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VISUAL-SENSORY-BASED QUIET ROOM: A STUDY OF VISUAL COMFORT, LIGHTING, AND SAFE SPACE IN REDUCING MALADAPTIVE BEHAVIOUR AND EMOTION FOR AUTISTIC USERS

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Abstract: This study investigates strategies for developing visual sensory-based quiet rooms for individuals with autism spectrum disorders to reduce maladaptive behaviours and emotions. Optimizing visual sensory comfort in a quiet room is expected to help a person relieve the maladaptive behaviours and emotions that he/she is experiencing. This laboratory-based case study was conducted through a literature review and case studies in two quiet rooms in a school as the laboratory observation. Both schools provide special education services and an inclusive education school. This study aims to provide a reference for creating spaces for autistic individuals in supporting a more inclusive and sustainable environment. A total of eight respondents (four students from each school), aged between 7-21 years old, were involved in this study. Data for the analysis was obtained by observing the physical conditions of the existing quiet room and assessing the respondents' behaviour and emotions while they were inside the room. The behaviour and emotion assessments were based on 12 active behaviours and emotions on the Aberrant Behavior Checklist - Irritability (ABC-I) instrument. Meanwhile, lighting simulations were also conducted using the software DIALux evo 8.1 to determine the rooms' lighting situation. The case studies showed that (1) most of the respondents showed response related to the

quiet room's visual comfort; (2) the respondents in a quiet room with less lighting contrast intensity were more likely to experience a decrease in maladaptive behaviour and emotion; and (3) one of the respondents gave more response in auditory stimulation, which showed that non-visual sensory stimulation should also be put into consideration for a quiet room design. It was concluded that visual stimulation in a quiet room might affect the users' maladaptive behaviour or emotional change. Therefore, a visual-sensory-based intervention for a quiet room potentially increases its effectiveness.

Keywords: quiet room, maladaptive behaviour, and emotions, autism spectrum disorders, visual sensory, visual comfort, quiet room needs, quiet room security.

Introduction

Autism Spectrum Disorder Syndrome, or widely known as Autism Spectrum Disorder (ASD), is a neurodevelopmental disorder characterized by several unusual behaviours (Ismail, W, Wiguna, & Kaligis, 2018). According to Gillberg & Coleman (2000), ASD is a disorder in the part of the brain that regulates a person's ability to communicate and interact socially (Barakat, Bakr, & El-sayad, 2019). Currently, cases of individuals with ASD are widespread in the world. The estimated prevalence of autism spectrum disorder cases globally is 62/10,000 or approximately 1:160 of the world's population (Elsabbagh, et al., 2012). There is no definite statistical data available in Indonesia, but it is estimated that the number of autism spectrum disorder cases in Indonesia reaches 2.4 million cases out of a total of 237.5 million people, or a ratio of 1:100 individuals (The Ministry of Women Empowerment and the Child Protection Republic of Indonesia, 2018). Thus, the importance of discussing issues about individuals with autism spectrum disorders is vital, including those relating to their needs for space.

ASD is closely related to Sensory Processing Disorder (SPD), which is a term to describe someone's inability to effectively utilize sensory information in daily function (Kranowitz, 2005). A certain degree of SPD suffered by an autistic individual may affect spatial experiences and trigger responses in the form of disruptive or maladaptive behaviours and emotions. The earlier study stated that about 69% -93% of individuals with autism spectrum disorders, both children and adults, have sensory issues (McCormick, Hepburn, Young, & Rogers, 2016). The

sensory hypersensitivity of autistic individuals makes them more sensitive to the small details around them (Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009). Moreover, Baker et al. (2008) found a consistent and moderate to strong correlation between sensory processing difficulties and the presence of maladaptive behaviour (Lane, Young, Baker, & Angley, 2010). Maladaptive behaviours are behaviours that interfere with everyday activities, including self-injurious behaviour, withdrawal, uncooperative, aggression, damaging objects, and even the increasing of negative emotions (Shattuck, et al., 2006; Samson, Hardan, Lee, Phillips, & Gross, 2015). The level of sensory stimulation in a room for an autistic individual may determine its space comfort and affect the presence of maladaptive behaviour and negative emotion.

Among all the sensory comforts that someone can feel, the provision of visual comfort in a room may have more effect on how an autistic person perceives a space. This is supported by the fact that at least 80% of the information received by the brain is obtained from eye-sensory visual input (Kranowitz, 2005). Also, individuals with autism spectrum disorders generally learn something from their visual senses (Shabha & Gaines, 2013). The important role of visual input shows that visual sensory concept for a quiet room potentially brings a more considerable effect to gain space comfort, which may lead to a lower level of maladaptive behaviours and emotions. Therefore, the developed quiet room interventions in this study were primarily based on the visual comfort consideration, while comfort issues were taken as supporting considerations.

This study discusses visual-sensory-based spatial intervention strategies for a quiet room to help autistic users relieve their maladaptive behaviour and emotion. The purpose of this study is to investigate possible interventions that may work in gaining a comfortable space for a quiet room and reducing disturbing behaviour and emotion. The results of this research are expected to be a reference for further study and development of architectural spaces for autistic users.

Methodology

This study is a laboratory-based case study and was carried out with a qualitative approach. It started with literature studies and continued with case studies in

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two quiet rooms as the laboratory observation. Each quiet room was in two different types of schools; a special education school and an inclusive school (from now on referred to as the Special School A and the Inclusive School B). The selection of these two types of schools is aimed at obtaining more diverse profiles of respondents since autistic students in inclusive schools are more likely to be able to sit still for long periods, can follow the rules, can understand instructions, and control emotions (Ekawati & Wandansari, 2012). The case studies include (1) profiling the existing quiet room, and (2) observing the interaction between the respondents and the quiet room including by doing assessments and online interviews. The overall data obtained from the case studies and theories regarding spaces for autistic users were analyzed and elaborated to formulate a proposed intervention for a quiet room, according to the needs of the existing space.

The respondents who participated in this study were students aged 7-21 years who used the school's quiet room to deal with the maladaptive behaviour and emotion they experienced. The activities of the respondents in the quiet room were observed by (1) assessing changes in behaviour or emotion before the respondent entered the quiet room and during their presence in the room and (2) observing and analyzing the interaction between the respondents and the quiet room from the spatial context. The Closed-Circuit Television (C.C.T.V.) cameras were installed to obtain the supporting data needed, followed by an online interview with the teacher as the assessor.

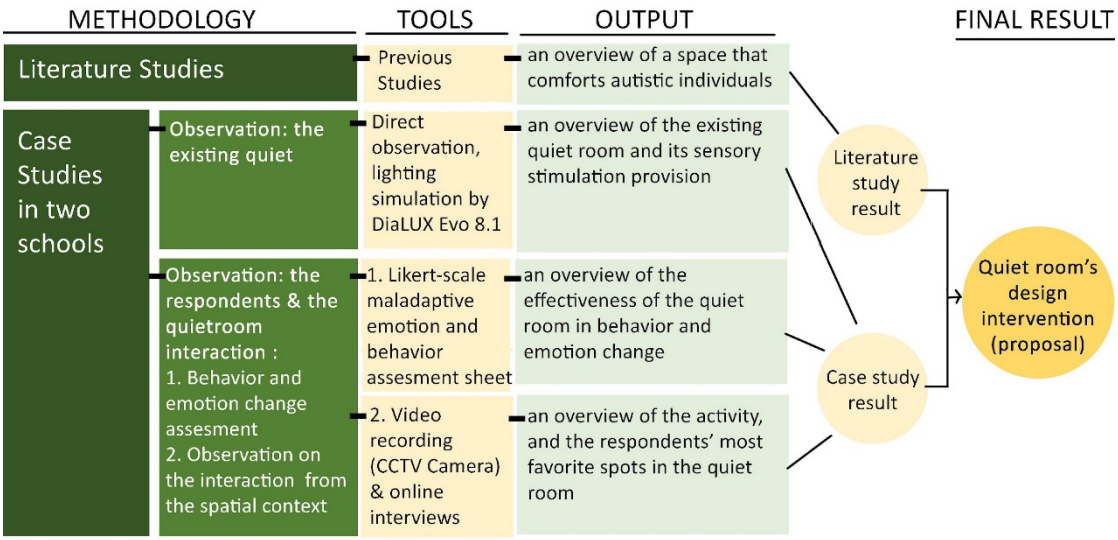
Assessment of behaviour and emotional change was done within a 5 minute range until the respondent could leave the quiet room. The assessment was carried out by the respondents' teacher, as the teacher was more familiar with the respondent's daily behaviour and more competent in recognizing the unusual behaviour shown by the respondents. A Maladaptive Emotion and Behaviour Assessment Sheet with a Likert Scale was used as the assessment tool. This tool was arranged based on the active behaviours or emotions listed on the Aberrant Behavior Checklist - Irritability (ABC-I) instrument. The ABC-I instrument is widely known for measuring behaviour problems in individuals with developmental disorders, including autism spectrum disorder (Brinkley, et al., 2007; Kaat, Lecavaller, & Aman, 2014). Moreover, further behavioural observation was done with the support of video recording. The use of video technology offers

advantages in assessing complex behaviours, although it could be intrusive as it may alter the naturally occurring behaviours (Haidet, Tate, Divirgilio-Thomas, Kolanowski, & Happ, 2009). Therefore, the camera was placed high enough so it could be as idle as possible to the respondents. However, according to Latvala, Vuokila-Oikkonen, & Janhonen (2000), video recording may provide incomplete real-time situation and lack of important contextual data (Haidet, Tate, Divirgilio-Thomas, Kolanowski, & Happ, 2009). For that reason, online interviews with each of the respondents' teachers (who also did the maladaptive and behaviour assessment) were carried out to get a clearer contextual image of what happened inside the quiet room.

The case study, including the lighting intensity simulation, was analyzed by the DIALux evo 8.1 lighting simulation software to obtain data from the spatial context. The simulation was not aimed to get the nominal value of lighting levels in the quiet room but rather to help determine the spread of light inside the room instead.

The literature and case studies results were then analyzed and elaborated to formulate appropriate design interventions for each school (See Figure 1). The formulation of the intervention was subsequently translated into an image of a proposed quiet room design intervention. This laboratory-based case study was the initial research for the development of a visual-sensory-based quiet room, and it has not been tested for a wider range of autistic users.

Figure 1. Methodology flow.



Results

Literature Studies

A visual-sensory-based quiet room is developed based on three parameters, namely visual comfort for autistic users, quiet room's calming function, and safety (Marwati, Dewi, & Wiguna, 2020). Thus, the following literature study will mainly discuss the strategies of the three parameters that make a visual-sensory-based quiet room.

Visual Comfort for Autistic Users

Differences in perceptions of individuals with autism spectrum disorders should be seen as a unique perspective of the dimensions of space and time rather than as a disability (Ahlquist, 2015). For this reason, in presenting a visual-sensory-based quiet room, it is important to understand the perspective of individuals with autism spectrum disorders in perceiving space visually, including their view on the suitability of lighting. There are four factors of the suitability of lighting: colour, lighting atmosphere and colour, light direction, and glare level (Szokolay, 2004). The following paragraphs will mainly discuss the three keywords in these factors: colour, lighting, and glare.

For a space that is intended for autistic individuals, it is recommended that the colours chosen should be muted (low-saturated) colours. Disturbing and overly stimulating colours should be avoided (Altenmüller-Lewis, 2017). Furthermore, colours that create a safe, comfortable, and soothing ambience are the colour of green or blue (Mahnke & Mahnke, 1993; O'Connor, 2011). Thus, the suggested colour for the quiet room is muted colours. Meanwhile, blue and green may give a more calming atmosphere to the room.

The next keyword to the suitability of lighting is the lighting itself. Based on its sources, at least there are two kinds of lighting, which are natural lighting and artificial lighting. Natural lighting brings many benefits to individuals with autism spectrum disorders (Altenmüller-Lewis, 2017). However, the use of natural lighting must be controlled to avoid excessive contrast and glare. For artificial lighting, it is not recommended to use fluorescent lamps since autistic individuals usually have high sensitivity to flickering light (Altenmüller-Lewis, 2017). LED

lighting is recommended as it is also more energy efficient (Szokolay, 2004). Moreover, warm colour temperature lamps are likeable for autistic individuals' rooms (Long, 2010). Artificial lighting should also be equipped with a dimmable system to adjust the light intensity as needed (Altenmüller-Lewis, 2017). Therefore, adjustable LED lights with less flickering effect and a warm-colour temperature are preferred.

For the lighting glare, it should be kept as minimum as possible. Glare can be avoided by using an artificial light diffuser, indirect lighting design, shades, openings/windows at both low- and high-level allocation, non-reflective materials, and maintaining enough distance from the centre of vision to the lighting source (Lechner, 2015; Mostafa, 2008; Ghazali, Md. Sakip, & Samsuddin , 2018). It should be noted that careful control of reflections, glare, and shadow pattern is also necessary (Altenmüller-Lewis, 2017).

Supporting the calming function of a Quiet Room

Quiet Room is one of the facilities needed within the education establishment for individuals with autism spectrum disorders (Mostafa, 2014; Altenmüller-Lewis, 2017; Ghazali, Md. Sakip, & Samsuddin, 2018). A quiet room or also referred to as an "Escape Space," is defined as a space that is intended as a 'resting' space for autistic students who experience excessive stimulation (Altenmüller-Lewis, 2017; Mostafa, 2008). Another study defines a quiet room as a space that provides a calm effect when students are experiencing behavioural disturbances caused by fatigue, stress, or excessive stimulation (Ghazali, Md. Sakip, & Samsuddin, 2018). This space can be a partitioned area or a space to crawl in a room (Mostafa, 2014). Moreover, a quiet room should have minimal distraction and stimulation, and it may also be equipped with sensory stimulation, which can be adjusted according to the stimulation intensity needed, either for stimulation or for a calming effect (Altenmüller-Lewis, 2017). For this reason, it is possible to equip a quiet room with items that have sensory stimulation, such as pillows with different textures, brushes, small tents, blankets, etc. (Mostafa, 2014). Stimulation-based zoning of space should be provided. The zoning consideration should include whether it is for hypersensitive or hyposensitive individuals. Quiet rooms should be separated acoustically (Ghazali, Md. Sakip, & Samsuddin, 2018). It needs to have a quiet

room to reduce distraction and sensory discomfort for children with autism spectrum disorders. Moreover, there is no definite standard dimension for this room, but the size of the quiet room should not be too big or too small, considering that room size can be a factor of fear in children with autism spectrum disorders (Mayes, et al., 2013).

Safety

The safety aspect is also essential in a quiet room because the behaviour of individuals with autism spectrum disorders can be difficult to predict. A Quiet room must not provide a chance for someone to endanger himself/herself (Ghazali, Md. Sakip, & Samsuddin, 2018), especially if he/she is behaving aggressively. However, it is important always to note that safety is considered the most critical aspect of spatial planning for individuals with autism spectrum disorders (Altenmüller-Lewis, 2017).

Case Studies Results

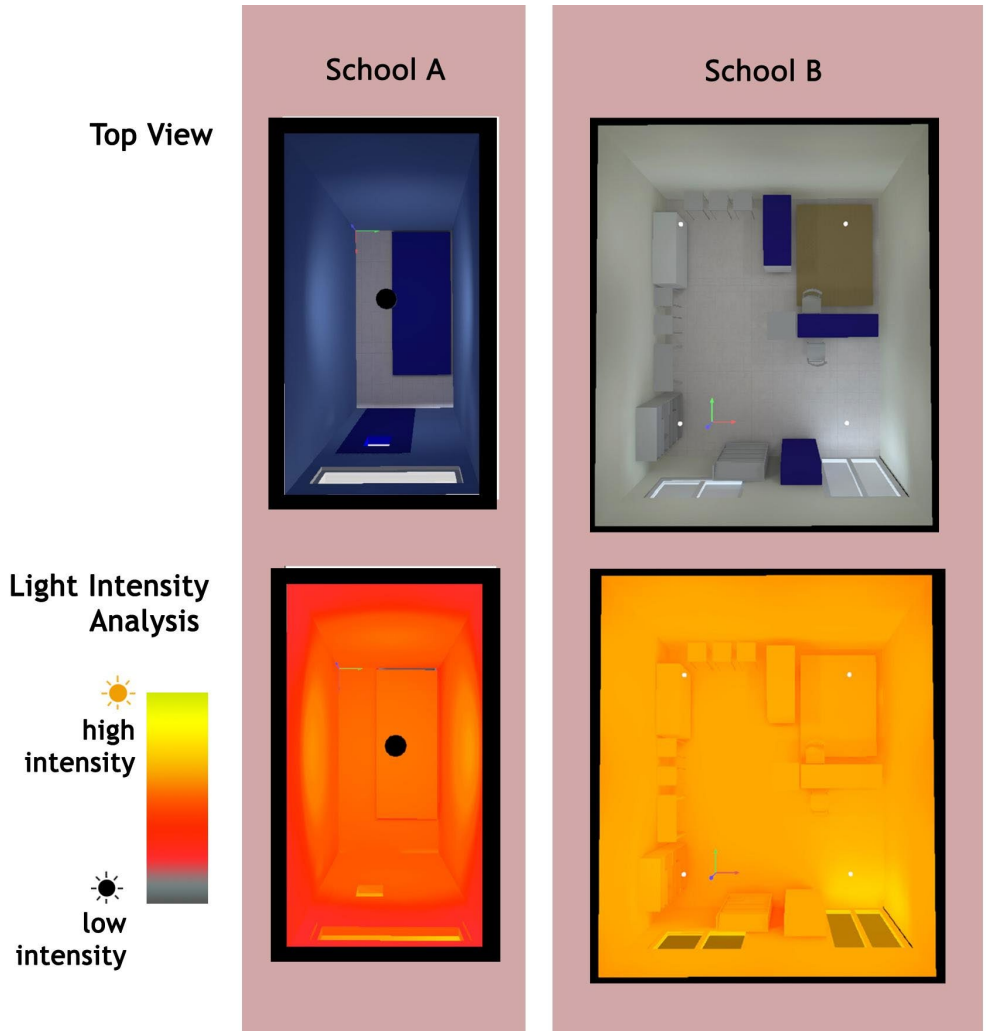
School A, a school with a special education service, has two quiet rooms called quiet room 1 and quiet room 2. In this study, only one of the quiet rooms which highly aggressive students frequently use will be observed, namely quiet room 1. Quiet room 1 has a size of 1.58 x 2.9 m and a ceiling height of 3 meters which serves as a space to cool off. In contrast to quiet room 2, which has a bed, quiet room 1 only has a mattress as a comfortable area for students who need to calm down.

In terms of lighting, Quiet Room 1 relies on artificial lighting from a single point of light and indirect natural lighting. The electric lamp is a downlight-stick lamp with a cool colour temperature light (6500 K). The lighting glare from electronic lamps is minimized with the use of downlight luminaire. In this room, there is no direct natural light source, but natural light from the nearest window can slightly enter the room through the reflection of the surrounding surfaces. The light glare is hardly found in this room.

At School B, the Inclusive School, there is no dedicated quiet room for autistic students, but there is a room with a similar function. This room has an area of 30 m^2 with a length on each side of 6 m and 5 m, respectively. The height of the

room ceiling is 3 meters. This room has many functions related to educational service activities for students with special needs, including a temporary quiet room for children who show disruptive behaviour during school hours. The room is equipped with various kinds of furniture, such as carpets, cupboards, gym balls, tables, and other therapeutic equipment. In using the room, the teachers accompany students with maladaptive behaviours and emotions. In terms of lighting, the existing quiet room has direct natural light sources in the form of sandblast-finished glass doors and windows. Natural light can enter the room directly because the corridor to this room is semi-open. The artificial lighting installed in the room is four cool-coloured temperature stick lamps.

Figure 2. Light intensity simulation analysis using DIALux evo 8.1 software at School A (Left) and School B (Right)



Based on the lighting simulation by the DIALux evo 8.1, it is known that the spread of lights in the existing School A's quiet room is perfectly even; no area looks

much lighter or darker (See Figure 2 - Left). Meanwhile, the quiet room at School B has the most contrast light intensity, and the area with the lowest light intensity is covered with a carpet (See Figure 2 - Right).

The interaction between the respondents with the existing quiet room

During the interaction between the respondents and the existing quiet room, an assessment of the behaviour and maladaptive emotional changes was performed by analyzing it along with its spatial aspect analysis. The assessments were based on 12 active behaviours and emotions on the Aberrant Behavior Checklist - Irritability (ABC-I) instrument. The behaviours and emotions assessed at this stage are coded with the M1 – M12 code, as listed in Table 1.

Table 1. List of observed behaviours and emotions. (a) Non-verbal behaviour.

Behaviour (Non-Verbal)	**Code**
Excessively active at home, school, work, etc.	M1
Meaningless recurring body movements	M2
Abnormal repetitive movements	M3
Aggressive to other children or adults	M4
Injures self on purpose	M5
Impulsive (Acts without thinking)	M6

Table 1. List of observed behaviours and emotions. (b) Verbal behaviour.

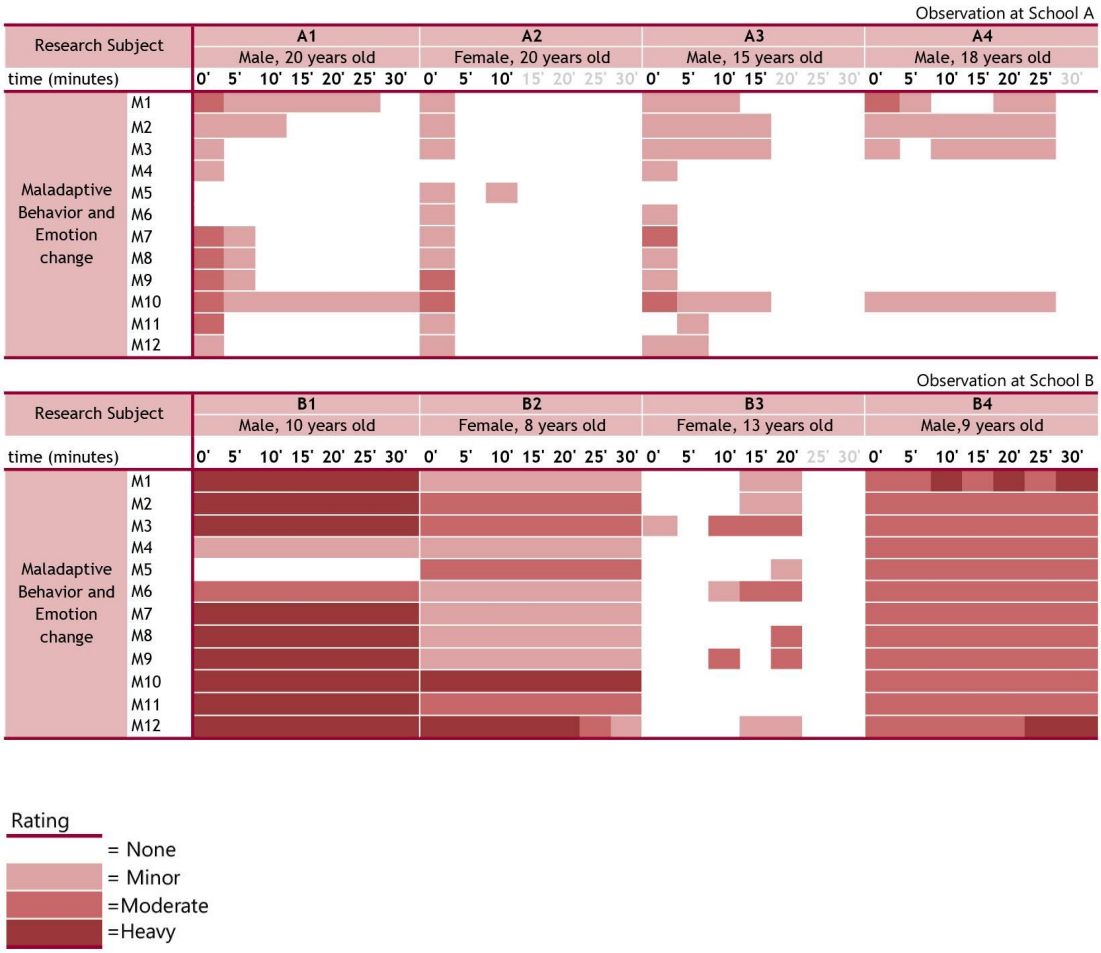
Behavior (Verbal)	**Code**
Screams inappropriately	M7
Talks excessively	M8
Boisterous (inappropriately noisy or rough)	M9

Table1.List of observed behaviours and emotions. (c) Emotions.

Emotion	**Code**
Restless, unable to sit still	M10
Irritable and Whiny	M11
Temper tantrums	M12

The observation and assessment of two different quiet rooms showed various behavioural responses. Behavioural and emotional problems that frequently surfaced were excessively active, meaningless body movement, abnormal repetitive movement, and restlessness, unable to sit still. Graphs of changes in behaviour and emotions that occurred while in the existing quiet room can be seen in Figure 3.

Figure 3. Graphs of changes in behaviour and emotions before and during entering the existing quiet room at School A & School B.



At School A, four subjects joined as the respondents, further referred to as A1, A2, A3, and A4. From the observations, the maladaptive behaviours and emotions had decreased since the 5th minute and gradually decreased after that (See Figure 3). At School B, four subjects also used the existing quiet room, further referred to as B1, B2, B3, and B4. During their stay in the existing quiet room, the respondents were accompanied by each of their shadow teachers. From the assessment results, it appears that not all subjects experienced a decrease in maladaptive behaviour and emotions. Subject B1 did not experience changes in behaviour and emotions even after 30 minutes, B2 experienced a decrease, while B3 and B4 experienced an increase in behavioural and emotional problems.

Based on this assessment, it can be concluded that only one subject at School B experienced a decrease in maladaptive emotional and behavioural problems during their entry into the existing quiet room. Meanwhile, the other two subjects had more problems, and the other one did not experience any changes.

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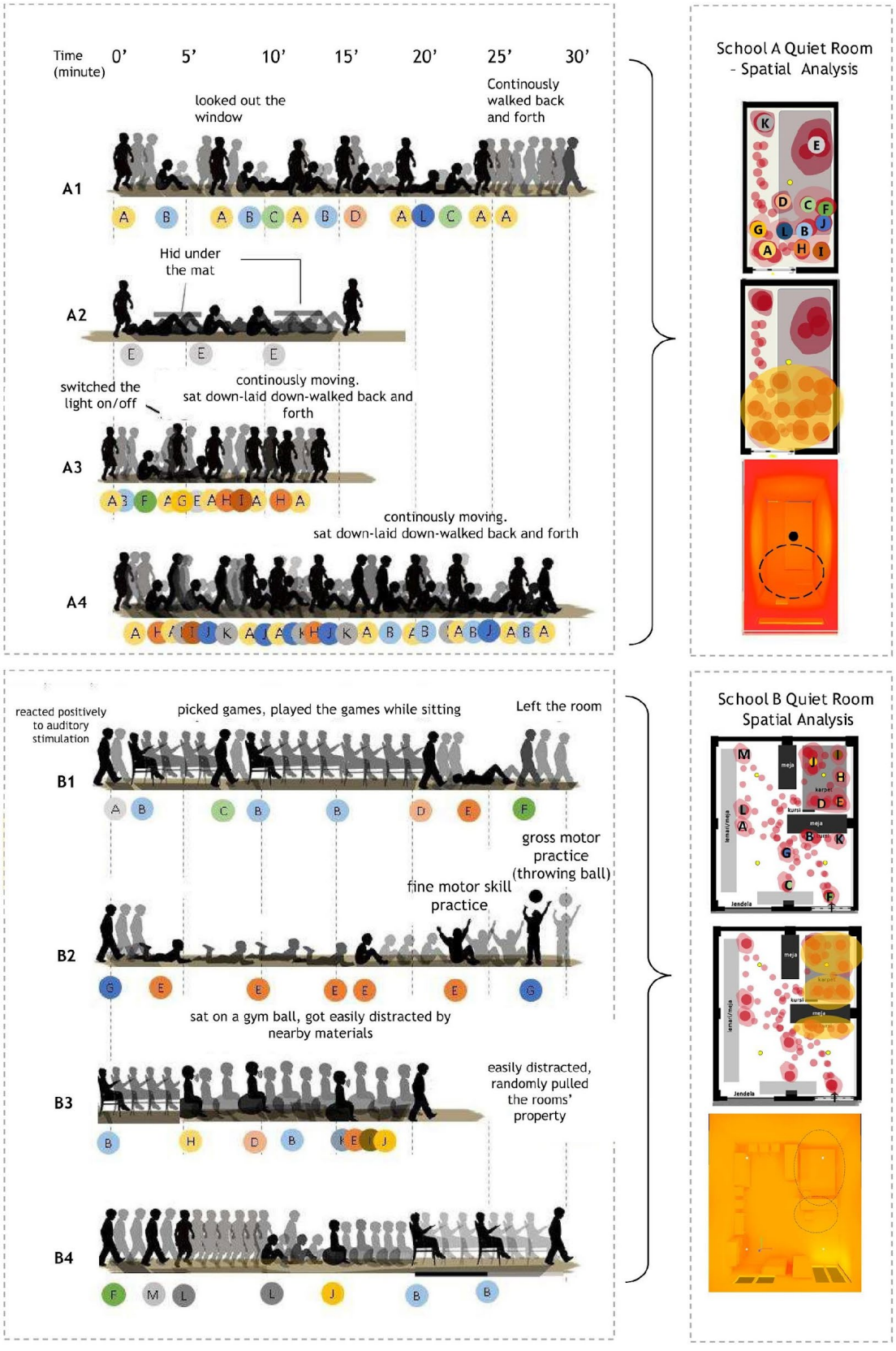
Moreover, almost all respondents at School A showed interaction related to visual comfort. A1, A3, and A4 often looked out of the room through the door openings when standing at point A (See Figure 4 – top right box). In contrast, A2 covered her body with a mattress during the 5th and 10th minutes while calming herself down. While this behaviour might show that A2 needed proprioceptive input, there was also a possibility that she might need to reduce the visual stimulation she received by hiding under the mat. However, this situation was a hint that non-visual sensory stimulation was also important to be available in a quiet room. Furthermore, A3 repeatedly pressed the room light switch button in the 5th minute as if he wanted to control the light intensity of the room (see Figure 4 – top right box).

Figure 4. Spatial Analysis of Respondents' Interactions in the Existing Quiet Room of School A, and School B.



Overall, the most occupied area in the room was the one close to the door, near the opening that provides natural lighting with an outside view (See Figure 4 – top right box). The variety of behaviours associated with visual stimulation showed that each subject had different stimulation needs. However, this stimulation need cannot be defined specifically because each subject showed different behaviour according to their respective needs.

Meanwhile, the situation in School B's quiet room was slightly different. While entering the room, students at Inclusive School B walked to several sides of the room, sat down, or rocked on the gym ball, and also sat and lay down on the carpet. Several other activities, such as playing games and motoric skill activities, were carried out with guidance from the teacher (See Figure 4 – bottom left box).

The behaviour related to visual comfort was shown by B4, preferring the room's lights to be turned on. Moreover, for B3, too many objects in the room caused a distraction. One of the respondents seemed to enjoy more auditory sensory stimulations to calm down. Once again, this showed that the availability of non-visual sensory stimulation should also be put into consideration.

For the spatial pattern analysis, there were two areas that were favoured by the respondents. One of these favoured areas was the one with a closed, bordered area that formed a separate space in the existing room. According to the simulation, this area received the least light in the entire room. Another frequently visited area was the one near the table with seating. What these two areas had in common is that they both had a separate space limitation from the placement of the furniture in the room (See Figure 4-bottom right box). A more detailed spatial analysis regarding the interaction of research subjects with the existing quiet room can be seen in Figure 4.

From the case studies, at least three points can be concluded; (1) most of the respondents showed a response in terms of the quiet room's visual comfort. This showed that visual stimulation in a room might have a certain effect on behaviour and emotional change while using a quiet room. However, each subject had different stimulation needs; (2) the respondents in a quiet room with less lighting contrast intensity were more likely to experience a decrease in maladaptive behaviour and emotion; (3) two of the respondents showed responses that could

be related to proprioception and auditory stimulation respectively, which showed that for a quiet room design, non-visual sensory stimulation should be put into consideration.

Discussion

This section mainly discusses the possible visual-sensory-based design intervention that can be implemented in both existing quiet rooms. The intervention discussed also put forward the efficiency value by minimizing unnecessary interventions and optimizing the existing conditions that can be maintained. The design intervention was carried out by elaborating the results of case studies with previous theoretical reviews.

Intervention Design for the Visual Comfort

One concept in a visual-sensory-based quiet room is the optimization of visual comfort in that space. The proposed design interventions that need to be carried out in the existing quiet rooms at Schools A and B are as follows:

- Replace existing lamps with LED lamps with warm colour temperatures (2700-300K) so they are comfortable for the child's visual senses. This is in line with several theories that say that warm temperature and soft-white-golden lights are recommended for rooms for individuals with autism spectrum disorders (Long, 2010; Kinnealey, et al., 2012). Meanwhile, this type of LED lamp is recommended as it is more energy-efficient than other types of lamps (Szokolay, 2004).

- Provide dimmable controls that allow children to adjust the brightness of the light. Dimmer control provides an opportunity for individuals with autism spectrum disorders to self-regulate the light intensity they need to receive (Altenmüller-Lewis, 2017).

- Room lamps are installed with downlight housings and equipped with light diffusers. In addition to avoiding glare, the diffuser also functions to reduce bright lights (Lechner, 2015).

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- Arrange the room so it is not exposed to direct light sources to minimize glare. Of the two rooms, the quiet room at School B potentially causes glare. In this case, the proposed design intervention is to create a separate quiet space with clear boundaries within the room.

- Covering the floor with a non-reflective material.

- Gives an atmosphere of soothing blue and green colours that give a calm atmosphere. In this case, the blue colour, which has now become the colour of the walls in School A's quiet room, is proposed to be applied to the B School quiet room. Green artificial lighting is added to give the room a greenish-blue atmosphere. This light can be deactivated so that one can choose whether to add green to the room or not. This artificial lighting will be designed with an indirect lighting system that is planted in a wall higher than the eye level (180 cm) and covered with acrylic to avoid glare.

Intervention Design to Support Calming Function of the Quiet Room

A visual-sensory-based quiet room is not only concerned with the aspect of visual comfort. Quiet rooms must still meet the needs of space as a resting space for individuals with autism spectrum disorders who are experiencing maladaptive emotions and behaviours. In the proposed design interventions for School A & B quiet rooms, the proposed design interventions are as follows:

- Provide an area with minimal stimulation in the form of a tent. This proposal is based on the theory that an escape space may be in a form of crawling (Mostafa, 2014). This tent also acts as a space with minimal stimulation for hypersensitive children who require it.

- Only provide minimal numbers of furniture or items to minimize distraction. This is mainly in response to the behaviour of one of the respondents who was easily distracted.

- Separate the quiet room from rooms with other functions. Apart from reducing light contrast and intensity from the door area, this is also proposed based on the consideration that quiet rooms should be acoustically separated from other rooms (Ghazali, Md. Sakip, &

Samsuddin, 2018). This point is also related to the recommendation that rooms in schools for students with autism spectrum disorders should have clear boundaries in terms of function and sensory quality so that the users can easily recognize the use of these spaces (Ghazali, Md. Sakip, & Samsuddin, 2018).

- Equip the quiet room with items that can provide sensory stimulation safely (other than visual stimulation), such as pillows with different textures.

- Adjust the room size so that it is neither too small nor too large to anticipate the fear in children with autism spectrum disorders. In this case, the size of the quiet room at School A cannot be changed because the change in size will affect the construction of other rooms around it, so it will be less efficient. Hence, this step can only be done in the quiet room proposed at School B. The proposed size of the room is 2 m x 2.5 m with a fixed ceiling height of 3 meters. This is suggested so that the room is not too large and too small and does not interfere with the existing room's functions.

Intervention Design for Room Safety

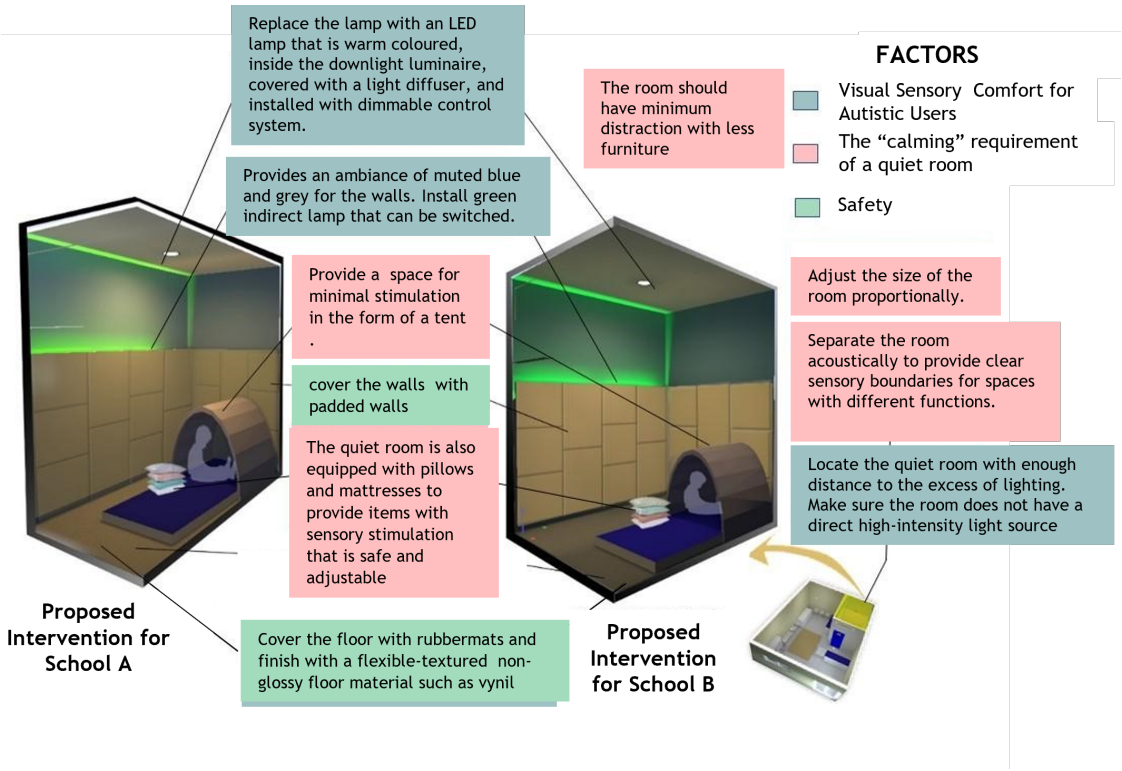
The quiet room proposed in this study is a quiet room that autistic users can use with minimum assistance from other people. For this reason, the quiet room must be equipped with safe materials to anticipate aggressive behaviour, which can lead to injury. Suggestions in the safety aspect are as follows:

- Cover the walls with padded walls. The addition of this material aims to make the walls less hard and risky when the user is aggressively hitting his/her body against the wall.

- The floor area is covered with a rubber mat so that its surface becomes softer and more flexible. The rubber mat floor can eventually be finished with a non-reflective material.

Based on the previous description, an illustration of the proposed visual-sensory-based quiet room is shown in Figure 5.

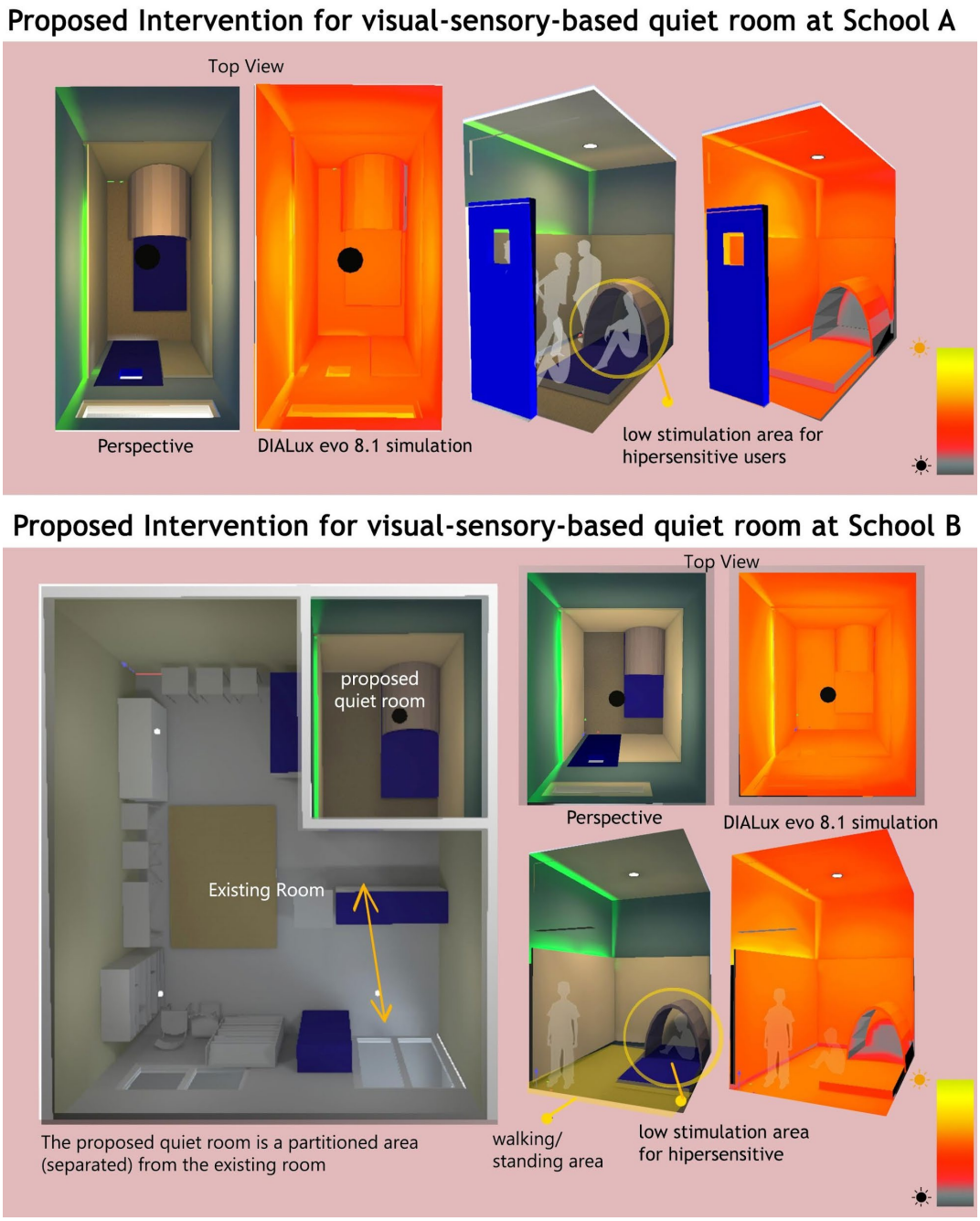
Figure 5. Illustration of Proposed Visual-Sensory-Based Quiet Room.



The results of lighting analysis with DIALux evo 8.1 software (Figure 6) in the proposed room showed that the proposed intervention design has less light contrast intensity. However, the tent in the room provides more variety of sensory stimulation zones, and it can be used by individuals who need minimal stimulation.

At the Inclusive School B (picture at the bottom), it can also be seen that separating the quiet room from the existing room simultaneously reduces the intensity of excess light that enters the quiet room.

Figure 6.Lighting analysis on the proposed Visual Sensory-Based Quiet Room for School A (top) and School B (bottom) .



Conclusion

The study shows that visual stimulation can affect a person's behaviour in a quiet room. Considering most of the case studies' conclusions are related to visual stimulation, a visual-sensory-based intervention for a quiet room may make a quiet room more effective in decreasing maladaptive behaviour and emotion. Moreover, a visual-sensory-based quiet room means an escape space that (1) has

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lighting with a warm colour temperature, free from glare, and a calming character colour atmosphere, (2) does not have excessive sensory stimulation, especially for non-visual stimulation, (3) is separated, and has different sensory stimulation level compared to other rooms around it, (4) has sensory stimulation that can be controlled and/or adjusted to each of the users' sensory needs to calm down, and (5) responds to the possibility of unexpected dangerous behaviour that may occur. This concept can also be embedded in any room with a similar relaxing function, such as a multisensory room, although some adaptations should be carefully considered to support the actual or other function of the room.

This research explored the use of the existing quiet room in each school and attempted to provide design intervention proposals based on the available theory and data. However, until now, no research has proven the effectiveness of visual-sensory-based quiet rooms in relieving maladaptive behaviour and emotion. In this case, it is necessary to carry out further experimental research to obtain an evaluation of the proposed design intervention.

Evaluation can be done in the form of research regarding (1) the light intensity for individuals with autism spectrum disorders, (2) the latest available lighting technology used for the development of this quiet room, and (3) the light setting preference of autistic individuals in a quiet room.

Additionally, further research can be carried out regarding the findings that the subjects of child age tend to experience higher behavioural and emotional problems than adolescents and adults. These findings reveal opportunities for tracing the (1) hypersensitivity comparisons of individuals with autism spectrum disorders at different age groups, (2) recommendations on the importance of assistance and supervision for younger users in a quiet room, and (3) the needs of different quiet room formulation for each lifespan. The intervention strategy in this research can be adjusted and implemented in any room intended for autistic users. The existence of quiet rooms in public spaces can provide more inclusive space for individuals with autism spectrum disorders. It is hoped that this may bring more autistic individuals' involvement in society.

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