Evaluating Adaptability in ASD centres: A study conducted in Egypt

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Abstract: 87% of children on the autism spectrum disorder (ASD) display signs of sensory abnormalities thus interact differently with the built environment. To create better environments, guidelines suggest designing adaptable spaces without defining how. This paper presents the development of an adaptability evaluation metric for classrooms that accommodate for ASD students. Drawing upon the definition of adaptability, recommendations are compiled from the literature and verified by teachers to develop the adaptability evaluation metric. Not all classroom features have the same impact on adaptability therefore variable weights were calculated for the assessed features. The metric was tested in five ASD centres and one classroom with only neurotypicals (NT). Finally, through interviews with supervisors, it was determined that the main benefit of using this metric would be knowing the recommendations for improvements.

Keywords: Autism, Classroom, Adaptability, Guideline,

1.   Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder with no known cause or origin. The prevalence of autism increased by 200% since 1931 (Xu, et al., 2018). Given the breadth of the spectrum, no single teaching method or design addresses all the needs of those diagnosed. Many teaching interventions have been developed to support people with ASD; however, research asserts the need for a personalised plan of treatment for each unique case of autism to produce the most beneficial result (Callahan, et al., 2010). Likewise, extensive research has been done to gather the best design guidelines for the built environment, however, due to the different spectrum of needs, obtaining a universal solution that benefits most occupants with ASD is highly unlikely; thereby the promotion of a flexible or adaptable built environment. Ideally, adaptability should be assessed quantitatively, since only then can they be evaluated. However, no set guideline offers a measure of inherent adaptability. This research aims to develop a method to assess adaptability for the context of ASD educational facilities to 1. Promote better designs and 2.Provide guidance and improvements for existing facilities.

2.   Literature review

2.1   Autism Spectrum Disorder (ASD)

ASD is characterized by difficulties in social communication, social interaction and restrictive and repetitive behaviours and interests, also known as the dyad of impairments (DSM-5, 2013). Those dyads have been explained by many cognitive theories (Baum et al., 2015). However, although the theories differ regarding their emphasis on the source of the deficit causing such difficulties, the underlying difficulties in processing sensory information may be a contributing factor to all three domains (Baum et al. 2015). Over 87% of children with ASD show signs of sensory abnormalities (DSM-5, 2013). These sensory problems are often characterised as either hyposensitivity or hypersensitivity, which refer to the decreased or heightened sensitivity to sensory stimuli (Baum et al., 2015). However, there is often

significant variation both within and between individuals, in that the same individual could be hyper, hypo or neutral to certain stimuli. Correspondingly, such difficulties largely influence all aspects of the environment, involving how individuals with autism perceive, react and understand certain scenarios (Baum et al., 2015). Based on this belief, many researchers begun to explore different methods to alter stimuli by removing or increasing it for hyper-sensitive and hypo-sensitive children, to better conform to students' needs.

2.2 Defining Adaptability

To assess adaptability, it must be defined based on the context and must not be limited to the definition of flexibility. A description of flexibility is the ability of the space to modify its physical qualities to match the occupants' needs better. Vogel (2008) explains that for a classroom "flexibility will not mean constant change, but rather being able to transform an environment on a moment's notice". Flexibility can be then defined as the ability of the space to respond to the students' new needs and usage patterns through physical rearrangements in a set time (Maltese, et al., 2015). Adaptability, on the other hand, requires flexibility, but also convertibility, which allows for the change of usage and interaction within it. The space needs to be agile to allow for quick switches between task setups using the least changes and time (Maltese, et al., 2015). The adaptability of the space can only be assessed by whether it is compatible with all actions and not dominated by one that directs the interactions within the space. By designing a classroom that can "relate to the perceptual world of everyone" designers enable students to express themselves through their environments, thereby leading to a celebration of differences and an extension of wellbeing (Gaudion, et al., 2014).

3. Method

This paper is part of a larger study; Table 1 presents the method for the full study however this paper will focus only on Part 2 which addresses which follows the data compilation.

Table 1 Breakdown of method

	Objectives	Procedure
Part 1	Objective 1: To accumulate the criteria for the metric	1. Literature review of all aspects in the classroom that need to be able to correspond to the students' needs (adaptable nature)
		2. Organize recommendation into classroom features they relate to
		3. Consult with teachers in ASD centres to verify and improve the results
Part 2	Objective 2: To calculate variable weighting for classroom features	1. Literature review on the different methods guidelines utilize in specifying differing importance of aspects
		2. Teacher questionnaires teachers to develop variable weighting
		3. Analyse results to obtain weights for classroom features
	Objective 3: Test Metric	1. Use developed metric in Part-1 to assess different classrooms
		2. Analyse data using specified weighting obtained in Objective 2
	Objective 4: Determine metric grading system	1. Literature review of how different guidelines and standards classify and grade the assessed object or person.
		2. Analyse different methods and decide on the most suitable one
	Objective 5: Design method for data presentation	1. Literature review of results presentation in different guidelines
		2. Questionnaires to heads of centres to determine which information they believe is important to have and how the results should be presented

3.1 Literature compilation

The aim of the literature review was to provide a background on the existing recommendations relating to adaptable classrooms and to compile recommendations to be

used in the survey. Through the literature, the main classroom features were found to be lights, layout, surfaces and furniture. Recommendations regarding these features were noted to be used directly in the surveying checklist.

3.2 Surveying checklist

Using the recommendations from the literature, lights, layout, surfaces and furniture within the classroom were assessed using 25 yes or no questions. Only recommendations with adaptable natures were taken into account. An example is "can intensity of light be varied?"; if the intensity of light can be varied then teachers can vary the classroom atmosphere therefore this recommendation is deemed adaptable. However, a recommendation that proposes the use of only LED lights, although it is beneficial, is not considered since it provides no variation or chance to adapt. Classrooms with a higher "Yes" frequency were assumed to be more adaptable. Teachers were approached to verify the draft metric.

3.3 Variable weighting

The effect classroom features have on inherent adaptability differs therefore, variable weighting factors were calculated for each. BREAAM's method is adopted to be used in this metric; modifications have been made for it to be applicable.

BREEAM's weighting system sets a scope, and a set of broad goals with defined boundaries that need to be related to the assessed factors. The way BREEAM assesses such factors is through developing a committee that reviews how each assessed factor relates to the scope by referring to evaluation criteria (refer to Table-2). For example, how water affects Social sustainability (scope) in reference to seriousness (evaluation criteria). Water would need to be assessed 9 times to cover the evaluation criteria for each of the scope goals. Table-2, highlights the adaptations done to the BREEAM method for it to be applicable in this scenario.

Table 2 Adaptations done to the BREEAM method for variable weighting

	BREEAM	This Metric
Scope	Social, Environmental, and Economic sustainability	Social and Functional Adaptability
Evaluation criteria	Seriousness, relevance, and potential	Seriousness and impact
Point system	6-pt system	5-pt system that removes N/A
Results from	Designated committee	Teacher questionnaires

Following the same procedure as BREEAM there were 16 questions for this study set in a questionnaire, four for each classroom feature. An example question is:

Rate the impact of lighting systems on the occupants of the classroom?

1→ Very low   1.5→Low   2→ Medium   2.5→High   3→Very High

Once questionnaires were returned by teachers the following procedure was done to translate the results to weighting values.

Step 1.   Setup scores

	Seriousness	Impact	X, Y, Z, A → refer to values from rating scale 1-3
Social (S)	X	Y	
Functional (F)	Z	A	

Step 2. $Social\ Impact\ [S] = X * Y$ and $Functional\ Impact\ [F] = Z * A$

Step 3. $Total\ Category\ score = S + F$

Step 4.   Normalise scores so that the sum of them is 100 to obtain weighting

Step 5. $Category\ weighting = \dfrac{100}{\sum Category\ scores} \times category\ score$

3.4 Testing the Metric in Different Centres

Special Educational Needs (SEN) centres that cater for children on the spectrum were tested using the metric. All visited centres have experience teaching children with ASD and provide group classes. Also, a NT was assessed and used as a base case.

3.5 Grading

This metric aims to assess the design and present potential for increasing adaptability rather than relative performance. Although some classrooms do not have many adaptable features, students manage to adjust and benefit from the overall experience, meaning that all classrooms are to an extent, beneficial. Using a rank-based system would give high rankings to classrooms that still require significant improvements as very few centres meet all criteria. Therefore, this metric uses a standards-based system that assess classrooms based on met criteria. Like the Environmental Performance Certificate (EPC), this metric will present a percentage for potential improvements. The potential for improvement is calculated by:

$$100\% - obtained\ percentage\ from\ met\ criteria = potential\ for\ improvement$$

3.6 Presentation

Short interviews were conducted with the seniors in each centre to help determine the most suitable form of presentation and the type of data they deemed helpful. Options ranged from numerical to graphical, detailed to simple, and extra desired functions of the results such as further recommendations or risks associated with specific aspects.

4. Results

The points addressed in the surveying checklist were as follows:

Lights→ varying intensity, varying colour, task lights, more than 1 light circuit, easy controls, sufficient daylight penetration, sun control and glare control.

Layout→ withdrawal zones, group zones, distinct functional zones, physical space dividers, and spaces for student's belongings.

Surfaces→ neutral walls, controlled colour, easily maintained displays, durable floors, acoustic control and removable carpets.

Furniture→ mobile, adjustable, alternative seating, large storage space and clutter free.

A notes section is added to account for the variation that different designs may offer.

Using the questionnaires described in section 3.3, variable weighting was calculated for the different classroom aspects. Seven teachers returned the filled-out questionnaires explained. Looking at Figure 1, no trend can be seen between the respondents' replies. Given their differing expertise and difference in exposure to ASD students, the variation in results was expected. Ranked from the aspect with the most to least impact the order is: lights, furniture, layout, and surfaces, but the difference between the most and least is around 5%, which in comparison to the full range of possibilities, is a small difference. The averages used for the final evaluation of the classes fall within the interquartile region ensuring they are not the outliers of the data set, although they are affected by them.
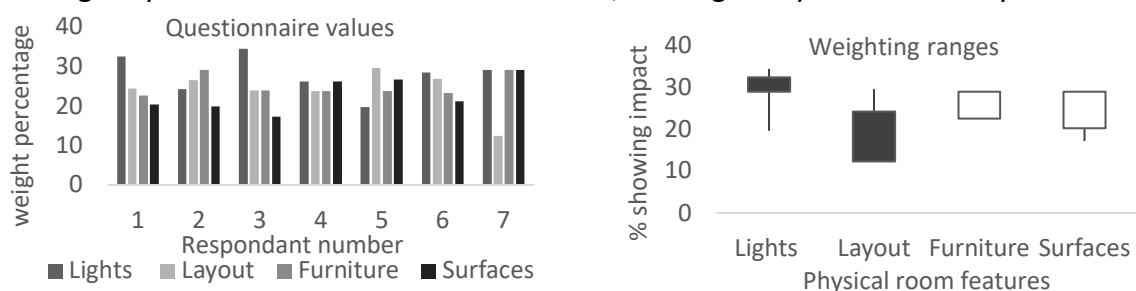

Figure 1 Weighting results analysis

Combining the surveying checklist with the weighting factors, 5 centres were assessed. Based on Figure 2 some generalisations can be made: 1. all centres surpass the base case scenario, 2. centres attain higher percentages for layout, 3. varying intensity and colour of lights, although acknowledged as an important factor by teachers, was not present at any centre. Unexpectedly, funding and resources do not directly correlate to higher percentages. Centre 5 has the least funding yet manages to attain the highest furniture percentage. Other than the electric lighting controls and sound insulation, centres achieved different recommendations meaning that higher scores in the future are attainable.
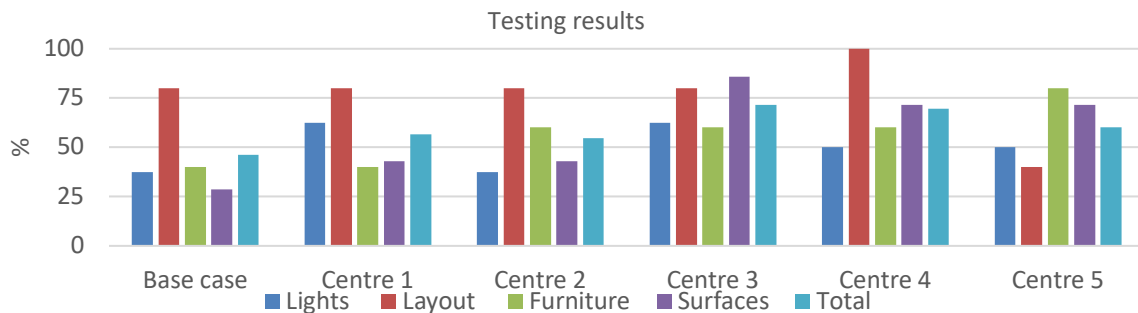

Figure 2 Testing results for NT classroom and SEN centres

Centre name: Vine branches   Assessed on: March 28, 2019   Potential for improvement:44%

Recommendations:

1. Clearing the clutter → allows for quicker transitions between activities (very low cost)

2. Defining Withdrawal zones→ allows for different activities to be done at the same time, (very low cost can be defined using classroom resources)

3. Alternative and adjustable seating→ better adapting furniture that meet the needs of most students (no price range since alternative seating's prices vary)

4. Smarter electrical lights control →(high cost-7% increase but highest impact on students)
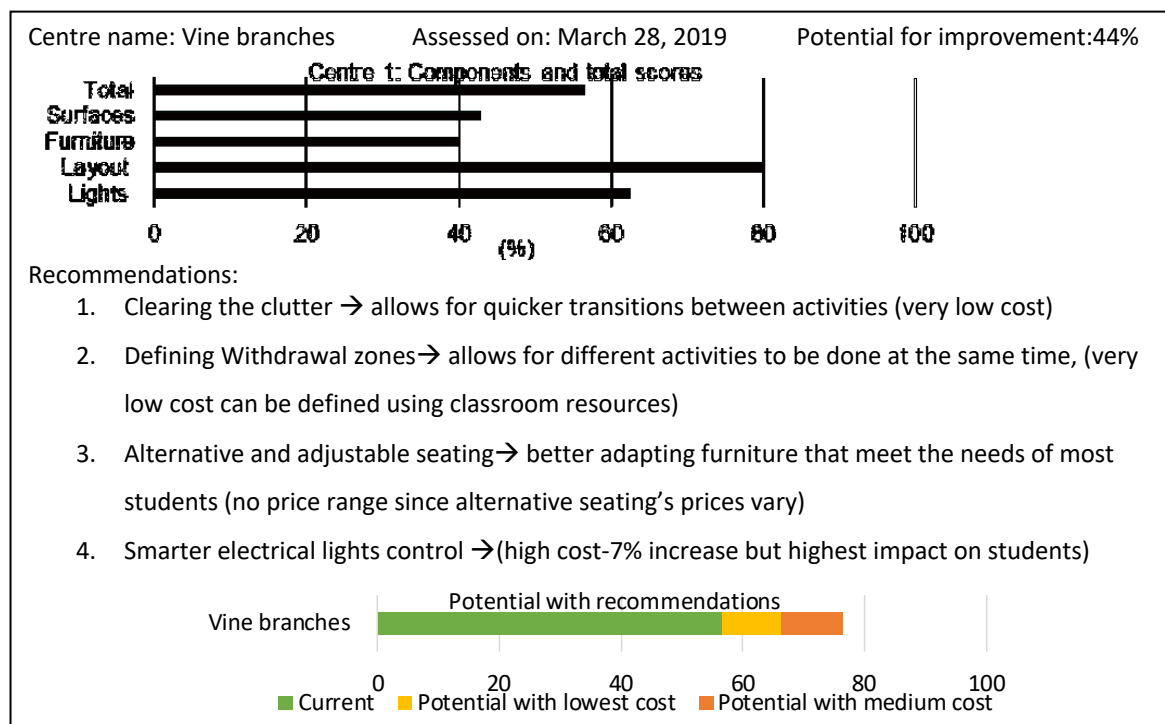

Figure 3 Vine branches metric results

Supervisors were asked about the data they believed would be most beneficial and how it should be presented. It was found that the biggest success for this metric is informing the current design and presenting areas for improvements. Supervisors wanted a breakdown of the scores rather than one cumulative score, since they wanted to see how each component performed within their centre. Finally, for the recommendations, they preferred to see the impact carried by each point. The supervisor of Vine Branches however, mentioned that even though some aspects may have a large effect, they may be out of budget therefore preferred recommendations to be split based on cost. Both these ideas were combined in the final results presented in Figure 3.

5. Discussion and further recommendations

The development of this metric was a multistage process with many advantages and disadvantages. It was decided to stick with a standards-based system which awards points based on the met criteria rather than a rank-based system. This system may not be the most beneficial in the future when there's a large pool of centres, and most of them have satisfied most criteria; in that case, another system may be needed.

Several comments could be made about the weighting process. Initially, a verification of the BREEAM's adopted process needs to be undertaken. Through the literature review it was determined that impact and seriousness on tasks and occupants are the most important factors. Other ideas were considered such as the post effect when students returned home however, it was decided that only aspects directly relating to adaptability will be considered for this study. Seven out of ten teachers replied to the weighting questionnaire however, the variation in the pool of respondents is very small with the ratio of female to male teachers being over 7:3. Additionally, all the centres assessed were in Cairo. In order to generalise the results obtained for the weighting questionnaire a larger pool of respondents with higher variation need to reply. Looking at the results of the weighting questionnaires it is evident that all classroom aspects need to be able to adapt and not just one since none dominate. Lights is the aspect with the highest weighting mainly due to the seriousness of its dysfunction on the students and teaching. Although analysing the centres is a simple process of ticking met criteria, one aspect that was not accounted for is the variation between classrooms in the same centre. For this analysis several classrooms were entered, and the response was based on generalisations of all their features. One unanticipated problem in the display of scores was that improving one lighting aspect had the least effect overall due to number of recommendations; possible solutions are not dividing guideline into aspects and giving higher weighting to certain points based on their aspects or making sure that number of recommendations for each aspect is similar.

6. Conclusion

With the development of adaptability evaluation metrics, emerges new opportunities for creating building guidelines for ASD classrooms and for informing current centres to better improve. Rather than referring to adaptability with a conceptual approach, assessing the building features supports architects in making informed decisions about the designs. This metric, a preliminary step in assessing adaptability in ASD classrooms, has proved the attainability of such a metric and urges for the enhancement of current guidance.

7.   References

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