MAJ
Malaysia Architectural Journal

Implementation of Advanced Sound and Visual Technology to Increase Architectural Space Quality for in Proposed Autism Explorative Edupark Centre in Kuala Lumpur

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Received: 15th June 2022 *Final version received: 01 Aug 2022*

In the modern era, visual technology offers significant impacts, especially in the architecture industry and sound technology. It is known that this modern civilisation is ocular-centric and relies heavily on visions. However, a thorough understanding of the aesthetic of visuals and immersive sound technology, especially towards the community with different abilities (this study focus on the autism community), may enhance the spatial planning is poorly known. Visuals and sound have influenced each other and brought us the most surprising outcomes. Sound and visual has advanced as a digital information method and have immersed into all life features, including giving impacts on visual perception in terms of architectural spatial design quality. Advance sound and visual technology – the extended reality technology has been implemented in a variety of fields these recent years, including medical, industrial design, modelling and production, entertainment, and leisure activities, interior and exterior design, virtual friends, the internet of things, as well as spatial design enhancer. This research aims to study the impacts of integrating state-of-the-art sound and visual technology in enhancing architectural space quality to elevate the engagement between architectural space and users with autism spectrum disorder (ASD). This research is based on data obtained from a survey questionnaire that polled autistic child's perceptions and acceptance regarding integrating state-of-the-art sound and visual technology in architectural spaces.

Keywords: Autism Spectrum Disorder, Advanced Technology, Sound and Visual

1. INTRODUCTION

"Human brain is primarily an image processor, the part of the brain used to process words is quite small compared to the part that processes visual images," says Dr Haig Kouyoumdjian from Psychology Today. From the statement, it is proved that visuals are essential in our lives. According to a study, autism spectrum disorder (ASD) is a group of neurodevelopmental, mental diseases defined by difficulties with sociability, communication, and restricted patterns of interest that affects one out of every 59 people (Rodríguez, Rotbei, Banos, Gil, & Medina, 2021). Autism was identified as a disorder by psychiatrist Leo Kanner in 1943. A later study by Jeffrey and Baker (2013) shows that Dr Leo Kanner could identify 11 pupils who were providing comparable outputs in behavioural activities. Autistic persons perceive, hear, and feel the environment in ways other people do not. They tend to have repetitive behaviour and are easily affected by sensory sensitivity. Hence, architects and designers shall focus on essential elements such as acoustic, lighting, spatial

configuration, and materials to create an autistic-friendly space. These elements are closely affecting the sensory sensitivity of the autistic community.

Sounds and visuals are of the utmost importance in architectural spatial design. The process of how these elements influence each other has brought the most surprising outcomes, referencing the existing conditions. Architectural acoustics emerged in the second part of the twentieth century (Joanna Jablonskaa, 2015). Builders, composers, architects, and performers have all tweaked their work depending on their previous experiences to obtain the finest possible spatial and acoustic effects. As architecture affects humans emotionally, it shows that the sense of architectural space is not merely a subject of theoretical conceptions but is also something that happens in ordinary people's lives (Spence, 2020). When we think of space as a living organism capable of stimulating our senses, it opens a whole new universe of sensory clues just waiting to engage with the occupant's senses. Light and shadow, colour and contrast, scale and proportion, textures and materiality, rebounding sound, shifting temperatures, seducing fragrances, and many more are all part of this universe of sensory information.

This study explores the best possibility of audio and visual technology integration with architectural spaces to enhance the quality of spaces for the autistic community. In particular, the reactions and responses of autistic children towards the integrated sound and visual technology in designated spaces will be observed and analysed. The research objectives were as follows: (1) to analyse the state-of-the-art sound and visual technology toward autistic children's reactions and perception; (2) to observe the influencing factors that enhance the efficiency of the sound technology in architectural design; and (3) to explore the relationship of architectural space design and the behaviour of autistic children.

2. LITERATURE

Integrating state-of-the-art sound and visual technology with the architectural spaces for the autism community is then studied to focus on the efficiency in enhancing users' acceptance and perception of areas. It will then be used as guidelines for designing spaces to improve inclusivity for people with disabilities in the community.

2.1 Basic Architectural Spaces

In a study by Christina M. (2013), 'space' has occupied a significant role in architectural discourse throughout the twentieth century. A few twenty-first-century publications indicate that interest in this concept is unlikely to wane soon. American architect Claude Bragdon (2005) perceived space as a principal architecture category. From the current vantage point, the relationship between architecture and space may appear natural and self-evident.

Existing research has dated the term 'space' in architectural terms. It was not until the 1890s that vocabulary became an essential architecture category. Meanwhile, Poppelreuter (2012) stated that according to Franz Lowitsch (1928), architectural environments differ in terms of characteristics, which are referred to in German as '*Raumwirkung*' and can be roughly translated into English as experience qualities. The phenomenon is highly prevalent and easily verifiable by examples, but it eludes early attempts to grasp it. Despite precise needs, the consideration of experiential qualities in architecture is intuitive or normative; systematic or even scientific information appears to be frequently lacking, and they do not play a decisive or defined role in the practical design and building process.

2.1.1 Relationship between Architectural Space and Human Behaviour

It is said that human functioning depends on information. The reciprocal link between spatial features and intuitive human reactions has been the subject of several hypotheses. A German professor of geography who is also the theorist of the concept of determinism, Friedrich Ratzel (2019), once asserted that the physical environment governed all human behaviour and actions, and humans were seen as 'passive agents' (Hong S. 2010). Canter (2001) and Valena (1994) mentioned that the experience of natural settings is one source of human interest in properly planning architectural space. As a result, the deliberate separation of length and the related allocation of meaning (in this case, sacral-profane) were fundamental to the act of making architecture.

2.2 Autism Spectrum Disorder

From the first reports of autism to the current day, the description, diagnosis, and theoretical understanding of what are now recognised as

autism spectrum disorders (ASDs) have been evolving (Volkmar, 2015). The word "autism" was used by the Swiss physician Bleuler in 1911 to characterise a subset of symptoms noticed in schizophrenic patients. These patients were said to have retreated into their inner world and become disconnected from outward reality. Nonetheless, this word was not used to characterise people whose only problem was with social communication, and it was not used to youngsters.

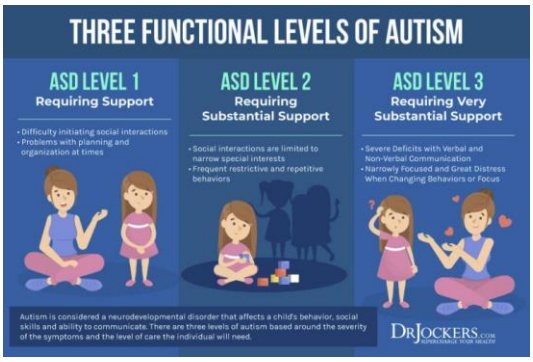

Figure 1: Level of ASD

2.3 Autistic Friendly Architectural Space

As the number of people diagnosed with ASD continues to increase, demand increases for environments that fit the needs of families dealing with the social challenges associated with ASD. ASD has become the fastest-growing severe developmental disability in Malaysia. Based on research by White (2011), calming behavioural reactions came mainly from occupational therapy resources and parents responding to various types of therapy for their children. Occupational therapists have extensively researched play therapy and how it affects behaviour in children with ASD. These resources benefit understanding the targeted audience because they give insight into what methods will work best for visitors to process the information being presented. Mostafa (2008) stated that by adequately understanding the mechanisms of ASD and the requirements of autistic people, this environment might be better structured to change sensory input, possibly modify autistic behaviour, or at the very least provide an atmosphere favourable to skill development and learning.

2.4 Acoustic

According to Caldwell (2006), acoustics is one of the most crucial elements in designing interiors for children with ASD. Baguley (2013) stated that most people with ASD live with auditory hypersensitivity. Music as a part of acoustic elements strongly influences autistic persons because it serves as a medium for engagement, social growth, and emotional development without requiring words (Quintin, 2019). Rhythm, on the other hand, is significant for learning, development and performance as many motor control and cognitive activities rely on movement timing (Thaut et al., 2009). The better autistic children grasp auditory information, the better they will understand their social and intellectual world (Autism Research Institute, 2013).

2.4.1 Mono Audio, Stereo Audio and Surround Audio

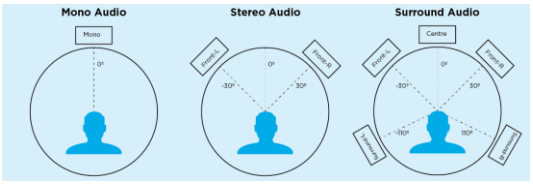

Figure 2: Type of Audio

According to an article, mono (meaning one) audio is a one-channel audio format that is one of the most broadly utilised. All audio is delivered through one channel for playback in mono (Anthony Mattana, 2022). The generation of sound using several audio tracks is referred to as stereo sound. It produces the illusion of sound originating from diverse directions and is far more successful than single-channel, mono audio systems at simulating the feeling of natural sound. Stereo sound is often produced by a network of at least two speakers spaced regularly from a listener.

As for surround audio, they have described the sound surrounding you. It entails placing a speaker in nearly every corner of the space and beaming high-quality digital sound at you from every angle, precisely as in a movie theatre. Surround sound audio also provides good variety, with deep, booming bass rattling the flooring when an explosion occurs on the screen and soothing sound effects skittering and tapping behind you in a scary scenario. In music, it refers to a song's total auditory envelopment. A surround sound system consists of several speakers—

typically five, including the centre speaker—and a subwoofer for solid bass. The word "5.1" refers to the combination of five speakers plus a subwoofer. (Casey, 2021)

3. METHODOLOGY

This research is conducted to measure users' perspectives towards the presence of sound and visual technology, predominantly focusing on the perception of the autism disorder community. A quantitative research method was conducted through questionnaires by distributing an online survey form. The questionnaires were generated online using Google Forms and distributed through social media such as Facebook and truncated WhatsApp apps. Twenty correspondents of autistic children's caregivers had filled up the surveys. It consists of three sections of 20 questions related to ASD child background, their behaviours towards sound and visual and preferences. The questionnaires were divided into four (5) parts:

- PART A: Demographic
- PART B: Autism Spectrum Disorder
- PART C: Child Preferences
- PART D: Elements of Architectural Design for Children with ASD.

Primary data need to be collected to analyse the impact of sound and visual technology in architectural spaces' quality in the autistic community. Questionnaires and observations of the target community were conducted. Target respondents are the guardians/parents of autistic children and medical officers/doctors. The collected data were then analysed for further research on the impact of sound and visual technology on autistic children and their preferences for elements of architectural spaces. Two interviews with medical experts on ASD children were also being regulated further to understand the issues with ASD children and their importance.

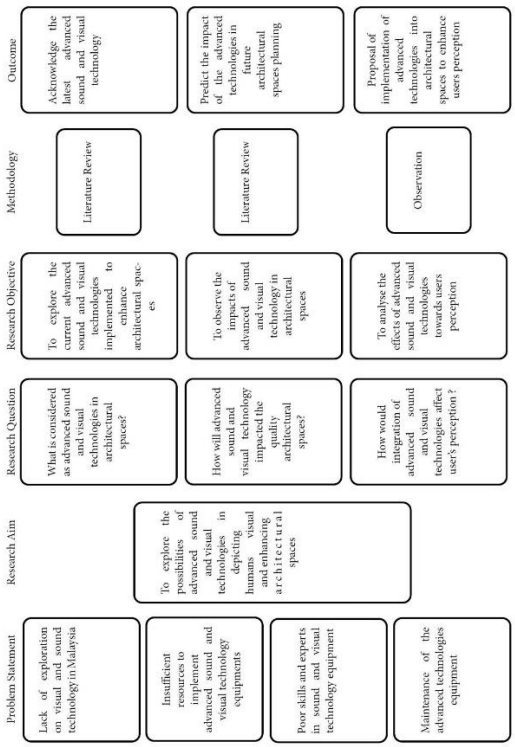

Figure 3: Research Framework

4. FINDINGS

This study aimed to look at the impact of specific acoustic and visual settings in architectural environments on autistic children's behaviour. The study focused on the effects of varied auditory and visual backgrounds on the psychology and behaviour of autistic children, as well as the design of architectural spaces.

4.1 Part A: Subject Demographics

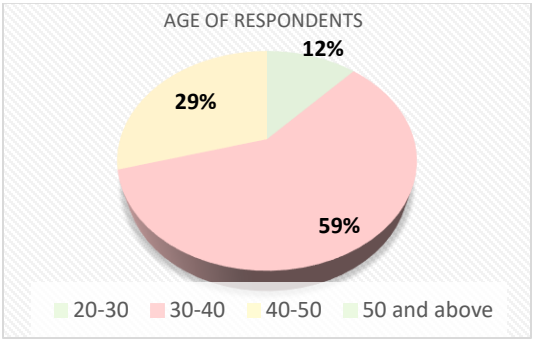

Figure 4: Age of Respondents

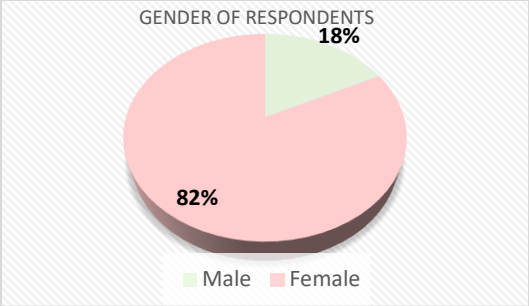

Figure 5: Gender of Respondents

Figure 4 and Figure 5 shows age and gender of respondents. Figure 4 shows that majority of the respondents are aged between 30 to 40 years old. Meanwhile in Figure 5, it is stated that majority of the respondents are female.

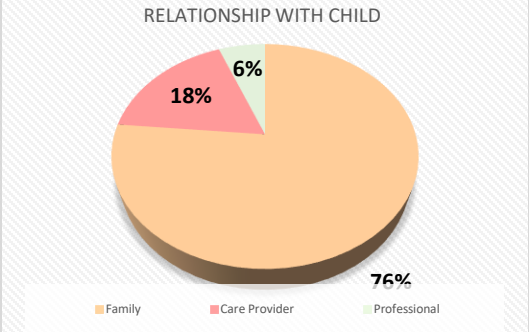

Figure 6: Relationship with Child

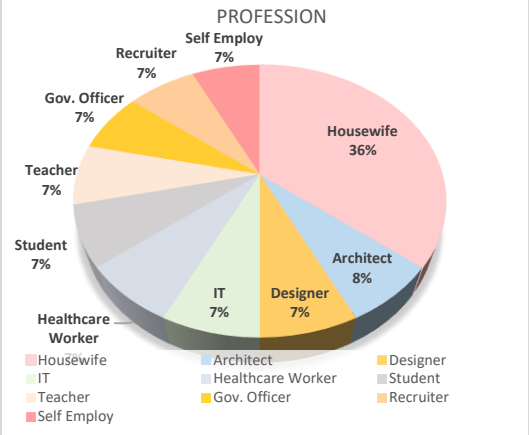

Figure 7: Profession

Figure 6 shows that most of the respondents are a family member of an autistic child, with minorities are the care provider and professional. Figure 7 shows the careers of target respondents.

4.2 Part B: Autism Spectrum Disorder

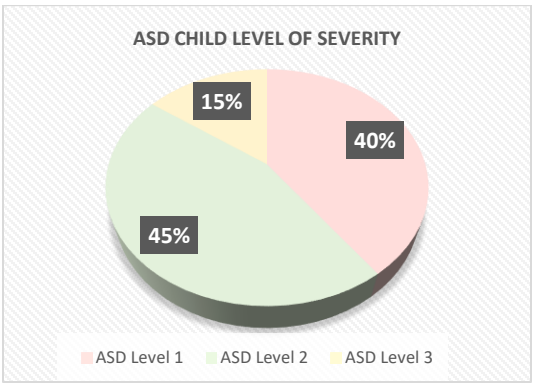

Figure 8: Level of Severity

Figure 8 shows the level of ASD Children that are related to the target respondent. 45% are on ASD Level1, 15% are on ASD Level 2, 40% are ASD Level 3.

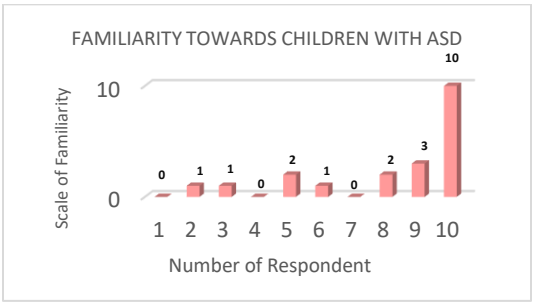

Figure 9: Familiarity with Children with ASD

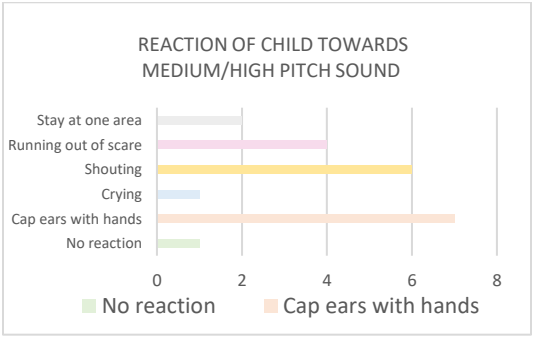

Figure 10: Reaction of Child towards Sound

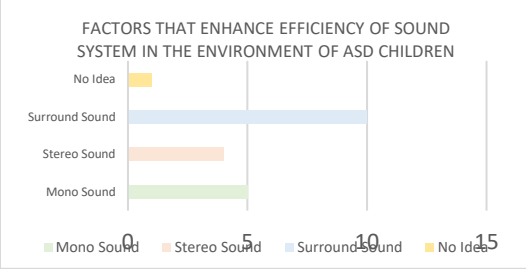

Figure 11: Factors of Sound System Efficiency

4.3 Part C: Child Preferences

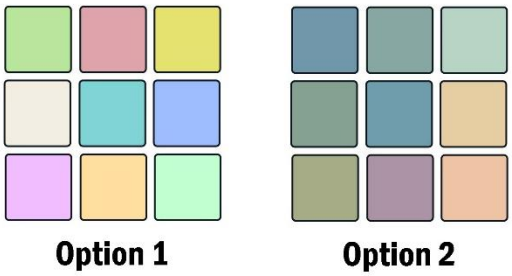

Figure 12: Colour Palette Options

Based on author's research throughout the studies, author comes out with the possible colour palette that will work best with autistic children. According to Figure 12, option 1 portrays more attractive colour rather than option 2, However, some autistic children could not handle the overloading sensory effects given by option 1.

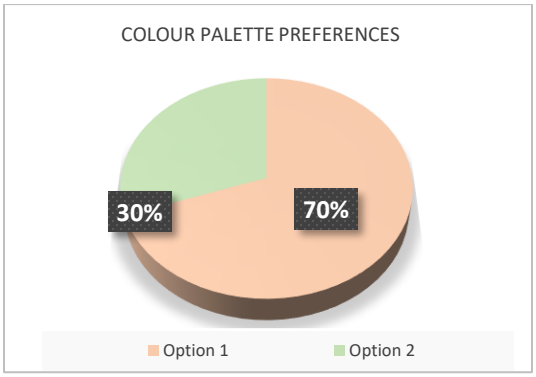

Figure 13: Colour Palette Preferences

Based on chart 23, 70 percent of the respondents agrees that ASD child prefers colour palette option 1 rather than option 2.

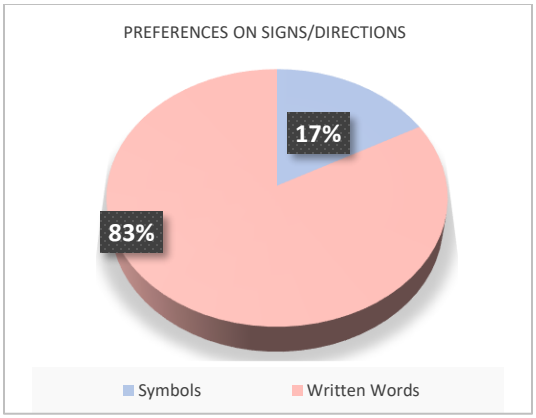

Figure 14: Preferences on Signs/ Directions

The last question as state through Figure 14, 83 percent of respondents agrees that written words work best towards their child, meanwhile another 17 percent prefers symbols.

4.4 Part D: Elements of Architectural Design for Children with ASD

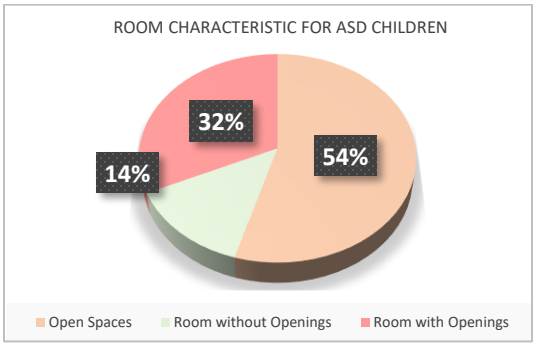

Figure 15: Room Characteristics for ASD Children

Figure 15 shows attributes of room characteristic that suits children with ASD. 54 percent of the respondents agrees with open space environment, 32 percent goes with room with openings and the other 14 percent agrees with room without openings.

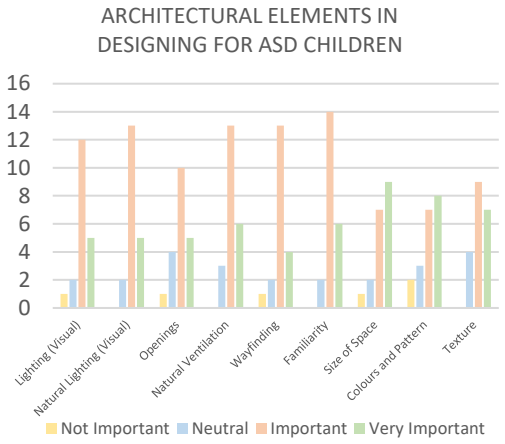

Figure 16: Architectural Elements Preferences

The follow up surveys are on the importance of architectural elements in designing for ASD children. Question was constructed in a multiple-choice grid manner. Answers were then tabulated in a bar chart manner namely Figure 16.

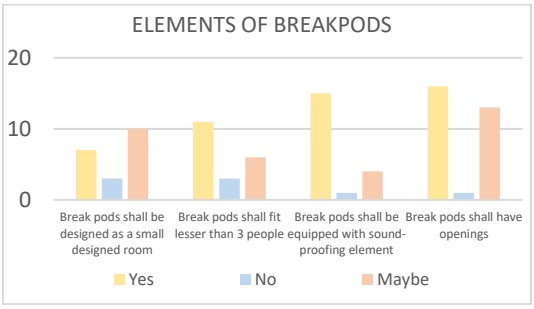

Figure 18: Elements for Breakpods Design

Table 1: Suggestion from respondents on Breakpods Improvisation

Suggestion on Break Pods Improvisation
Equipped with Headphones
Filled with Calming Elements
n/a

Towards the end of this part, the surveys inquire about the importance of break pod – a safe space designed specially for the ASD children when overloading sensory hits. Chart 33 indicates the respondents' perspectives on the important elements in enhancing the efficiency of break pods. This includes the size of the room, recommended capacity of the room, desired element needed in the room and the importance of openings for the room. Then, respondents were asked to give suggestion towards improvising break pods design as tabulated in table 3.

The surveys are ended with an open-ended question on suggestions and recommendations from respondents towards enhancing architectural design in facilities for the ASD community. Proposals are then tabulated in table 4. From the findings, the author observes that most of the respondents are more concerned about sensory elements in a facility.

Table 2: Suggestion and Recommendation To Enhance Architectural Design In Facilities For ASD Community

Suggestions and Recommendations for Architectural Design in ASD Facilities
Integration of Audio and Visual Technology
Equipped with Textured Surface to overcome Sensory Issues
Creating Safe Space
Create the facilities in Every state equally
To have more accessibility to ASD facilities with reasonable charges
To streamline with open, airy space with outdoor elements design such as grass and soils
Less imposing design and more neutral environment

This study aimed to look at the impact of specific acoustic and visual settings in architectural environments on autistic children's behaviour. The study focused on the effects of varied auditory and visual backgrounds on the psychology and behaviour of autistic children, as well as the design of architectural spaces.

5. DISCUSSION

A survey with 20 respondents was performed to study, observe, and analyse the impact of sound and visuals in enhancing architectural spaces for children with autism spectrum disorder (ASD).

The results and findings highlight that the disease is a spectrum with different positions, opinions, etc., between two extreme points and has a range of parameters to measure the severity of the scope.

This study first approached respondents that related to ASD child, the parents, guardians, and professionals who worked closely with ASD patients. As questionnaire surveys were given through online mediums, the majority of the respondents are the individuals who are active on social media platforms, as it is easier for the author to reach out. This study also has reached out to more female respondents. Throughout observation, the author concludes that mothers are closer to the child as most of the mothers of ASD children opt for being a housewife as a career.

From the research, ASD children will now be diagnosed under the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and categorised under three levels. A chronic deficiency in social communication, interaction, or both, and confined, repetitive patterns of behaviour are the two core symptom categories of ASD, according to the DSM-5 (RRB). It also shows that the sensitivity of ASD children towards both sound and visual differs individually; regardless of the diagnosis, it is affected by the environment surrounding the ASD child. The child diagnosed with ASD Level 1 may also show more aggressive reactions than the child diagnosed with a severe case, depending on how the child copes with the surrounding environment. The findings also highlighted the importance of safe space, or break pods, in an architectural area to provide a sensory break zoning when overloading sensory triggers.

6. CONCLUSION

The surveys show that the severity affects the child's preferences. Hence, to cater to their problems, designers or architects should be more aware of the categories and design accordingly. The first-level ASD group may consolidate with the technology approach faster than the other. In contrast, the second-level group of ASD children do not prefer vibrant lights but coincide well with soft frequency sound. However, the third-level group of ASD children may require substantial support and prefer to be in an enclosed space with a highly insulated wall with less noise due to their sensitiveness. Still, it may also cooperate reasonably with visual technology.

Throughout this study, it is concluded that integrating sound and visual technology into designing autistic space is vital to creating inclusivity for the autism community. As architecture affects humans emotionally, sounds and visuals are of the utmost importance in architectural spatial design, especially for those with high sensory sensitivity. Jablonska et al. (2015) mentioned that the process of how these elements influence each other has brought the most surprising outcomes, referencing the existing conditions. Architectural acoustics emerged in the second part of the twentieth century.

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