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Towards Safe Cities & Resilient Communities

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PRELIMINARY STUDY ON SENSORY DESIGN FOR ASD: AUTISTIC CLASSROOM

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Abstract **-** Autism Spectrum Disorders (ASD) refers to a range of condition characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication as well as unique strengths and differences of a child. The child can survive independently, continue their routine lives and exhibit regular development in the future with the support and encouragement in order to continue their education in different learning environment. Every ASD child is unique and has his or her own combination of characteristics. Unpredictable disruptive behaviors among autistic child could occur in the classroom. Autistic people may appear to behave unusually and they can meltdown when they are in difficulties situation. The impact of sensory differences in people with Autism has been recognized recently. Therefore, designated learning environment should consider sensory issues to overcome their needs. Architects are responsible to provide a design that responds to the needs of all members of society. However, they lack awareness of sensory issues regarding the built environment in the daily life of an individual with autism prior to designing stage especially in terms of safety and security for autism. Thus, this research objective is to identify the criteria of sensory design in the classroom for autism. Developing the Design Criteria Checklist of sensory design for Autism Centre is the aim of this paper. It is hoped thatthis Design Criteria Checklist is part of benchmarking tool that can be usedin identifying the design criteria for autism classroom. The preliminary site visit was conducted accordingly to ensure relevant variables are met in the literature. The result has highlighted the criterion factors that are related to the quality of the physical learning environment and was considered at early design phase. It is hoped that this paper could contribute tlo architects and designers to utilize this Design Criteria Checklist of sensory design during the design stage and create a quality environment for autistic children in Malaysian. Therefore, the paper intends to measure the conduciveness of environment for autism as well assuggestion on the benefits of creating a conducive learning environment which not only optimize the classroom environment but also fulfill the parent's satisfaction.
Keywords **-** Autism, Sensory Design, Physical Learning Environment, Safety, Security

1 INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurological disorder that affects a child's developmental disability causing social, communication and behavioral challenges(Yates, Mclaren, & Proksch, 2016)**.** Individual with autism often affects ability to communicate, understand language, play and relate to others (Boyce, Hunter, & Howlett, 2003). In addition, ASD children can develop skill, social interaction and develop their fullest potential while in school(Shaari & Ahmad, 2016). Therefore, a quality and properly designed physical learning environment will enrich the development and education of autistic children. Hence, Shaari and Ahmad suggested that ensuring the quality of classroom contributing to improve school readiness among them and a better education system. Autistic children with disable should not be exempted from education. UNICEF (2014) stressed that disable children to Malaysia's Person who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society falls under the Disabilities (PWD) Act. UNICEF has categorized children with disable under learning difficulties. They include condition that effects the learning ability of an individual such as Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity (ADHD) and specific

learning difficulties such as (dyslexia, dyscalculia and dysgraphia). Thus, the major issue raised is when the learning environment does not constitute sensory design on autistic behavior due to sensory differences. Unpredictable disruptive behaviors among autistic child could occur in the classroom whenever the physical learning environment unconducive for them. Autistic people may appear to behave unusually and they can meltdown when they are in difficulties situation. It is important for architects to provide design that respond to the needs of all members of society. However, they are not aware of sensory issues regarding the built environment in the daily life of autism. This research objective is to identify the criteria of sensory design in the classroom for autism. Architects and designers should be aware the needs of ASD to ensure unpredictable disruptive behaviors do not happen. This paper will elaborate on sensory design which will help designers to create a physical learning environment for the educational and behavioural needs of individuals with autism.

2 DEFINE THE AUTISM BEHAVIOR

The term "spectrum" reflects the wide variation in challenges and strengths possessed by each person with autism (Autism Spectrum Australia, 2017).For instance, the functional impairment of the central part of their brain as well as other neural transmitter malfunction. This is because autistic children hardly concentrate on their activities (Noiprawat & Sahachaiseri, 2010).Yeo and Teng (2015) mentioned that ASD restricted repetitive patterns of behavior, interests and activities. Not only that ASD has poor social skill, they also experience poor eye contact, lack of joint attention, pedantic or odd speech patterns, lack of social problem-solving ability, lack of empathy, and difficulties interpreting body language. Children with ASD are having difficulties in developing their language skills, hearing and communication. Therefore, they express themselves by exhibiting unconventional behaviors such as being aggressive, bad temper or injuring themselves.

3 SENSORY DESIGN

The concept of sensory environment is still on how to create environments for people with autism in the design world (The National Autistic Society, 2015). Architects and designers should be aware how a space feels, sounds, looks, smells and functions can be incredibly influential to how autism children experience their world. Interviewed session Your Autism Magazine with Dr. Magda Mostafa highlighted that the growing population of individuals and families with autism have gained a voice and rise in autism awareness. Thus, the sensory design offered effective architecture to those with challenges and special needs. This topic will discuss briefly on sensory design and focus on safety and security towards the autistic classroom.

3.1 Acoustics

Acoustic is the most important issues in the interior design requirements for autistic children. They are afraid of noise and need a quiet and comfortable environment (Mostafa, 2014;Nazri & Ismail, 2016;Altenmüller-Lewis, 2017). A wide range of noise types were identified that caused distress for young autistic children such as sirens and whistles, bells, unexpected sudden noises, machinery noise, air hand dryers, crowd noise, classroom noise, sharp impact or explosive sounds as such hammering and others(McLaren & Page, 2015). A study showed that good acoustical quality can lead to significantly quieter teaching environments which is particularly important in enhancing the educational outcomes of autistic children. Designers are suggested to consider the level of noise and inappropriate behaviors of children with autism. This is due to their repetitive behavior usually exhibited because of their chronically high level stimulation.

3.2 Colour

The colours play an important role and may affect autistic behavior. Neutral, calming colours and the use of natural materials are best suited for autism-friendly learning environments (Altenmüller-Lewis, 2017; Nazri & Ismail, 2016). They suggested that architect or designer should carefully choose colours to ensure a good balance between the shared and private spaces and avoid disturbing and overly stimulating colours.

3.3 Smell

In addition, autistic children have difficulties and problems with strong smells and even odours. Mcnally et al. (2013) addressed that school kitchens, dining halls, swimming pools and bin areas are all potentially problematic sources of strong smells.

3.4 Lighting

Natural and artificial lighting need to be composed throughout educational facilities. This is because autistic children are sensitive to light. They will avoid a flickering light, once we switch on the pendaflour light (Nazri & Ismail, 2016; Altenmüller-Lewis, 2017). According to Nazri and Ismail (2016), designer should carefully control reflections, glare and shadow patterns of interior spaces. While artificial lighting should be equipped with dim control as to allow for adjustments or designed as indirect light source to create a glowing interior.

3.5 Accessibility

Children with autism having difficulties and stress when they change environment from the comfort of home to the hustle of school environment. Arriving at the school is an extremely important moment for all children.McNally et al. (2013) recommended that architect who designs the school environment should makethis transition as straightforward and as stress- free as possible. This will help to make the experience less stress, more tolerable and hopefully even enjoyable for the autistic child.

3.6 Wayfinding

Complex layouts, long corridors and frequent changes of level can contribute to a feeling of disorientation and create a sense of anxiety to autistic child. According to Mcnally et al (2013), designers should consider the circulation around the school is as clear and comprehensible as possible. Unclear circulation can be potentially distressing for pupils. When the autistic child becomes disorientated or lost it can cause great stress to a child with ASD.

3.7 Compartmentation

Compartmentation is to separate the spaces and to organize the spaces accordingly to its functions and sensory qualities (Mostafa, 2014). The philosophy behind this criterion by Mostafa (2014) is to define and limit the sensory environment of each activity, organize a classroom or even an entire building into compartments. Furniture, floor covering, floor level or lighting could be utilized to separate the spaces. Using transition zones helps the individual recalibrate their senses as they move from one level of stimulus to the next. This will help provide sensory cues as to what is expected of the user in each space with minimal ambiguity (Mostafa, 2014).

3.8 Building Scale

Children with ASD will be calmer in an environment that they can easily comprehend. Small-scale schools or those with simple building layouts offer the most basic surroundings for easy comprehension. The scale of a large school can be daunting for a pupil with ASD. The sheer number of buildings, doors, windows, staircases and the variety of classrooms, corridors, offices and countless other rooms to make up the landscape of any large school can present an stimulating yet sometimes disorienting universe for most children (Mcnally et al., 2013).

3.9 Quiet Room

Children with ASD can begin to demonstrate disruptive behavior when they become tired, distressed or over- stimulated. It needed to allow the children to calm down and in effect 'recharge their batteries.' A quiet room will be an area acoustically separated from but directly accessed from the classroom (Mcnally et al., 2013). It may also be treated as a flexible space, sensory room or as a small reading area that can contribute to the learning environment. A quiet room designated within the classroom itself or alternatively that may be separated but still adjacent to the classroom. Empirical research has shown a neutral sensory environment gives positive effect of such spaces with minimal stimulation, particularly in learning environments to these children with ASD. Such spaces may include a small partitioned area or crawl space in a quiet section of a room, or throughout a building in the form of quiet corners (Mcnally et al., 2013; Mostafa, 2014).

3.10 Safety and Security

An architect and designer should be aware of the need to design the so-called 'architectural barriers'. Arnaiz, Segado, & Albaladejo (2011)mentioned that behavioral problems related to cases of ASD and they would be aggressive at any time. Autistic children have the tendency to escape and run away. Therefore, mechanisms and warning systems that make unobserved leaving of spaces or facilities which are difficult to exit need to be developed. The layout design and setting of the facilities should allow the possible freedom for all users while minimizing hazards, security risks or behavioral triggers for those with ASD (Altenmüller-Lewis, 2017).Safety and security is the most important and concern when designing learning environments. Vulnerable children may have difficulty in realizing the dangers inherent in their environment and may have an altered sense of their environment. Designers should be aware of the fittings to protect the ASD children from hot water and an avoidance of sharp edges and corners (Mcnally et al., 2013; Mostafa, 2014).

Creating a safe environment can be a challenge. Designers need to pay attention to both physical hazards (wiring, open stairways, unscreened windows, loose flooring, toxic paints, etc.) and emotional safety and security. This is because children with ASD are often prone to seizures and behaviors like tantrums or "stimming," where injury to self and others can occur(Vogel, 2008). Behavioral problems are frequent in cases of ASD where their aggressive conduct may arise, and, therefore, elements present in the built environment must be designed and chosen bearing in mind the possibility of abuses. In particular, bathroom equipment, lighting fixtures and mechanisms, hardware, banisters, wall and floor tiles must be well anchored (Arnaiz et al., 2011).

According to Scott (2009), containment in the class base for reasons of supervision, safety or security by the use of two door handles, at high and low-level, must neither compromise escape procedures, nor violate human rights. In this situation, children must not be locked up unless they are secured or detained legally in secure provision. Scott (2009) also highlighted that robust materials should be used where there are pupils with severe disabilities. In cases like severe disabilities safety precautions for doors, windows, glass, plaster and piped or wired services will be required. He recommended designers to balance security and independence and to find the right mix between tough materials and special equipment on the one hand and ordinary, at the same time eliminating risks.

3.11 Garden

Autistic children responded positively in the garden. Exercise in a natural environment may promote directed attention and social interactions among autistic, which may positively influence exercise intentions (Hansen, Blakely, Dolata, Raulston, & Machalicek (2014); Rogerson, Gladwell, Gallagher & Barton (2016)). Research done by Hussein (2011) explored how autistic child utilized the garden She revealed the highest number of users, use of sensory gardens by observing the zones and she discovered the pathways that link the sensory garden to the site context which continuous pathways with easy access to the features. In addition, autistic children spent a longer time in zones where sensory provided rather than aesthetic values emphasized.

3.12 Alternative

The art therapy area incorporates various activities such as painting, printing, sculpture and pottery give benefits to autistic child. Activities located outside the classroom with natural lighting creates an enjoyable and creative environment. Pre-vocational and artwork workshop can be integrated to help students create beautiful and functional objects such as simple furniture, leather goods and home accessories (Mostafa, 2014). Pet therapy is also an alternative therapy for autistic children through increased social interaction and communication as well as reduced problem behaviors, autistic severity, and stress (O' Haire, 2013).

4 RESEARCH DESIGN

The quantitative method for this study was based on Creswell (2003) suggestion where survey would facilitate the study. The data collections involved at least three methods for triangulation - questionnaires, personal on-site observations and documentation.

4.1 Experiencing Autism

Based from reviewing previous literature, the researchers have identified relevant issues and problems regarding autism, sensory issues and physical learning environment. The researcher search information on autism behaviours, characters and environment by doing intensive literature review in order to understand their needs. The identification of related issues, establishment of problem statement, identification of research objectives, research questions and research methodologies used are explained in this first phase.

4.2 Preliminary Exploration

Initial site visit were conducted during this stage accordingly to ensure relevant variables obtained as mentioned in literature search. Pusat Permata Kurnia (PKK)was selected because it is the first Autism Centre in Malaysia facilitated by the Malaysia government and located at Sentul, Kuala Lumpur, which is in non-urban area. The preliminary exploration methodology involved site visit, personal observations (photograph), documentation (Design Criteria Checklist)and interviews with the interventionists.

Before visiting the site, the researchers had prepared Design Criteria Check List that was based on a research done by McNally et al (2013). Design Criteria Checklist is part of benchmarking tool assisted in identifying the design criteria in autism centre. The identification involves a series of statements, which encompasse four areas – physical building, internal environment, sensory issues and sensory space.

The physical building dealt with building entrance, building scale, safety and security. The internal environment dealt with personal space and movement, way finding, legibility, threshold, classroom, toilet, windows, playroom and quiet room. The sensory issues dealt with visual distraction, sun and glare, lighting, acoustics, smell and colour. Lastly, the sensory space dealt with calm, low stimulus spaces. Finally, yet importantly is the factor on safety and security which are elaborated in the findings.

5 FINDINGS

The results of the study highlighted factors that relate to the quality of physical learning environment. Based on the design criteria checklist it showed that the criterion has been taken into consideration at early design phase.

5.1 The Physical Building

The institution building designed the building into doublestorey. McNally et al (2013) explained that the larger schools can be disorientated and frightening places for autistic children. ASD children would be more tolerable and hopefully joy when they arrive to school. The entrance

designed as straightforward and stress-free for them. The design criteria check list for the physical building is showed in Table 1.

Table 1 The finding of physical building

	PHYSICAL BUILDING	YES (√)	NO (X)	COMMENTS
1.	**Building Entrance**	√		Straightforward transitions, however double volume spaces provided at drop off area.
2.	**Scale and Organisation** ▪ Classrooms grouped around a shared resource base. ▪ Courtyard shared area as an identifiable grouping or cluster.	√ √		2 storey height institutional building. The classroom and courtyard shared base.
3.	**Safety and Security**	√		Access to and from the school is secure and the children are monitored at all times.

5.2 Internal Environment

The internal environment has been designed to comprehend the ASD child's impairment. The overall findings for internal environment are tabulated in Table 2.

Table 2 The finding of Internal Environment

	INTERNAL ENVIRONMENT	YES (√)	NO (X)	COMMENTS
4.	**Personal space and movement**	√		Allowing extra space for circulation, especially at corridors and classrooms itself.
5.	**Wayfinding** ▪ Complex layouts ▪ Long corridors ▪ Frequent changes of level	 √	 X X	The circulation around the school is clear and comprehensible.
6.	**Legibility**	√		Personalising rooms using individual colours or objects to facilitate association for autistic children.
7.	**Threshold**	√		A seated space within the classroom or in the form of a recess in a corridor provided.
8.	**The Classroom** ▪ Feel comfortable and relaxed. ▪ A place of security and familiarity. ▪ A safe place to seek refuge from the chaos. ▪ The classroom environment is in order and routine and the pupil should know where each activity will happen and when. ▪ The identification of one activity with one area (zone within the classroom).	 √ √ √ √ √ √		The choice of colours, textures and materials are carefully selected physiologically, psychologically and therapeutically. The classroom was painted in light blue colour and off-white colour which consider as neutral and calming colors for the ASD.

	▪ Illustrated by a visual timetable and located in a prominent position in the classroom.			
9.	**Toilet** ▪ Ergonomic ▪ Sound ▪ Smell	 √ √ √		Toilets & pantries are provided as part of a toilet training programand also the living skill program.
10.	**Windows**	√		Provision of blinds to windows in order to minimize distraction.
11.	**Playroom / Activity Room** ▪ A classroom has access to a secure external play area associated only with that class or age group. ▪ This area can then be linked to a large play area for the entire school population.	√ √		The activity room was painted in light blue colour which consider as neutral and calming colours for the ASD.
12.	**Quiet Space**	√		Spaceprovided at nearby the classroom to allow the child to calm down.

5.3 Sensory Issues.

The designer has considered sensory issues, especially on visual distraction, sun and glare, lighting, acoustic and smell. The autistic children avoid bright shiny surfaces, strong texture, bright colours, bright sunlight and fluorescent lighting. The overall findings for sensory issues are explained in Table 3.

Table 3 The finding of Sensory Issues

	SENSORY ISSUES	YES (√)	NO (X)	COMMENTS
13.	**Visual Distraction**	√		The choice of colours, textures and materials are carefully selected physiologically, psychologically and therapeutically. The classroom was painted in light blue colour and off-white colour which consider as neutral and calming colors for the ASD.
14.	**Sun & Glare** ▪ Bright sunlight and glare can be disruptive for any class, especially so for pupils with sensory sensitivity.	√		Provision of blinds to windows in order to minimize distraction.
15.	**Lighting** ▪ A range of softer lighting provided to create a more calming environment.	√		Care has been taken in choosing artificial lighting.
16.	**Acoustics**	√		Care has been taken with choosing material.Acoustic panel provided at music room & assembly hall.

17.	**Smell**	√		School kitchen and dining hall have taken care in terms of smell. Location- away from the learning area. Swimming pool provided and located away from learning area.

5.4 Sensory Space.

ASD children having difficulty during their Meal times, PE time and break times. In PPK they allow the special space for ASD children to sit and calm down so that they can be familiar with their surrounding environment. Table 4 shows the findings of sensory space.

Table 4 The finding of Sensory Space

	SENSORY SPACE	YES (√)	NO (X)	COMMENTS
18.	**Calm, low stimulus spaces** ▪ ASD child love to see their work displayed. But too much display may distract them. ▪ All storage could be accessed directly from the classroom. ▪ Low arousal colours or calming pastel shades on walls, floors and ceilings.	√ √ √		Interventionist has determined what & how much to display. Care has been taken when choosing colour and materials forstorage etc. The wall was painted in light blue colour. The selection of floor material – non slip vinyl in light blue colour which isa neutral and calming colour for the ASD.
19.	**Engaging with others** ▪ Provision of respite places, where children can rest or pause momentarily to collect themselves, can be beneficial.	√		A rest space provided with a safe location from where the pupil can watch the others without being completely removed from their activity. Similarly a recess with seating along a corridor or circulation area has provided a refuge for pause or rest.
20.	**Safety and Security** ▪ Any escape path from the classroom to the exterior is hampered by the action of at least two doorways	√		Provided to ensure the safety for ASD child.
21.	**Garden**	√		Sensory garden provided.

6 CONCLUSIONS

This paper focuses on a design criteria checklist for Pusat Permata Kurnia (PPK). The result shows that most of the criteria have been considered by an individual who is an architect and a designer. This is because the architect is a mother who has an autistic child. She explored the autistic environment and transferred an idea to PPK in order to ensure the conducive and quality of the physical learning environment that can accommodate the needs of autistic children. In future research is needed to measure the conduciveness of autism center base on the design criteria checklist. However, the measurement would be more specific using 'Likert scale'. Creating a conducive learning environment should not only optimize the classroom environment but also upon a parent's and teacher's satisfaction. It is hoped that the architects and designers could create an appropriate environment to enhance and develop autistic behaviors, emotional and would accommodate autistic

children to live their lives like normal children. Hence, this research could contribute towards the creation of a quality environment for autistic children within the Malaysian context.

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