

## The importance of Multisensory architecture tools in designing learning spaces for visually impaired children

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### Abstract

This study discusses the importance of using multisensory architecture tools to reach the best performance in designing learning spaces for different levels of visually impaired children. It discusses the effect of designing by our five senses in achieving the purpose of our design. As it's known that Architecture is one of the main basics of environmental components. This study mainly aims to shed light on the idea that the Architecture can't be considered as a visual tool but it is a multisensory tool that could be used to feel and understand the environment.

So, it was important to discuss the architecture tools that could be felt by our all senses. Besides discussing the idea, that in the case of losing the visual sense, the building should have the same ability to be understood by other senses. By missing these tools, students with visual impairment disability cannot be able to use their right to live normally.

The study analyzes a successful case study of designing a classroom for the blind in Pattaya city in Thailand. This project has won a prize in 2019, in the World Festival of Interiors in Amsterdam. The analysis of this project showed the architecture tools that was used to make this classroom a multisensory space that could be felt by students 'different senses. Besides highlighting the basic senses that should be used to design a space for visually impaired users.

The study concludes that by applying the Multisensory Design tools, visually impaired users could feel space by **Touching, Hearing, smelling** or even feel space by their **thermoreceptors**. A building that was created with the multisensory can achieve great success as an architecture product or a human product.

### Keywords

Children, Blinding design, visual impairments, multisensory architecture, learning spaces, disability.

**ملخص البحث :**

تناقش هذه الدراسة أهمية استخدام أدوات العمارة متعددة الحواس للوصول إلى أفضل أداء تصميمي لمساحات التعلم لاطفال لديهم ضعف نظر مختلف . يناقض البحث تأثير التصميم بواسطة حواسنا الخمس لتحقيق الفكرة و الغرض من التصميم. كما هو متعارف عليه أن العمارة هي واحدة من المكونات الرئيسيه لبيئتنا المحيطة. .

لذلك تهدف هذه الدراسة بشكل أساسي إلى تسليط الضوء على فكرة أن العمارة لا يمكن اعتبارها كفنٌ متمثل في العناصر المرئية فقط و لكنه فن متعدد الحواس يمكن ان يستخدم لنشعر و نفهم بيئتنا المحيطة. لذا ، كان من المهم مناقشة الادوات المعماريه التي يمكن أن تشعر بها جميع حواسنا. ايضا فهم أنه في حالة فقدان حاسه البصر يجب أن يكون للمبنى نفس القدرة على الفهم بواسطة الحواس الأخرى. من خلال فقدان هذه الأدوات ، لا يمكن للتلاميذ الذين يعانون من إعاقة بصرية استخدام حقهم في العيش بشكل طبيعي. حللت هذه دراسة حالة ناجحة لتصميم فصل دراسي للمكفوفين في مدينة باتايا في تايلاند. حصل هذا المشروع على جائزة ٢٠١٩ داخل المهرجان العالمي للتصميمات الداخلية في أمستردام. ظهر تحليل هذا الادوات المعماريه التي استخدمت لجعل هذا الفصل الدراسي مساحة متعددة الحواس يمكن أن تشعر بها الحواس المختلفة للطلاب. إلى جانب إبراز الحواس الأساسية التي يجب استخدامها لتصميم م فراغ مناسب لضعاف البصر.

ويتلخص من الدراسة أنه من خلال تطبيق أدوات التصميم متعدد الحواس ، يمكن للمستخدمين الذين يعانون من ضعف البصر أن يشعروا بالمساحة من خلال حواسهم الأخره كاللمس أو السمع أو حتى الشم أو حتى الشعور بالمساحة بواسطة مستقبلاتهم الحرارية. يمكن للبناء الذي تم إنشاؤه باستخدام الحواس المتعددة تحقيق نجاح كبير كمنتج معماري أو منتج بشري.

**الكلمات الداله:**

العمارة متعددة الحواس ،الأطفال ، تصميم لذوى الاعاقه البصريه ، الإعاقات البصرية ، الفراغات التعليميه ، ضعف البصر.

**Research problem:**

- **The poverty of designing learning spaces for visually impaired and blind students.**
- Dealing with Architecture as a visual tool and neglecting the other senses such as hearing, smelling and touching sense.

**Research Hypothesis:**

By respecting the five human senses, the learning spaces for visual impaired children could be a way to create talented and independent adults in future.

**Research Aim:**

- The research aims to shed light on the idea that the Architecture can't be considered as a visual tool but it is a multisensory tool that used to feel and understand the environment.
- **The study's purpose is to give attention to the importance of respecting the visually impaired students' needs in learning spaces to make them able to learn how to face life and being independent by improving their spatial perception by using their other senses to understand spaces.**

**Research Methodology:**

**Theoretical Analysis Approach:** Discussing the theoretical points; what is the architecture role in visually impaired students' lives? The multisensory architecture and its importance, and discuss the multisensory design tools in creating proper space for visually impaired pupils.

**Analytical Approach:** Conducting applied studies by analyzing Case study that showed the architecture tools that deal with the different human senses to crystalize how space could be felt without seeing it.

**1. Introduction**

Visual impairment is a challenge for the architects who think that architecture is only a visual tool. This challenge makes the architects think about the other senses that could be used to achieve the building efficiency besides feeling its beauty. How can the architects use the human senses and perception to understand spaces? (Vermeersch and Heylighen 2012). The history appeared that a big category of people who have a visual impairment can focus and succeed in different fields such as Homer who was a Greek author at 800 BC and also Taha Hussein the well-known Egyptian writer. (“Famous Blind People Who Made It Big In Life” n.d.)

Globally, at least 2.2 billion people have a blindness or vision impairment, of whom minimum 1 billion have a vision impairment that could have been prevented or has yet to be addressed<sup>1</sup> (Vision impairment and blindness, n. d.). In Egypt, the digital estimates have been issued by the Central Agency for Mobilization and Statistics, and estimates from UNICEF, showing that the number of people with visual impairment reached 19975925 with 2011 statistics, and the number reached 2912175 people for the year 2016. So, it is important to understand and respect their needs while designing buildings to make them able to live and coexist with society (“مركز رعاية المكفوفين | مؤسسة مصر الخير” n. d.).

By increasing the numbers of visually impaired and blind people in the world, it's important to create a proper environment with less danger and more comfortable.

This challenge increases by designing for children with no experience or social background. By increasing the number of blind children, the poverty of architecture spaces has appeared. In this case, the architect's role becomes more essential and critical for being the main factor of creating learning spaces that could improve their skills and talents. So, the architects created some solutions to be able to create a proper space for blind and visually impaired students by focusing on other human senses such as hearing, touching and smelling senses. Moreover, the architects can benefit from the digital and information revolution and also computer technology in the architectural arena to create proper space for blind and visually impaired students. (Gouda, Radwan, and Alarnous 2020)

**2. The architecture role in creating a proper life for visually impaired pupils**

The designing for visually impaired users is a non-visual design which means that the users will not only be affected by the architecture visual tools but also feel the space by touching, hearing or even smelling. Countries shouldn't consider people with disabilities as obstacles but as wealth which has characteristics with a high level of senses who could be used for the benefit of their society.

Studies show that when humans lose one sense, the improvement in the other senses is caused by the learning behavior. So, in the absence of visual sense, blind people pay more attention to acoustic signs besides learning the ability to use this sense more efficiently. The brain adjusts to the human loss by transforming itself. If a human lost a sense, the brain's area normally dedicated to handling this sensory information that is not used anymore, rewired and work in processing other senses.

That is why people with disabilities become wealthy for any society. They are more focusing and having the ability to be more talented than people with the visual sense. A lot of famous writers and musicians have the disability of blinding such as Stevie Wonder, Ray Charles (musicians) and Helen Keller; the American writer who was both blind and deaf (Bates n. d.). Chris Downey; the Blind Architect who designed buildings with acoustics and accessibility in mind. He lost his vision suddenly while he was 11 years ago, he decided to keep on his field and functionalize his new sense of space in his works. He had a lot of successful works such as the Duke Eye Center and “the San Francisco Light House for the Blind and Visually Impaired” (“Chris Downey: The Blind Architect” n. d.)

Respecting the people with disability in design increases the ability to discover more creative and talented people in our society and also enhance their independency and wellbeing besides give the right to live normally and safely.

### 3. The Multisensory architecture

The building is a multisensory environment. It could be identified by see, hear, smell or touch so the multisensory architecture is important to make the building understandable by all human senses (Vermeersch and Heylighen, 2012). Steven Hall mentioned in the preface of Juhani Pallasmaa's book (1996); *The Eyes of the Skin: Architecture of the Senses* “the way space feels, the sound and smell of these places, has equal weight to the way things look” (p.6). “Every touching experience of architecture is multi-sensory; qualities of space, matter, and scale are measured equally by the eye, nose, skin, tongue, skeleton and muscles” (Pallasmaa 2012, p.41)

According to Berkeley, Hegel's argument; the only sense that can give a feeling of spatial depth is the sense of touching. A Touch can sense the material weight, resistance, and three-dimension shape which make us attentive to how things extend away from us from all directions (Pallasmaa 2012). So, the sense of touch founded a very important factor in designing spaces for visually impaired or blind users. So, the designers created different tools to improve the designing method to be able to be felt by human multisensory to achieve the perfect experience (as shown in figure 2).

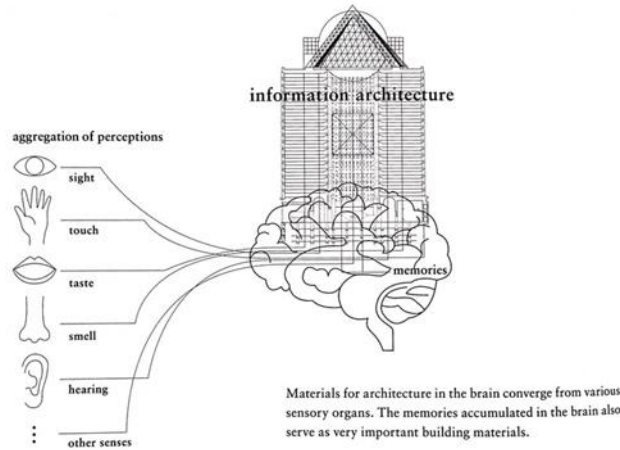


Figure 1. Information architecture. (Hara, 2018)

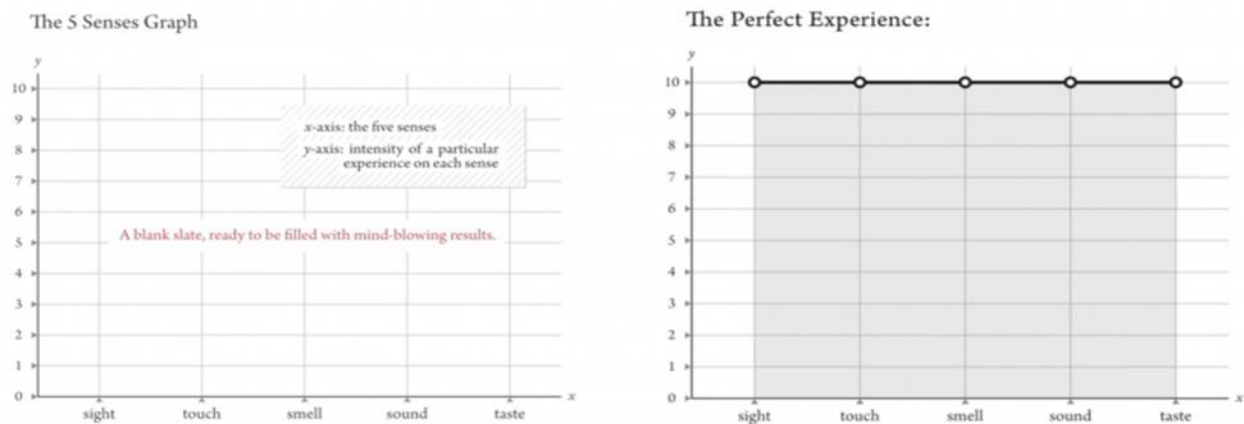


Figure 2: 5 senses graph and the perfect experience by Jinsop Lee. (Kumar, 2015)

## 4. The Multisensory architecture tools in designing spaces

### 4.1. What do blind people see?

Many people who formally are blind have some vision. Some elements could be noticed by blind people or visually impaired people:

- Murals, Bright Colors and also change in illumination that can help people who is suffering from being visually impaired.
- combine entryways and Halls into all architectural designs to assist eyes to adapt to illumination changes. (Craven n. d.)

### 4.2. The relation between architecture tools and human senses:

**4.2.1. Texture & Touching:** There are various architecture tools can be used to enhance touch sense for blind or visual impaired people:

- Using Tactile cues in pathways especially the outdoor ones.
- Using different Flooring materials to create contrast in texture to facilitate identifying the movement from place to other.
- Using textured wall panels such as tactile walls that could have a special texture design besides directing floor tiles to understand spaces 'directions (as shown in figure 2).
- Using different walls material to categorize spaces by varying wall materials.
- Using rhythm in designing walls panels to be understandable.

- Spaces users can understand building design by making them recognize building plans by using a Prominent floor plan (as shown in figure 3). (Kosasih, n.d.)

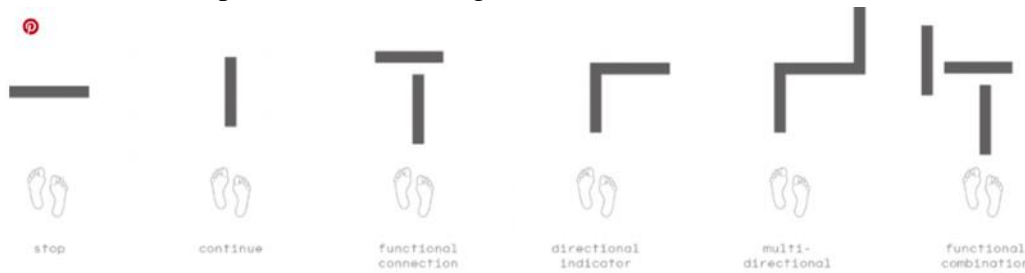


Figure 3: Recognize direction inside the building by using floor tiles. (So & So studio, 2018)

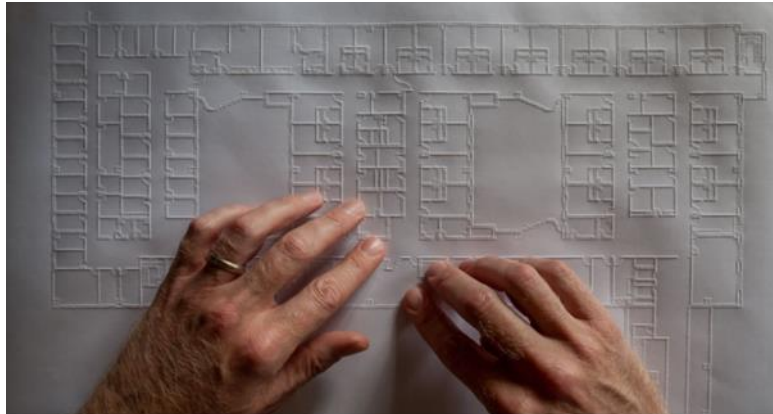


Figure 4: Prominent floor plan for blind and visually impaired users. (Photo by: Don Fogg )

**4.2.2.Space dimension & Hearing:** Sound reflection changes according to space dimension and finishing materials. One of the most vital factors in blind architecture is acoustics design (Picinali et al. 2014). The spaces could be identified by their sound by applying some architecture solutions. There are various architecture tools can be used to enhance the hearing sense for blind or visual impaired people inside spaces:

- Changing spaces dimension and ceiling height (As shown in figure 5).
- Varying finishing material between absorbing, sub absorbing and reflected materials to make a sound identity for each space.
- Adding acoustic landmarks inside long corridors to avoid the feeling of loss (As shown in figure 6). (“Centre for Blind Children | NSU” 2015)
- Adding water landmarks as a sound landmark which has its sound reflection. (according to tools used in the Centre for Blind Children | NSU, 2015)

**4.2.3.Odors & Smelling:** Adding some odors to especial spaces could ease the process of recognizing it. Some tools could be used to increase the ability to identify spaces by the smell sense (Feng et al., n. d.):

- Using certain flowers with a high and good odor that could be recognized easily by users in specific spaces.
- Adding some good odors in the ventilation system to be a mark for spaces.
- Making a smell landmark that could be used in long corridors (as shown in figure7). (according to tools used in the Centre for Blind Children | NSU, 2015)

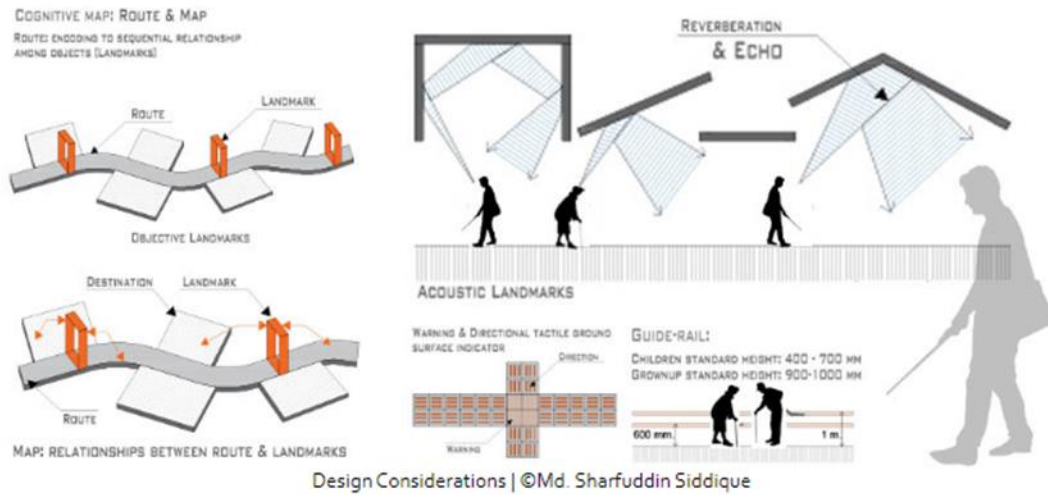


Figure 5: Changing in ceiling height to change sound reflection at Centre for Blind Children (NSU, 2015)

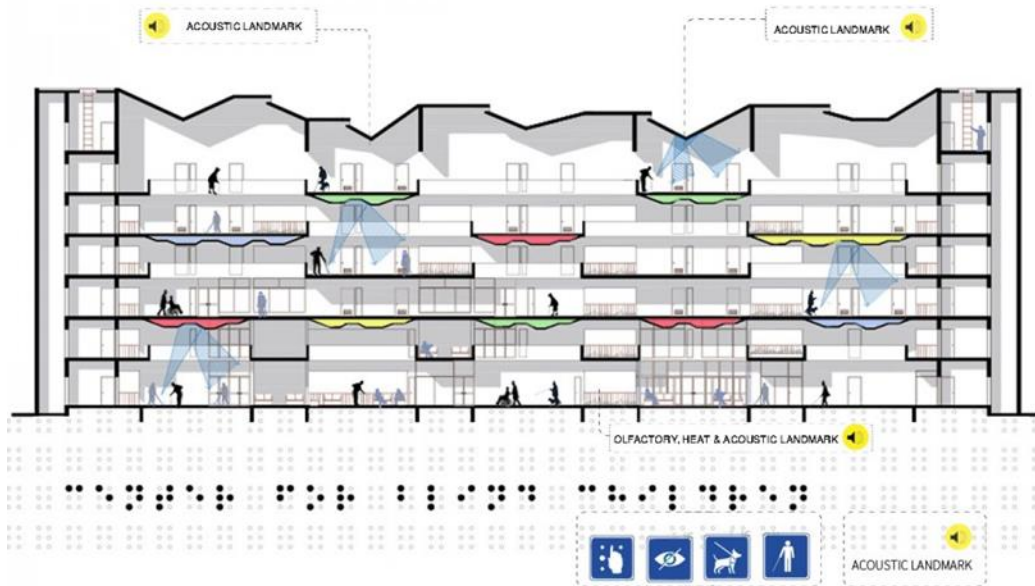


Figure 6: Changing in ceiling height to change sound reflection at Centre for Blind Children (NSU, 2015)

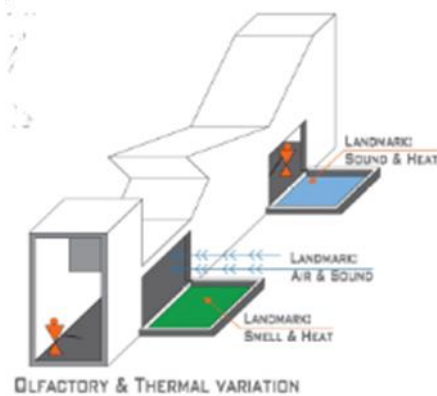


Figure 7: Smell landmark at Centre for Blind Children (NSU, 2015)

**4.2.4. Ventilation & Feel of Heat and Cold (Thermoreceptors):** The human body easily senses the difference between cold and hot areas. This can be a useful tool that could be used to differentiate spaces (Fernando & Hettiarachchi, 2016):

- The traditional natural ventilation tools could be used to create airflow inside spaces such as wind catcher and courtyard.
- Different materials have different characteristics of absorbing so adding various materials like glass and concrete will make a difference in the space temperature which makes it easy to recognize where the user is.

## 5. Case study : The Multisensory Architecture tools in designing learning spaces; “Classroom at The School for the Blind in Pattaya, Thailand”<sup>1</sup>



Figure 8: Blind School classroom in Pattaya. (Parida, 2020)

**Project type:** A classroom makeover for blind students in Pattaya.

**Project prizes:** The project won the health and education sector category at the 2019 Inside World Festival of Interiors, which was held on the sidelines of the World Architecture Festival in Amsterdam.

**Designers:** Puiphai Khunawat & Ekkachan Eiamananwattana of W Architects Singapore.

**The Project Concept:** The project main concept was equipping students for life beyond the school gate instead of saving them from deals with the surrounding.

**Users:** Pupils with varying degrees of visual impairment.

### 5.1. The Multisensory architecture tools used in Pattaya school’s Classroom:

The classroom before the makeover was covered by cushions and protective surfaces on all walls which treated students as porcelain dolls, shielding them from the elements. This way of thought resulting in a nondependent pupil cannot coexist with society or life in a fairway. So, the main concept was creating a place for these students that allow them to develop their senses with free barrier space by using the multisensory design (Parida, 2020). The design depending one designing details in the classroom to develop some senses as followings:

5.1.1. **Touching sense:** By understanding the importance of this sense, it was the main sense in the classroom design. The design is using some tools to improve this sense as followings:

- Adding different blocks inside the main box in the classroom each part has various blocks (animals, shapes and different colors circular blocks) to be touched by students. (as shown in figure 8)



- The blocks help students to learn shapes and types of animals besides giving them the knowledge of measuring size and weight (as shown in figure 9).
- The walls were full of holes that fit with shapes each wall has specific holes for each category of blocks which help students in different ways; first, learn directions by know where to go for the box and where they can put the block on the wall; second, enhancing the sense of touch by understanding the holes and how to put the shape inside the hole (as shown in figure 10 & 11).
- Adding a wooden tactile floor with a different texture surrounding the blocks table and walls for helping them to understand the dangerous points by themselves (as shown in figure 12).
- Adding plunge letters in the wooden tactile floor that surrounding the table to know their location inside the room (as shown in figure 12).
- Changing in walls design by adding different texture and also divided walls into parts to characterize each wall.



Figure 8: Animals shape blocks in the wall as learning material. (Parida, 2020)



Figure 9: The holes in the wall for shapes. (Parida, 2020)



Figure 10: The Geometric shapes inside holes. (Parida, 2020)



Figure 11: The wooden tactile surrounding table and walls. (Parida, 2020)

**5.1.2. Hearing sense:** The space is full of factors that cause space to have a unique sound reflection by using some design tools as followings:

- Ceiling Design: The classroom ceiling has prominent and plunges points like zigzag which make different levels in sounds caused by different reflections.
- Walls design: The walls are full of holes which makes changes in sound levels.
- Finishing materials: The classroom is covered by wood panels at walls and wood tiles on the floor; the wood is a good absorbing material that makes space gets a proper noise which has been made by the previous factors. (as shown in figure 13)



Figure 13: The classroom acoustical design. (Parida, 2020)

5.1.3. **Vision sense:** The previous studies appeared that the visually impaired and even blind people have a level of visual sense. The design didn't ignore this point by using some solutions as followings:

- Adding different and bright colors inside the holes to be seen by children.
- Panting blocks and shapes with bright colors.
- Using fade colors like brown and beige in the walls and floors to avoid making a distraction.
- Adding bright lights with hot colors inside space to make students focus on a specific wall by lighting it to increase their attention level.
- Maintain the natural light inside space.



Figure 14: Adding bright hot light to focus on specific walls. (Parida, 2020)

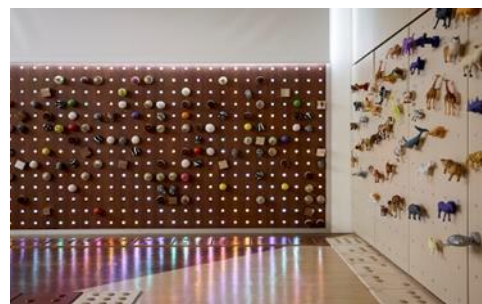


Figure 15: Adding bright colors inside holes to gain attention. (Parida, 2020)

5.1.4. **Feel of Heat and Cold:** The Design adding different types of ventilation systems; a fan which helps in natural ventilation and the air Condition.

- The Fan which located in the center has a good effect on understanding the space. The fan has its radius which distributes the air within it. So, by standing within this radius the user can understand that he is near to the center area in which the main table located.

- the Air condition also has a good impact on understanding where the students are inside the space. The air condition distributes the air in one direction which is in front of the air condition so the place directly locates under the air conditioner is a hot area compared to the other areas. So, if the students stand in front of this wall, he will know that he is under the air conditioner.

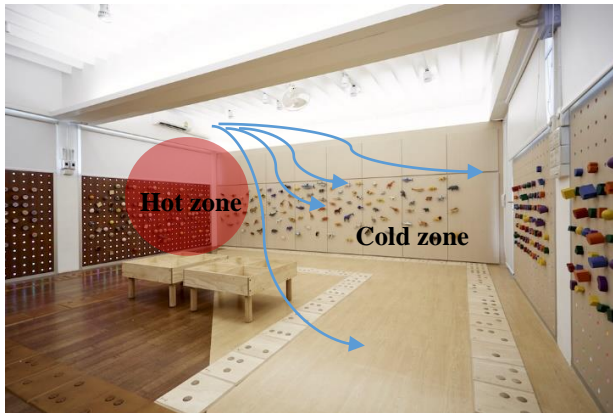


Figure 14: Hot and cold zones. (Parida, 2020)



Figure 15: Fan Air Radius. (Parida, 2020)

These tips improve the ability to gain experience from this space.

5.1.5. **Smelling sense:** There is no evidence that design worked on this sense in designing this classroom.

To conclude: This project work with four sense Touch, Hear, Vision, feeling of heat and cold, so according to the diagram sense we can evaluate the existing of each sense in project from 0 to 10 (10 means to exist, 0 means not exist) without comparing the importance of each sense, as following:

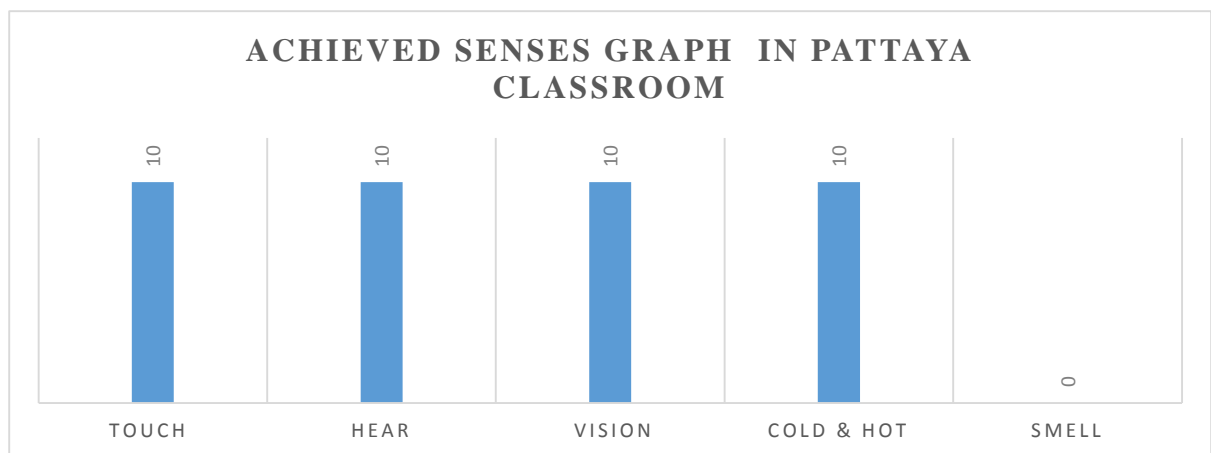


Figure 16: Achieved senses Graph in Pattaya Classroom according to Jinsop Lee sense graph for the perfect experience.

## Discussion:

By increasing the Visually impaired building users, architects cannot consider architecture spaces as only a visual tool. So, space design becomes a challenge for architects who have to respect all users' needs. The blind schools had faced a lack of creativity in design. The design for visually impaired children dealing with them as dolls that shouldn't face real life or their real environment. The architect's role is to create a proper environment to develop these

students' independency by enhancing their sense to understand spaces and surroundings by their five senses.

The study shows that using multisensory design gives more chances to achieve more success in spaces function. A lot of studies have been made to discuss the importunacy of using multisensory architecture in designing buildings. For example: In 1996 Pallasmaa discussed this idea in his book “The Eyes of the Skin: Architecture of the Senses”. In this book, the author focused on the importance of using the human five senses in designing spaces. Chris Downey; the blind Architect, nowadays he is one of the most effective architects in designing buildings with acoustics and accessibility in mind. Chris designs have achieved a great success by coexisting with his new feeling of senses and improve it to design proper spaces by using the non-visually design tools.

Undoubtedly, space design is not the only factor that affects the visually impaired users' lives and independency but there are a lot of social factors that could be taken into account to achieve the best way of living for pupils with disabilities.

The current blind schools can be improved by adding some architecture tools that let the users feel space with their other senses such as:

- Adding wall cladding with different textures that could be touched to identify space.
- Adding tactile to floors to create a clear pathway and directions.
- Adding bright colors and lights that could be seen by visually impaired students.
- Adding ceiling with a specific design to create different sound reflections to identify a specific space.
- Using prominent and plunged blocks in walls to create an acoustic landmark.
- Adding some flowers as a smell landmark to identify the location in the long corridors.
- Adding green areas, water spaces, or even air-conditioning as a thermal landmark.

Future studies could be discussing each human sense and how to enhance them by improving the architecture tools by mixing it with new technology that could help designers in achieving their missions.

### **Recommendations:**

This study suggests a group of points that can contribute to developing and improving learning spaces design efficiency for visually impaired students.

#### **General recommendations:**

- It is necessary to respect visually impaired users 'needs in spaces and avoid obstacles to allow them to use spaces easily.
- The new technology can give visually impaired users more flexibility to understand spaces and to facilitate their usage.

#### **Recommendations for Design:**

- It's important to involve users in the design step. By involving blind users in our planning step, it will facilitate to provide them with their needs in spaces.
- Designers should take into account understanding their designs by all human senses.
- More studies could be done to improve the architecture tools that could be used to applying the multisensory design.

- It's vital to link the new technology with architecture to produce new ways that could help users with disabilities.

### **Recommendations for government:**

The government should take into account people with disabilities in planning cities. It should give them the same right or even more to use streets, transportation and also parks to be the same as other citizens.

### **Conclusion:**

From this study, we can conclude that it is important to understand our human senses. Architecture is not a visual tool but it's a sole that appears in all senses. The designers have the ability to reach their idea and thoughts by using multi senses. The multisensory architecture is very important to understand how to work with the non-visual architecture tools. These senses can be concluded in five senses (hear, vision, touch, smell and feel of heat and cold). If the designer can deal fully or partially with these senses then his design will be a proper place for all categories of people to live in, and that's is the aim of the real architecture. People with disabilities have the right to feel our buildings and understand its function. The architecture space has to be a space that could be felt by all senses. Children with disabilities also have the right to learn, study and also to be prepared to coexist with the normal life and to be independent by giving them a proper place to learn and live.

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