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A Study on the Multisensory Interior for the Environmental Experience of Students with Down Syndrome

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***Abstract*—This paper seeks to study on the multisensory interior for the environmental experience of students with Down syndrome. A multisensory interior that enables students to sensorially engage on multiple levels is envisioned to facilitate them indirectly as to supplement the scheduled multisensory therapies in special rooms. Data are collected through an online questionnaire and a self-developed checklist as the 'schedule of accommodation'. 89.1% of respondents agreed that it is important for students with Down syndrome to have a space specially designed for them considering their significantly low muscle-built, showing preference on bright colours and a combination of polygonal and organic shapes. The study also included interviews with experts, on-site measurement and case studies of existing centres for Down syndrome. The collected data are analysed to develop a conceptual design proposal. The study is believed to have a research expand potential in the psychological effects on learning quality in general.**

Keywords—Multisensory interior; environmental experience; Down syndrome; conceptual design; applied psychology.

I. INTRODUCTION

There are a total of 845 students with Down syndrome recorded and registered up until 2012 as collected by the Malaysian Ministry of Health. In the national school system; the students may be registered to either: 1) Special Education Schools; 2) Special Education Integrated Programmed or 3) Inclusive Education Programmes; as stated in UNICEF June 2014 Inclusive Education Malaysia issue brief. Students with Down syndrome have an apparent exterior and body stature - transverse palmar creases; clinodactyly; brachydactyly and sandal gap as a part of their distinct limb features as listed [1] which require special practice of exercises to strengthen their muscle tone Multisensory techniques are frequently used for students with Learning Disabilities (LD) to stimulate learning by engaging students on multiple levels while encouraging them to use all their senses. As compiled in Study Guide for Psychology; multisensory integration is defined as: Multisensory integration; also known as multimodal integration; is the study of how information from the different sensory modalities; such as sight; sound; touch; smell; self-motion and taste; may be integrated by the nervous system. A coherent representation of objects combining modalities enables us to have meaningful perceptual experiences.

A multisensory interior is the design of the interior that is intended to incorporate the multisensory learning techniques into the building envelope creatively in design form. [2] stated that there has been an encouragement to design children's hospitals for the specific needs of the children and the family where planners and architects have put their best skills and talent into application in building design solutions that have positive impacts on the health and safety. He also mentioned that the challen ge for future designer is to create a more pleasant yet cost-effective interior care facilities for children with disabilities.

Hence; this paper seeks to study the multisensory interior for the environmental experience of students with Down syndrome. It is also meant to see the relationship between design; psychology and how it potentially affects the learning experience for students with Down syndrome in particular; and Malaysian public school students in general for future research.

II. METHODOLOGY

A. Case study and observation

Several visits have been done locally to Rumah Persatuan Sindrom Down Malaysia (PSDM) at Jalan U-Thant and TASKA Anak Istimewa Sindrom Down (ANISD) at Putrajaya to have an on-site measurement and observation on the required spaces for students with Down syndrome. The Rehabilitation Centre for Down Syndrome at Azerbaijan is chosen as the international case study for design reference.

B. Interview

A scheduled interview is done with the then President of Persatuan Sindrom Down Malaysia (PSDM) with specific question on care-taking kids with Down syndrome and the importance of surrounding factors that could facilitate their

learning. Another phase of interview is through a non-directive interviews with the caretakers; parents of students with Down syndrome; as well as the therapists on the idea of having a Down syndrome community.

C. Questionnaire

The questionnaire which is done through an online survey has a total of 44 items divided into four main sections. Part 1A: Demographic Background is for the background of the respondent consisting the gender; age; nationality and educational background status of the respondents. Part 1B moves towards the general understanding and awareness of the participants on Down syndrome.

For respondents that answered 'Yes' for question 'Have you experienced taking care of a child with Down syndrome'; they are redirected to Part 2: Care-taking a Child with Down Syndrome. For respondents who answered 'No'; they are redirected to Part 3: Perception of Design. Part 2 seeks to observe the relationship of the caretaker with the students with Down syndrome and their perception on daycare or centre for Down syndrome.

For participants who have been to any centre for Down syndrome; they proceed to Part 3: Current Design where participants are asked to evaluate the interior conditions based on their perception. Lastly; Part 4: Perception on Design is compulsory for all participants. This part deals with overall perception on interior design for students with Down syndrome.

D. Schedule of Accommodation

To propose a conceptual design idea; a draft schedule of accommodation (SOA) is then developed as a checklist table to determine the required area. The SOA categorises the items for each space as 'Zoning'; 'Activity'; 'Users'; 'Pax'; 'Facilities/Equipment' and 'Area'. An example of the table is as follows:

TABLE I A PORTION OF THE CHECKLIST TABLE THAT WAS DEVELOPED TO DETERMINE THE REQUIRED AREA BASED ON THE SPACES.

Space	**Zoning**	**Activity**	**Users**	**Pax**	**Facilities/ Equipment**	**Area (m^3)**
Occupational Therapy	Private	Fine motor activities; arts and craft; messy play; handling	Children and Teachers	20-30	Stationeries; art tools; clay; cutlery set	

III. RESULTS

A. Part 1: General Knowledge

50% of the respondents evaluated their knowledge on 3 from 1 to 5 Likert scale; indicating that they have an average understanding on Down syndrome.

B. Part 2: Care-taking

Only a total of 34 respondents or 20.5% who answered 'Yes' to the question "Have you experienced taking care of a child with Down syndrome" in Part 1 of the survey are redirected to this part (**Fig. 1**). A total of 61.8% of the respondents are parents and siblings of students with Down syndrome.

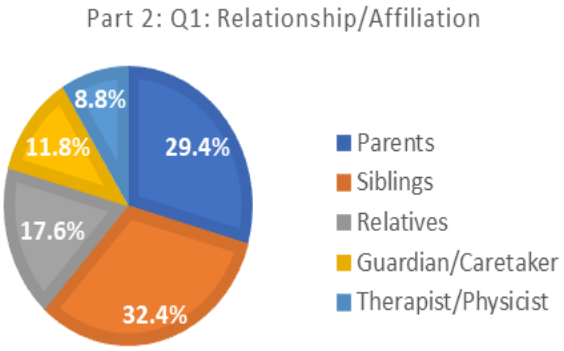


Fig. 1 *Relationship of Respondents with a Child with Down syndrome*

58.8% of the respondents either worked at or send their child to an educational therapy centre. The main reason that contributes to the choice of working at or sending their child to a daycare or centre is 'Environment' at 61.9%; followed by 'Service' (28.6%). It can be concluded that the respondents are indeed aware on the importance of having a well-built environment for the therapy of their students besides the specific services offered.

C. Part 3 and 4: Current Design and Perception on Design

From 56.1% of respondents who do know that students with Down syndrome have hypotonia; 89.1% of them agreed that it is important for students with Down syndrome to have a space specially designed for them while 8.5% feel neutral about it. 76.5% of the respondents preferred combination of organic or circular and polygonal or building blocks as suitable for future design of centres for students with Down syndrome. 51.2% of the participants of the survey respond to Colour Scheme B as the most preferred colour scheme for the play area (**Fig. 2**).

a. b.

Fig. 2 *Results of the Public Preference of Design based on Perception where:*

a) *The figure as option for Combination of both Organic and Polygonal Shapes*
b) *The figure as option for Bright Colour Schemes*

Respondents are also asked to rate the general and interior aspects of of existing centres for Down syndrome (**Fig. 3**):

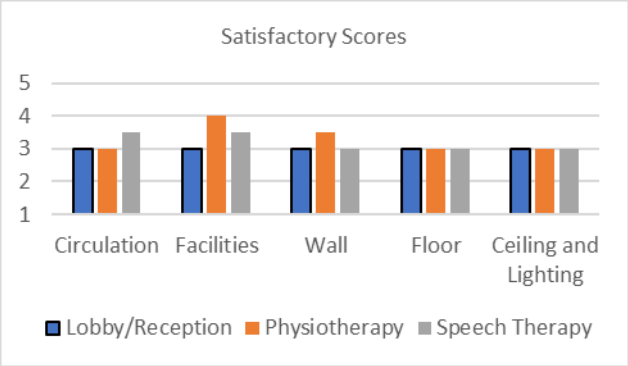


Fig. 3 *Summary of Satisfactory Scores for general and interior aspects of existing centres for Down syndrome*

IV. Discussion

A. Designing a Learning Environment for students with Down Syndrome

Respondents are generally satisfied with the current design of existing centres for Down syndrome; but welcome thorough design thought and interference for a prospective improvement. The behavioural and physical condition of students with Down syndrome should be considered when designing a learning environment for them. Pinantoan (2012) highlighted that hypotonia may affect how the students perform hence ergonomic desk size and writing tools can make a big difference to help them learn better. It is also important to integrate various psychological approach in designing such as visual perception and developmental psychology.

B. Visual Perception

Students or students can see and understand things better when they are able to look at the larger and global images [3]. Children need intact visual perception for them to be able to understand; evaluate and interpret what is seen [4]. It is vital for the students to have a good visual perception in performing daily life skills as deficits in visual perception might affect their self-esteem and motivation especially in a classroom. Shijomo [5] stated that neural activity in early visual cortex (vision) is necessary for conscious experience of perception; and that neuronal connections and interactions at these levels are reflected in the content of perception of the child. It is important for school management to know the importance of having a good design of classrooms to help students in their learning.

51.2% of respondents agreed that students with cognitive impairment are more attracted with bright colours such as yellow and red; and 76.5% of the respondents also agreed on having organic or circular and polygonal or building blocks as the learning aids for Down syndrome child. This showed that having objects to hold and see in classroom might help those students with cognitive impairment to learn better.

C. Developmental Psychology

[6] believes that there is an additional need for babies and children with Down syndrome to grow. [7] wrote that exercises can improve gait and posture; breathing and the fitness of students and teenagers with Down syndrome in general as many of them are considered overweight and have the tendency to gain even more weight after puberty. In terms of social development; 86% of teenagers with Down syndrome had their own bedroom with up to 70% proudly keep their room tidy. They are also encouraged to care for all the domestic tasks for vocational practices which may include laundry; bedroom making as well as starting to learn some cooking skills in small steps with supervision.

Based on [8]; children with Down syndrome usually learn and progress slower than normal children. [9] stated that the environment itself is conceptualized as the changing agent in the child development process and this applies to almost all children regardless of their mental state. This finding showed that learning environment for children; especially in school – especially those with special needs – is important in helping them to learn.

C. Significance of Psychology in Designing a Learning Environment

[10] a good design is when psychology and technology are understood to put human needs; capabilities and behaviour first in designing. With an envisioned set of goals; a design team's investigation would have focused on the understanding of environmental psychology specifically how physical and psychological aspects may influence a student's ability to concentrate; promote a willingness to collaborate as well as communicate a sense of collegiality [11].

Conceptual Design Proposal

With regards to the survey results and literature reviews on multisensory activities and psychological approaches in designing for students with Down syndrome; a conceptual multisensory interior is proposed. The following shows a

sample of the design on Ground floor; which is the main area with main therapeutic functions. Although the play area is designed in such a way the students are playing around and at the same time enhancing their muscular strength; this main play area are let vast to allow conventional therapy tools. It is designed so that the students may explore the area in a playful mood. **Fig. 4** shows sample of rendered drawing for Ground Floor followed by **Table 2**; a sample tabulation of a design proposal.

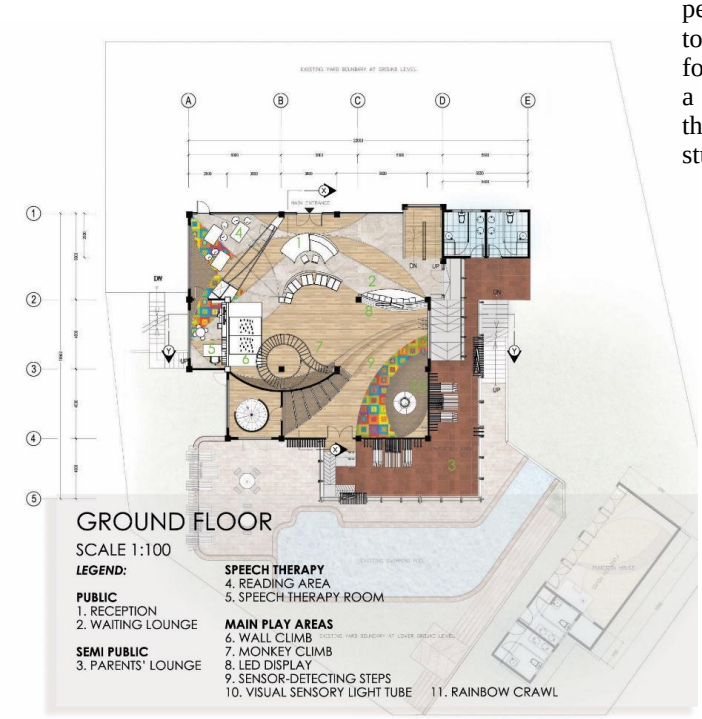
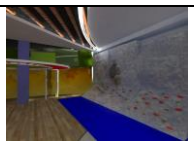


Fig. 4 *Rendered Floor Plan of Ground Floor (NTS)*

TABLE II SAMPLE TABULATION FOR DESIGN PROPOSAL

No.	Area	Purpose	Proposed Visual
1.	Play area: Climbing	Monkey and wall climbing for body and arm strength	
2.	Play area: Rainbow crawl	Rainbow panels with light windows to encourage arm reach and crawl hole to enhance arm; leg and abdominal muscle.	
3.	Play area: Light tube	Custom irregular steps with illuminated bamboo railing that leads to the light tube for visual simulation and tracking practice	

V. CONCLUSION

The development of various sensory centers in the brain depends on the stimulation of the respective senses through active engagement with the environment [12]. The idea of having a multisensory interior is proposed to provide a pleasant and meaningful environmental experience for students with Down syndrome to trigger and better develop their senses instead of depending on loose sensory tools and educational toys. It may be deemed impossible to provide a perfect learning environment for everybody; but it is possible to provide some general insights and outlines. This paper had focused on the potential physical and psychological effects of a multisensory interior for students with Down syndrome but there are several limitations that can be looked into for future studies:

1. The study only collects data on the perception of design and its potential effects based on the respondents' perception and psychological theories rather than measuring the real impact due to the conceptual nature of this design proposal.

2. The study collects responses from the public rather than a specific target group especially the first-hand users.

3. Individuals with Down syndrome covers a wide spectrum of physical; cognitive; and social characteristics and abilities hence focusing on the muscle build alone may be insufficient to design a space that caters to their actual needs.

It is recommended for future researchers to address these flaws to further expand the study on the impact of a multisensory interior towards the environmental experience of students with Down syndrome. Furthermore; future research may also be done to study how a well-thought design of a school impacts the learning experience of mainstream students in the Malaysian public school by applying the visual and developmental psychological theories.

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