschool area could be more helpful for an appropriate implementation program and help the children to experience related activities in individual and group training constantly during the day. Many activities and teaching tools used in occupational therapy classes have the potential to become ideas for designing the preschool (Fig. 20).



<Figure 20 > some of the activities related to the occupational therapy class

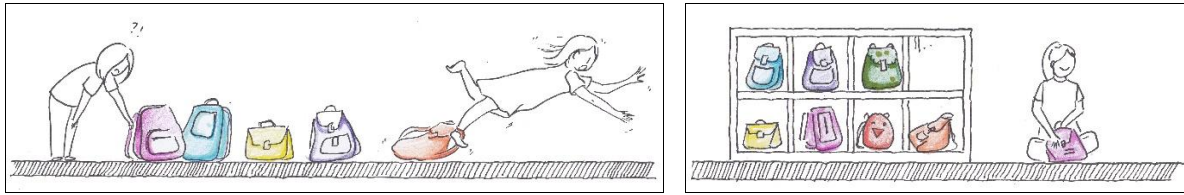
Ideas like using flooring and furniture with various textures and materials, puzzle walls, the experience of volumes and geometric shapes in various scales, along with the architect's smart choice in selecting and combining them, lead to a more dynamic environment that in addition to its learning aspect, bring joy to the children and make the preschool a more pleasant place (Fig. 21).



<Figure 21 > Influence of occupational therapy classroom activities on preschool interior design

Besides the role of furniture in defining the overall form of the place and its flexibility, it has a unique role in making it attractive. For example, the shelves used for storing teaching aids and children's belongings would be turned into a tool to arouse children's curiosity by combining it with some ideas.

No place is dedicated to children's personal belongings in the current situation. This caused lots of bags around the rooms, leading to children feeling nervous about finding their stuff and endangering their safety, causing them to fall while these problems will be solved by just allocating shelves to them (Fig. 22)

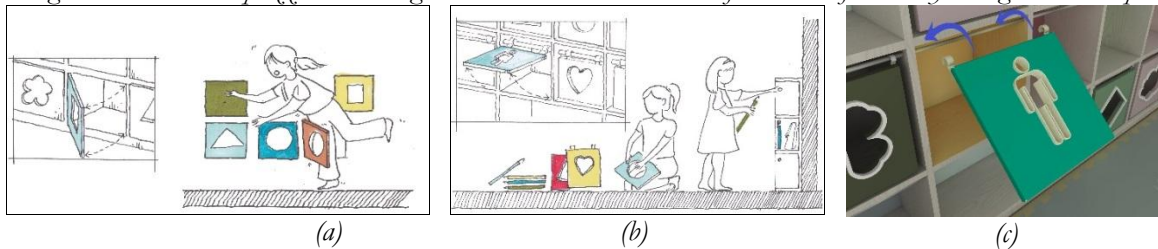


<Figure 22 > Use of shelves to create order and security in the learning environment

Instead of ordinary shelves, in the proposed design, inspired by teaching aids (Fig. 23), shelves with hanging doors are used, chosen, and easily installed by the child every day. So they close after each use and do not endanger the child. The door surfaces, painted in various colors, contain holes with embossed edges and familiar objects' shapes (Fig. 24). In this way, there will be an interactive wall that has a different appearance each day based on the doors chosen by the children (Fig. 25). Most of these children avoid touching objects with unfamiliar textures and materials due to fear and need encouragement to do it (Fraiberg, 1977), and this is what made this design special. It engages the children's sense of touch and encourages them to use both hands simultaneously to touch and explore objects.



<Figure 23 > embossed puzzles as teaching aids to stimulate child's sense of touch and familiarity with geometric shapes



<Figure 24 > a) dangers caused by the open door, b) hanging doors and their easy installation, c) The proposed design



<Figure 25 > Interactive wall with various appearances, created from shelves door

Another example of teaching aids in the design process is using the drilled plate with pins on a larger scale (Fig. 26). Covering the wall with a punched metal plate and boxes containing colorful wooden pins provides the VI child with a chance to have a tactile experience, similar to sighted children's painting experience on the walls (Fig. 27).

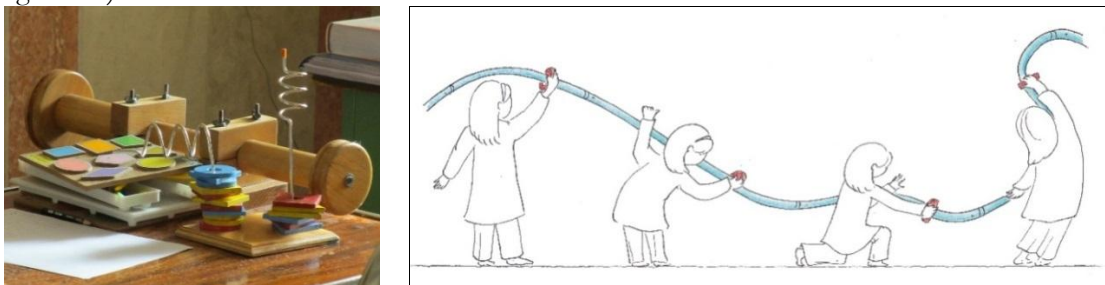


<Figure 26 > Drilled plate to sensitize child's fingers to prepare for learning Braille



<Figure 27 > Punched metal wall covering to create a tactile experience of painting on the wall

As one of the occupational therapy class's goals, physical activities and their coordination with the mind would also be obtained through interactive design. One answer is using wavy rods with rings as handrails and encouraging the child to move the rings along with the rods. Besides its benefits, such as coordination between mind and body, make the children continuously change their body positions (getting up, bowing, or sitting) and stretch their muscles (Fig. 28-29).



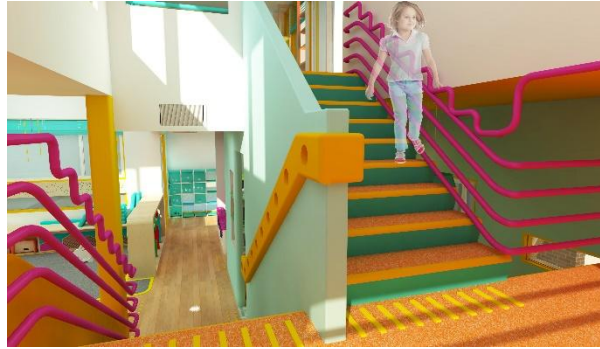
<Figure 28 > Using educational aids on a larger scale as part of interactive architecture



<Figure 29 > interactive design as an educational aid to strengthen the child's muscles

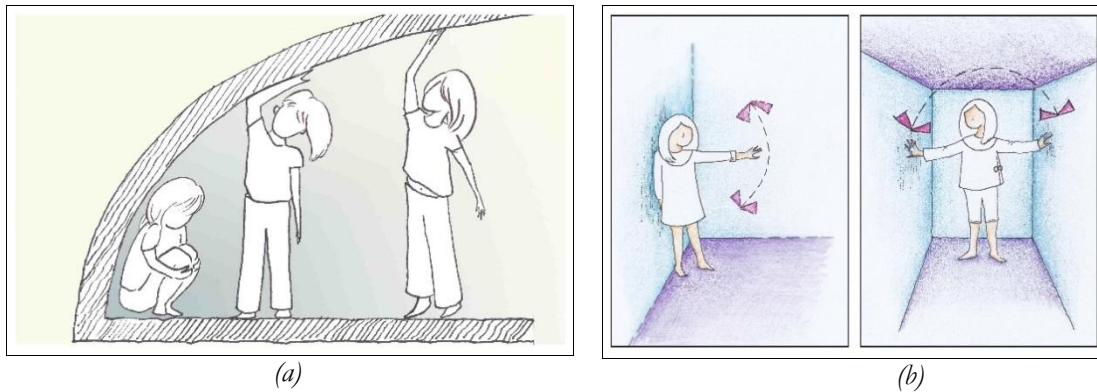
It would benefit VI children to have similar experiences to their sighted peers, which are virtually incomprehensible and intangible due to their poor eyesight. Getting familiar with the surfaces which are creating the indoors is one of them. The concept of floor or wall is evident for them due to their accessibility, unlike the ceiling, which is out of reach.

Also, they can hardly experience and understand physical concepts such as a room's dimensions, being surrounded by a small place, types of openings and passing through them, being at a height, or other examples. By applying relatively simple ideas and the environment's components in the design process, children's ambiguity about these concepts can be reduced. For example, a staircase in this indoor environment brings opportunities in this regard. The recognizable steps' nosings, the contrast between treads and risers' colors, and standard handrails on both sides of the staircase (Stuart, 2013) bring a safe condition for children to gain stair climbing skills under the teacher's supervision (Fig. 30).



<Figure 30 > Example of a safe staircase for VI children

On the other hand, the staircase has the potential to define various concepts. The stair spandrel can be used to define the physical nature of the ceiling, changing its height and shape due to its sloped ceiling (Fig. 31-a). Due to its surfaces' accessibility in the radius of the child's arms, its area can define a small and cozy space in front of the larger learning space outside, leading to their familiarity with the concept of small and large dimensions (Fig. 31-b, 32).

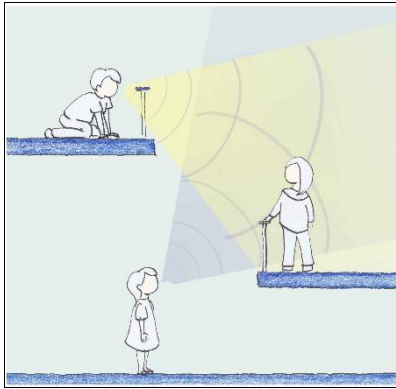


<Figure 31> a) ceiling concept experience, b) familiarity with the small space versus the large one based on their accessible surfaces in the radius of the child's arms



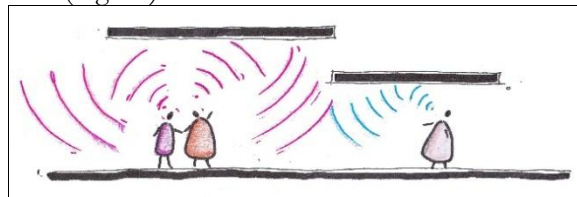
<Figure 32 > Examples of spandrel design

The height difference is another concept that the staircase can indirectly introduce. Standing on the stair landing at a higher or lower height than the other floors helps the children understand their different position compared to other children through experiencing different temperatures or sound qualities (Fig. 33).



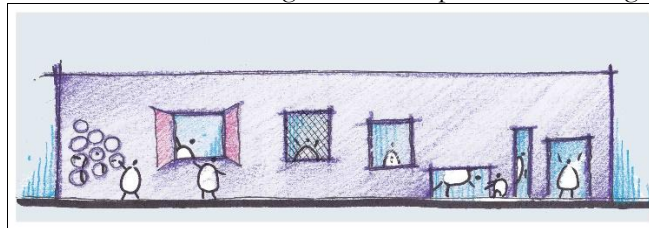
<Figure 33 > Different sound qualities in different height

Another way to clarify the height concept in children’s minds is by using different ceiling heights in different parts of the preschool environment. In this way, children perceive the effect of ceiling form and height on the sound quality and can imagine invisible areas (Fig. 34).



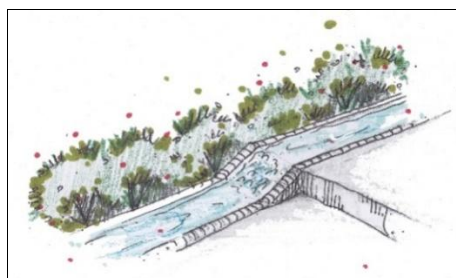
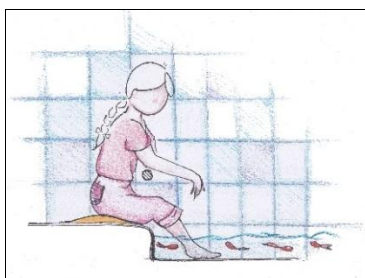
<Figure 34 > places with different ceiling heights and sound qualities

Another concept is openings and their types. The different roles each opening has and the way people interact with them is an intangible concept for VI children, which can be clarified by using different kinds of them with varying roles in the design process of the preschool. The architect’s conscious decision in defining the openings indoor helps these children to interact with them and perceive that some of them are windows to transmit light, sound, and fresh air, some of them are out of reach, some of them are embedded in walls as doors to let people moving between rooms and some, due to their low height made the person to bowing and crossing them (Fig. 35).

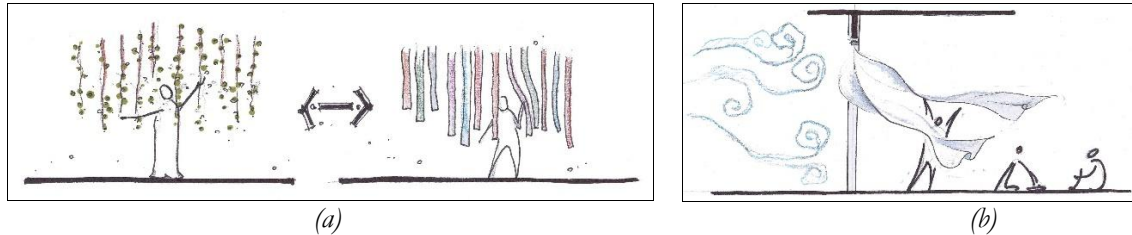


<Figure 35 > Children’s interaction with types of openings indoor

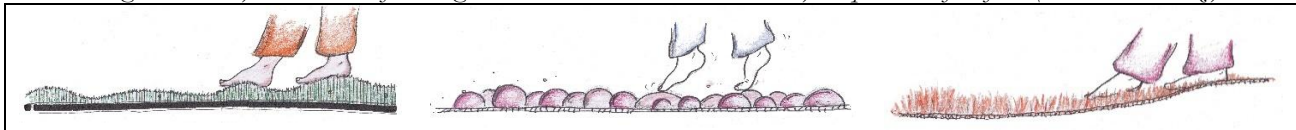
In addition to the elements of space and their quality characteristics, There are many other concepts these children, due to their circumstances, can not experience, such as contact with nature and animals. Of course, their real ones are preferred, but their similar simulation would be helpful as compensation for the lack of real experiences. This task is mainly the responsibility of educators and the used educational philosophy. However, designers’ knowledge of these subjects and their application through the design process provide a better experience for these children in this environment (Figs. 36-37-38).



<Figure 36 > Experiencing water with different qualities by hearing and touching



<Figure 37 > a) Simulation of moving between a willow tree's branches, b) Experience of airflow (such as the breeze)



<Figure 38 > Stimulating the child's soles senses by using artificial and natural flooring materials

4. Summary and conclusion

Chris Downey, who keeps working as an architect after becoming blind, said: "We are used to thinking of design as a visual process. However, the design is an intellectual process, and the visual dimension is a tool to aid in that. It is one way of getting information, but it is not the only way" (Firestone, 2010). The importance of Downey's point of view becomes apparent when the subject is the environment for VI people, using other senses. The lack of this approach in the design and construction process will be Iran's VI children's schools without any targeted planning to stimulate senses. As a result, no effective dialogue between the children and the learning environment forms, and their curiosity about it will not arouse.

To overcome this disadvantage, an extensive field study was done in the Narjes visually impaired children's school. Besides a general review of current studies, the field study included interviews with several people, such as teachers and trainers, and attending children's classes for several months to observe them interact with the current situation. Based on these studies, in addition to providing a complete interior renovation design for Narjes preschool, some general approaches were classified to help the architects have a better point of view during the design process of similar environments to achieve a design that fits better with the needs of these children which are summarized as follow:

- Considering children's perceptual tools (senses) in designing and providing various related contexts to engage them in the environment perception process and strengthen them
- Including the educational approach to the environment's design which could be achieved in three aspects:
 - Meeting the special learning needs of these children, such as the control of light amount, adequately with the amount they need based on their vision conditions
 - Matching the environment's condition with the learning subject, like providing an appropriate design for the cloakroom for the training of wearing clothes in a real situation
 - Getting ideas from educational concepts in the environment design and its furniture, concepts such as concepts like symmetry, rows, and columns or scale
- Facilitating the children's independent use of the environment that requires recognizing their needs and difficulties in dealing with the environment, such as facilitation of independent use of toilets
- Defining constant and clear clues in different learning environments parts to convey information about the usage, quality, or even warning about possible dangers in these parts, such as using small tiles for places with slippery flooring
- making the children feel security towards the environment by keeping it familiar, stable, and predictable, for example, by defining fixed visible and invisible areas around particular furniture
- Making flexible furniture to allow the children to move or change them for individual and group activities or playing hours
- Adding to the attractiveness of the learning environment by considering these children's interests in the environment design process and its furniture
- Providing conditions to have different experiences in a safe and controlled environment, such as building elements or communication with nature

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