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The Design of Autism-Friendly Learning Environments:

Exploring Flexibility in the Built Environment as a Means to Support the Variability of Individual Manifestations of ASD

Assignment 2a | Final Research Report

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DESN47900 | Design Research 2

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ABSTRACT

The contents of this research paper focus on the impact of flexible design approaches within the physical learning environment (PLE) on adults with autism spectrum disorder (ASD). An emphasis is placed on the spectrum aspect of this disorder throughout the text; as existing literature generally presents design solutions intent on making spaces easier to adapt to, rather than creating a space that adapts to the users' varying and changing needs. The objective of this research is to study flexible design elements identified through a review of relevant literature. The study will measure their positive impact (quantitative survey) to determine how designers can utilize flexibility more effectively to elicit desired behaviours and assist specific functions (support learning, socialization, independence, a variety of needs/ learning styles, and overall comfort/ well-being). Findings gathered through additional qualitative research (open-end survey questions and follow-up interviews) fill the gaps in the existing literature by connecting broad approaches and specific elements with practical applications for interior designers. This study successfully links flexibility and growth in adults with autism; in turn, validating the need for such design approaches. Using results, I have been able to devise a "Revised Flexible Design Criteria for Autism-Friendly Spaces" along with five key implications for developing future learning spaces capable of supporting the variability of individual manifestations of ASD. The need for additional research has been highlighted to examine the relationship between socialization in adults with ASD and the built environment as well as explore solutions that can be used along with flexible approaches to enhance the overall environment for adults with autism (colour, finishes, textures, etc,).

KEY WORDS:
Autism, Autism Spectrum Disorder (ASD), Learning Environments, Flexibility, Space Planning, Interior Design

CONTENTS

1.0 INTRODUCTION

The job of architects and designers is to create spaces that are not only functional but also improve the users' experience; this means considering all occupants and their different abilities to effectively remove barriers within the built environment for those with disabilities. In this industry, we have access to resources such as The Americans with Disabilities Act (ADA) and Universal Design Standards that help guide the design of inclusive spaces. These codes and standards tend to focus on physical/ visible disabilities and are extremely helpful in this regard, but what is to be done when tasked with designing a space for disabilities that can't necessarily be seen like autism?

Autism Spectrum Disorder (ASD), often referred to simply as autism is a complex range of closely related neurological and developmental disorders. ASD is known as a "spectrum disorder" because of how symptoms and their severities vary dramatically across individuals with the disorder (Clouse et al., 2019, p. 217). Although symptoms of ASD may differ from person to person and even vary within an individual, there are often similarities when it comes to the core identifying characteristic of the disorder. These characteristics include difficulty communicating, trouble with social interaction, issues with sensory processing (hypo or hyper sensitivities), and an affinity for routine and predictability (Hosny & Anous, 2015, p. 91).

In the past few decades, scholars and policymakers have become increasingly aware of the relationship between those on the autism spectrum and the built environment. This awareness is reflected in the focus of recent research studies and the development of new design guidelines. The existing research and standards provide designers with a foundational understanding of the physical barriers in the built environment; as well as their impact on the behaviours, reactions, and overall learning experience of those with ASD. With this said there is still a lot to be studied so designers can create physical learning environments (PLE) capable of meeting the different needs of individuals with ASD occupying the same space.

The following report aims to emphasize the spectrum aspect of the disorder; this means understanding that the needs, preferences, capabilities, and symptoms as well as their severities vary dramatically across those with ASD and even within an individual on a day-to-day basis. It is my belief that once we understand, acknowledge, and focus on the inconsistencies in the needs of those with ASD we will be able to design autism-friendly spaces that not only eliminate barriers but are able to meet the needs of many (not only beneficial for those with autism but also makes space universal and comfortable for all). My research sets out to explore the impact and effectiveness of flexible design approaches identified in the existing literature. The primary and secondary findings will be discussed in terms of practical applications; effectively guiding designers in the development of future PLE that are better equipped to meet the needs and desires of adults with autism.

2.0 LITERATURE REVIEW

This literature review and the subsequent research study/ thesis work will focus on the design of practical life-skill learning environments for individuals with ASD aged 18+ (adults preparing to enter adulthood/ looking for more independence) as they are often overlooked. Individuals with ASD each have their own unique set of abilities, challenges, sensitivities, and needs that must be taken into consideration throughout the various stages of the design process (Sheykhmaleki et al., 2021, p. 557). There is a well-known aphorism that states "If you've met one child with autism, you've met only one child with autism"; it is important to recognize and understand this idea so we as designers refrain from generalizing. In other words, we must not only design spaces to accommodate the different symptoms and challenges experienced by those with ASD but we must also consider how the changing needs of each individual will be addressed within each space (depending on the situation, activity, and other external or internal factors). Upon establishing this need within autism-friendly spaces it is clear that designing with any one-sided

approach (the idea of one size fits most) is unrealistic for fostering growth and independence.

This report will go on to present flexible design approaches as a solution to meeting and accommodating the conflicting needs of users with ASD within a single space. Flexibility in design has been debated by researchers for decades, but such research has only begun looking at its impact on those with ASD in recent years. This literature review looks over a total of 12 articles on the topic and will discuss both the strengths and weaknesses of flexible design approaches. The review will cover 3 main themes:

1. Flexibility for different users in the form of adaptable/adjustable furniture and equipment,
2. Flexibility for different uses in terms of a variety of options in the size, type, and arrangement of furniture and equipment,
3. Flexibility for different needs in the form of mobile components that allow users autonomy through design.

Through analyzing the existing research I hope to deepen my understanding of the conceptual framework and practical design implications needed to create an autism-friendly learning environment. Additionally, I have included the following inquiry questions to help guide my analysis and make a stronger connection between the built environment and the behaviours of adults with ASD.

A. What effect do flexible design approaches within the PLE have on adults with ASD?
B. What are the limitations to flexible design approaches? What problems does this design strategy present?
C. How can the implementation of flexible design solutions address the varying needs of users and in turn influence their behaviour and reactions (facilitate learning and growth, support social interactions/ socialization, foster independence)?

I hope to find the answers to these inquiries within the existing research to determine what elements of the PLE can be used to facilitate learning and elicit desired behaviours (e.g encourage interaction and promote independence). On the other hand, if questions are left unanswered this will help me identify gaps in the existing literature in order to guide and position my own research study.

2.1 Adaptability & Adjustability (Flexibility for Different Users)

The simplest way to introduce flexibility for individual occupants is through adjustable furniture and equipment (designed to adapt to the user's body/ needs). To achieve adjustability and adaptability designers must carefully consider what products they use within a space, including anything from seating and tables to lighting. By selecting furniture and equipment with adaptable/adjustable assemblies and configurations (e.g sit-to-stand desks) designers can accommodate a wider range of occupant needs. Presently this selection process has become increasingly easier as many manufacturers develop products that are customizable (add different levels of adjustability) or simply offer products with a choice of fixed or adaptable components. Adjustability can be seen in a product's ability to adapt at a moment's notice to serve users of various shapes, sizes, and physical capabilities (Clouse, 2019; Fehlandt, 2017; Gaines,2016; Öktem, 2010). This ability to alter the elements already included within a space eliminates the need to add additional features, making this one of the most popular solutions for achieving such flexibility.

Much of the literature pertaining to the design of autism-friendly spaces does not explicitly mention this element of flexibility (Apart from Clouse, 2019; Fehlandt, 2017; Gaines,2016; Öktem, 2010). In reference to current trends and emerging standards in design, I speculate this lack of discussion exists due to the increasing consideration and awareness surrounding ergonomics and anthropometrics within the design industry. This awareness has led adjustable and adaptable solutions to become more of a common practice within the field. For this reason, I believe the minimal discourse should not be interpreted as a lack of support for these design implications; but rather viewed as a consequence of changing values and standards within the design community (becoming an expectation in a lot of public spaces).

Gaines (2016, p.177) explains the need for such flexible furnishings in learning environments by emphasizing how these adjustable elements provide users with a sense of control. Such control over their environment is important as it allows individuals to adjust freely to accommodate

stimming behaviours used to regulate and focus (e.g standing, fidgeting, swinging, etc.). Furthermore, I would like to stress the importance of adjustability in connection with my target group (individuals with ASD aged 18+); including furniture that can adapt at a moment's notice to fit its user is vital for this group as discrepancies in the shapes, sizes, and mobility of these individuals is to be expected. Adjustable/adaptable furniture and equipment should be considered in all spaces throughout the PLE as they are not only helpful for users with ASD but they also contribute to the overall accessibility of the space; with ergonomic benefits that can be enjoyed by all.

2.2 Variety & Options (Flexibility for Different Uses)

Flexibility in design does not only refer to the ability of an individual element to adapt, adjust, or move; flexibility can also mean providing opportunities for choice-making. This principle of flexibility is identified as the presence of variety/options within the built environment. Similar to principles of adjustability/adaptability, variety is only explicitly mentioned a few times throughout the literature. In contrast to adjustability/ adaptability, variety/options have been researched more in connection to ASD specifically. As a result, researchers have been able to gather more empirical evidence on the positive effects variety/options have on the behaviour of individuals with ASD.

This flexible design approach has been proven to enhance feelings of comfort, intimacy, and safety by allowing users to control levels of social interaction as well as their desired learning style through opportunities for choice-making (Fehlandt, 2017; Gaines et al., 2016; Hosny & Anous, 2015; Sheykhmaleki et al., 2021; Tola et al., 2021). The simplest way to include variety is through the types and sizes of furniture and equipment (Fehlandt, 2017; Martin, 2014; Patel et al., 2022); for example, incorporating a variety of different seating options that offer different experiences (e.g task chair, soft seating, bench, floor cushion, therapy ball, swing, bean bag, etc.). Furthermore, options may be provided through a variety of different spatial layouts of such furniture that allow for different learning experiences and levels of privacy/ social interaction (e.g chairs around a large table, individual workstations, etc.). Fehlandt (2017, p. 28) goes on to add to the scope of options by suggesting that designers not only consider variety in the types of furniture, but also the types of uses (addition of multifunctional elements). Potential design implications may include mobile shelving units that can act as a partition to separate independent spaces from the more lively group environments (Fehlandt, 2017, p. 29). This approach is significant for autism-friendly spaces as such design implications have the ability to positively impact student behaviours (e.g aid social interaction) and support development (allowing independent work, group work, and leisure to take place simultaneously).

2.3 Mobility & Space Planning (Flexibility for Different Needs)

The last flexible design approach of mobility that I will be discussing is also the most controversial among scholars. The scope of mobility within interior design ranges from individual furniture to the addition of freestanding dividers or temporary partitions; all of which are equipped with lockable wheels or made of lightweight materials to allow for easy transportation. Since these elements are mobile they make it possible for users to alter the spatial arrangement; meaning we must also consider the potential issues of space planning that may occur as a result of such flexibility.

Öktem states the “balance between an overwhelming crowded space and a space which is too much isolated can be attained by being able to change a room according to the needs and preferences of a child. Since these children differ from each other in terms of their likes and dislikes, flexibility becomes another important concept which is stressed by the people working with autistic children.” (Öktem, 2010, p.49). Scholars generally agree with this idea that including flexibility in the form of mobility is beneficial (Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021). This positive opinion is based on how the approach allows users to alter the spatial layout/ change arrangements; as a result affording occupants with autonomy through design. Such autonomy over the PLE is beneficial to users with ASD as it provides more control over

situational factors such as privacy and proxemics. According to Gaines (2016, p. 71), “choice involves the ability to decide how much interaction we have with others and under what circumstances; control involves the ability to adjust the physical environment or regulate exposure to surroundings.”. This statement further explains how mobility can be utilized so that users with ASD are supplied with a safe space that allows for emotional release, self-evaluation, and protected communication (Gaines et al., 2016, p.71). Although a majority of the research cited in this literature review supports this positive relationship between mobility in the PLE and those with ASD (Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021) support for this approach is not universal.

In contrast to these positive views on mobility are scholars capitalizing on the affinity of individuals with ASD toward routine and predictability (Altenmüller-Lewis, 2017; Henry, 2011; Hosny & Anous, 2015; Tola et al., 2021). The opposition proposes that the amount of change made possible with the addition of mobile components may be harmful/ disruptive to individuals with ASD using the space (in terms of comfort, focus and perception of space). Altenmüller-Lewis (2017, p. 174) argues this position by relaying results from “the study of the world of experience of people with autism” which found that the predictability and regularity of a physical environment play a large role in the spatial behaviour of people with autism. In other words, the opposition operates on the belief that it is a space's predictability that is responsible for/ necessary to create such a safe autism-friendly space.

This will likely remain an ongoing debate between scholars, as those with ASD experience space differently. Because of this difference in experience discrepancies in research results on the debated topic of mobility will persist, making it hard for scholars to arrive at a concrete answer (inconsistent research findings in turn create inconclusive implications). My views on this debate align more with scholars in favour of mobility, with my position landing somewhere in the middle. Based on the existing findings, I think mobility does indeed have a place in the PLE as it allows for a truly responsive design equipped to meet the needs of many. On the other hand, I agree with the concerns of the opposition regarding a lack of predictability/ familiarity. Öktem (2010) began to explore this idea of balancing the two views (opposing sides); it is this balance that I want to study more in my own research to be able to determine a more comprehensive solution that is capable of addressing both sides of the debate. Öktem (2010, p.49) has defined this balance of flexibility in design as the ability to transform an environment at a moment's notice rather than the presence of constant change. I am interested in discovering how this could be accomplished using seemingly unrelated spatial design criteria to restrict the amount of change caused by mobile components. An example of this controlled mobility may be the use of well-defined rooms with smaller mobile furniture and dividers within. Having fixed a spatial structure helps to enhance predictability and reduce unexpected situations that may prove troublesome for people with ASD (Tola et al., 2021, p. 7); while the accents of mobility within the spatial structure allow users to control/ customize their learning environment at an individual level.

2.4 Overall Effectiveness + Limitations (Flexible Design Approaches)

The existing research adds to my understanding of the benefits of using flexible design approaches, while also opening my eyes to the potential challenges and set of limitations. The use of adaptability/ adjustability, variety/options and mobility have been studied moderately; with most scholars' agreeing that flexibility has the potential to enhance learning and overall quality of experience. These shared opinions are based on the idea that “as designers, it is important to empower each person using a building to be able to interact with and modify spaces to address their immediate and changing needs” (Clouse et al., 2019, p.227). Alternatively, Henry (2011) warns designers of the limitations as it is possible to go overboard; he urges them to question “how much flexibility and diversity is too much?”. It is important to remember who you are designing for and consider all of their needs; this includes the strong aversion to change possessed by many individuals with ASD (forming

the basis for such cautionary statements and the opposing views on mobility).

Seeing as the research in favour of flexibility and that of the opposition both have empirical support and their own set of challenges, I think it is worth exploring how they can be balanced. With this, I am proposing the development of a more responsive solution/ list of design applications that are aimed specifically at managing the degree of flexibility in different environments. For these reasons, I have adjusted my research to focus on the effect of flexibility within certain impact areas and the balance of meeting a variety of needs while providing a space that feels safe and familiar. Henry (2011) briefly touches on this idea of balance with the statement; "creating as diverse an environment as possible, that isn't over-stimulating to provide a space that children feel safe and comfortable in".

2.5 Considerations

Upon completing my literature review it is clear that designing autism-friendly spaces is a complex task (no one size fits all approach). This is evident by the contrast in findings and the range of different design criteria put forth by scholars throughout the analyzed texts. A consistent theme throughout all of the literature is an issue of how to design for the diverse spectrum of needs that come with ASD, illustrated further by Tola et al., 2021 (p13) in the statement: "we did not consider the great variability of individual manifestations of ASD". Additionally, there is the issue of flexibility being touched on briefly by many, but not researched as the focus of most studies. In light of these issues, my own research will focus on flexible design approaches as they deserve to be explored in depth for their potential to address diverse and changing needs.

My next step will be to determine how the findings on flexibility in design relate to adults specifically (rather than younger children) and consider how they might differ depending on the users, activities, and levels of interaction expected in each program type. Furthermore, although some articles looked at educational spaces I think it is important to consider how results may vary if studies were conducted exclusively within learning environments (instead of looking at the built environment as a whole) to determine the best way to facilitate learning and elicit desired behaviours through design.

Altogether this review has effectively identified what flexible design criteria exist and their effectiveness + limitations; in addition to how the built environment impacts the behaviours of those with autism. This information is referred to as secondary research or the "known" as it is well established throughout the existing literature. It was important to me that I developed a comprehensive understanding of what is "known" to position my own research in a way that does not simply reproduce the findings from these studies. With the knowledge gained through the literature review, I hope to add to the understanding of the relationship between ASD and the built environment; helping designers connect principles and practical applications. To achieve this I plan to create a new precedent for the design of autism-friendly learning environments based on flexible approaches.

3.0 METHODOLOGY

The objective of this study is to gain insights needed to answer each of my research questions and find balance in the areas within existing research which are heavily debated or have repeatedly displayed inconsistent results. The research will aim to answer the following questions:

1. How important is flexibility in the learning environment (specifically pertaining to adults with ASD) to the learning process and development of life skills?
2. To what extent are flexible design elements being utilized within existing spaces and are they effective/ appreciated?
3. Where in the PLE is the application of flexible design approaches most (or least) effective/ appropriate?

Overall I believe it is important that flexible design approaches are researched further, as such knowledge has the potential to improve the design of future PLEs for those with ASD. If we deepen our understanding of this relationship and how it can be made more flexible to accommodate the variability in individual manifestations of ASD; designers can use the built environment more effectively as a tool to assist specific functions and

elicit desired behaviours (in this case facilitate learning, independence and the development of social skills). The hope is that my findings will be able to validate/ confirm the need for flexible features in autism-friendly spaces. In turn, allowing me to confidently present flexibility as a design solution for the development of future PLEs supporting adults with ASD (acting as a precedent for designers).

3.1 Participants

The research study has been designed with consideration to the rules and guidelines outlined by the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS) and takes into account that this research topic involves individuals who lack decision-making capabilities (in this case due to cognitive impairments and/or intellectual disabilities). This makes them vulnerable in the context of research but does not mean they are to be completely excluded from the study. Consequently, I have decided to sample support workers of those with ASD rather than the individuals themselves. I am doing this for two reasons; the first being that I am a student with limited access and am conducting research on a more restricted timeline. The other motivation behind the decision is that the secondary research analyzed earlier included individuals with ASD as participants. Therefore, for the purpose of my study, it is not necessary to have this vulnerable group consent to additional testing as the information I would be gathering through interviews or observation has already been widely studied. This includes the behavioural aspects of the disorder and research on how they perceive and experience space as a whole (these are known and agreed upon so conducting added research in this area would not benefit the field or add to our existing knowledge/understandings).

The sample group for this study is to be comprised of informants with professional experience supporting individuals with autism; looking specifically at those who have worked in learning and development-type settings. Responses will be based on the professional opinion of participants; using their experience, observations, and knowledge of ASD.

To gauge the eligibility of participants and the relevance of their responses; the survey starts with general questions about their qualifications (positions held supporting individuals with autism) and the age of individuals they have professional experience supporting. These have been added to ensure results are indicative of the specific group and space type being studied.

3.2 Process

The study will utilize mixed methods for data collection; conducted in 2 parts. Methods include a quantitative survey and a qualitative question & interview(s). The first step in my research process was the development of “Flexible Design Guidelines” based on the recommendations and design criteria in existing studies (focusing on flexibility); this is a synopsis of secondary research findings (Table 1). The design approaches and specific elements outlined in the table take what is known from the 12 sources analyzed in the literature review to test the information in a new/ more focused context (e.g I will be looking specifically at the use and impact within the learning environment and not the built environment as a whole).

These design guidelines have then been placed in a survey-type format; titled “Flexible Design Guidelines Survey”. The survey is broken up into 3 parts based on design approach (Table 1, Column 1). Under each approach, specific design elements are listed (Table 1, Column 2) and rated in different sections using a 5-point scale (on which 5 is the highest positive impact and 1 being no positive impact). The sections will measure the perceived effectiveness and impact of elements on adults with autism, they are labelled: (A) Facilitating learning, (B) Encouraging socialization, (C) Promoting independence, (D) Supporting different needs & learning styles simultaneously, (E) Overall Wellbeing & Comfort. Following each rating section participants will be asked if they have seen the elements within spaces they have worked (answered with a simple YES or NO). Putting it in this format will allow me to quantify some of the qualitative aspects of the research on flexibility by generating more direct responses that relate directly to the research topic. The hope is that this will make analyzing the data more straightforward (within this first method) to effectively establish a clear

relationship between design elements in the PLE and their ability to elicit desired behaviours from individuals with ASD.

The second data collection method is qualitative; this includes a single open-ended question placed at the end of the initial online survey, as well as an optional follow-up interview. The written survey question will focus on the research topic: "Note below any additional design recommendations that you believe would make the physical environment more conducive for adults with autism". On the other hand, the questions asked during the follow-up interview will be framed around the participants' survey ratings/ responses; allowing me to gain a deeper understanding of the results and identify + fill gaps within my own research.

*Note: The full survey & list of interview questions can be viewed in the Appendices; included at the end of the report.

TABLE 1
Flexible Design Guidelines - Approaches & Elements to be Studied

	Design Approach (Definition)	Design Element (Example)
1.0 Adaptable/ Adjustable	**Flexibility for Different Users:** Including elements within the design that can be adjusted and adapted to its users' body & needs.	**1.1 Furniture & Equipment** (adjustable height tables & armrests + seats on chairs) **1.2 Environment - Lighting** (top-down bottom-up shades & dimmable light fixtures)
2.0 Variety/ Options	**Flexibility for Different Uses:** Providing occupants with design elements (such as furniture) in various sizes, types, functions/ uses, as well as spatial layouts/ furniture arrangements. Such options create opportunities for choice-making and control; for example, a space with both individual workstations and large tables surrounded by chairs allows independent and group work to take place simultaneously.	**2.1 Furniture & Equipment (variety in types/ sizes)** (seating options within a single room include rolling office chairs, a couch, bean bags, and floor cushions) **2.2 Furniture & Equipment (multifunctional elements)** (storage units that act as dividers in open spaces) **2.3 Spatial Layouts** (variety of furniture arrangements such as chairs around a table, lounge seats, individual workstations, etc.) **2.4 Space Types/ Uses** (escape spaces within larger rooms to retreat to)
3.0 Mobility	**Flexibility for Different Needs:** Mobility in design can include various products ranging from furniture/ equipment to the addition of freestanding dividers (temporary partitions); all of which are either equipped with wheels or made from lightweight materials to allow for easy transportation. This offers occupants autonomy through design by allowing a space to be reconfigured to meet changing needs of its users and functions.	**3.1 Spatial Layouts (mobile furniture & equipment)** (chairs & tables on wheels to be easily rearranged) **3.2 Temporary Walls** (additional freestanding dividers on wheels, etc.) **3.3 Multifunctional Spaces** (dividable rooms - built-in folding panel/ accordion wall) **3.4 Environment - Acoustics** (mobile acoustic barriers such as acoustic panels on wheels or acoustic fabrics on curtain tracks)

4.0 RESULTS/ FINDINGS

This section will report the findings of my research study; summarizing the information gathered using the applied methodologies (survey and follow-up interview). The purpose of this study was to obtain clear quantitative data on the relationship between the design of PLE and the behaviour/ reactions of adults with autism who interact with them (flexible design guidelines survey). The additional qualitative data obtained through the interview and open-ended survey questions are in place to deepen the understanding of participants' reasonings (behind survey ratings) and uncover potential improvements and barriers that are not explored in depth through initial impact scale ratings.

My research focuses on the application of flexible design approaches (adaptable/adjustable, variety/options, and mobility) in terms of their perceived impact in 5 key areas:

(A) Facilitating learning,
(B) Encouraging socialization,
(C) Promoting independence,
(D) Supporting different needs & learning styles simultaneously,
(E) Overall Wellbeing & Comfort.

With this focus, the study aims to identify the realized and/or potential value of specific flexible design elements (if any) and identify where their application adds the most value. The information gathered will allow connections to be made between occupant experience and the built environment (more specifically, understanding the appropriate implementation of defined approaches & elements).

A total of 3 participants took part in this study; each having worked with all ages throughout their careers. Participants were reminded throughout the survey to focus ratings on the impact to adults (aged 18+) with autism. All three informants completed the online survey; including one or more recommendation(s) in response to the final open-ended question along with ratings. In terms of follow-up interviews, only 2/3 of those took part.

Results gathered from participants using methods outlined in the previous section are to be detailed in 3 parts:

1. Impact scale ratings of flexible design approaches; breaking down the total weight of individual flexible design elements (Figure 1a-1e) & overall of each approach (Figure 2).
2. Presence of elements studied within existing spaces; based on observation and experience of research participants (Figure 3-5).
3. A summary of findings and recommendations from follow-up interviews & final open-ended survey question (Table 2).

4.1 Part One - Impact

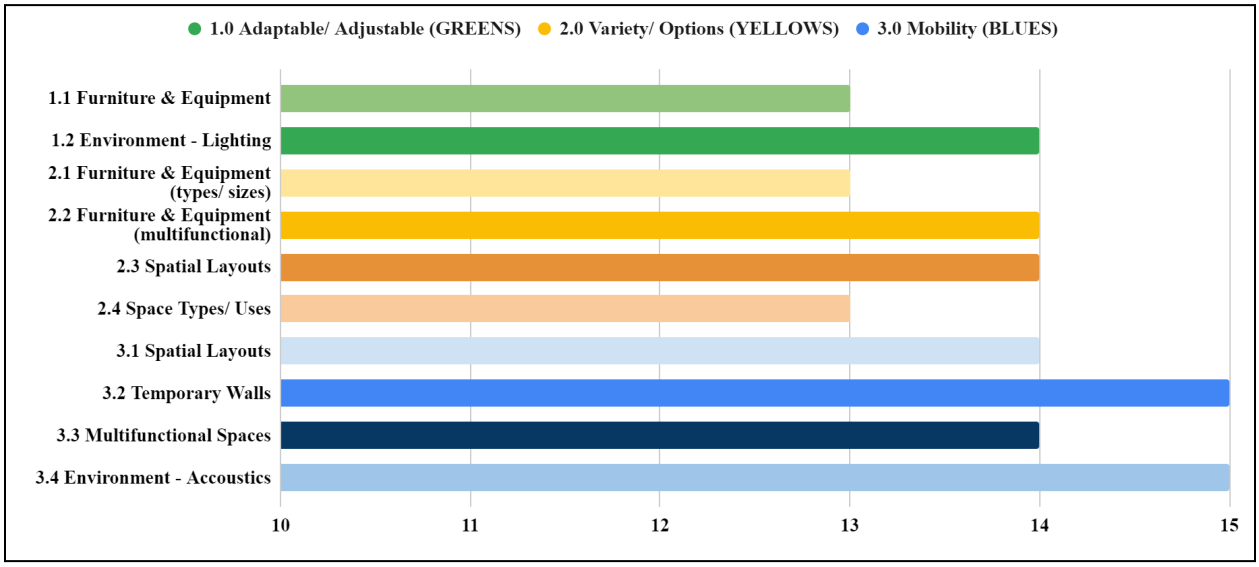
The relative weight of the five key areas studied are shown in Figures 1 and 2. These figures show the individual impact rating of design elements researched within three design approaches, as well as the overall weight of each. Flexible design approaches were identified during the review of existing literature and defined for participants, as outlined in Table 1, Column 2 (to ensure accurate rating could be made without the need for previous design knowledge). Additionally, participants were given examples along with each design element in the survey (Table 1, Column 3). This was done to provide clarity as to what was to be rated (an actual feature rather than a concept) and make sure all participants were rating the same elements (not left up to interpretation/ assumptions).

Informants were given the following 1-5 rating scale breakdown to use in response to the flexible design guidelines survey.

1 = no positive impact
2 = positive impact is minimal
3 = positive impact is moderate
4 = positive impact is sufficient
5 = positive impact is substantial

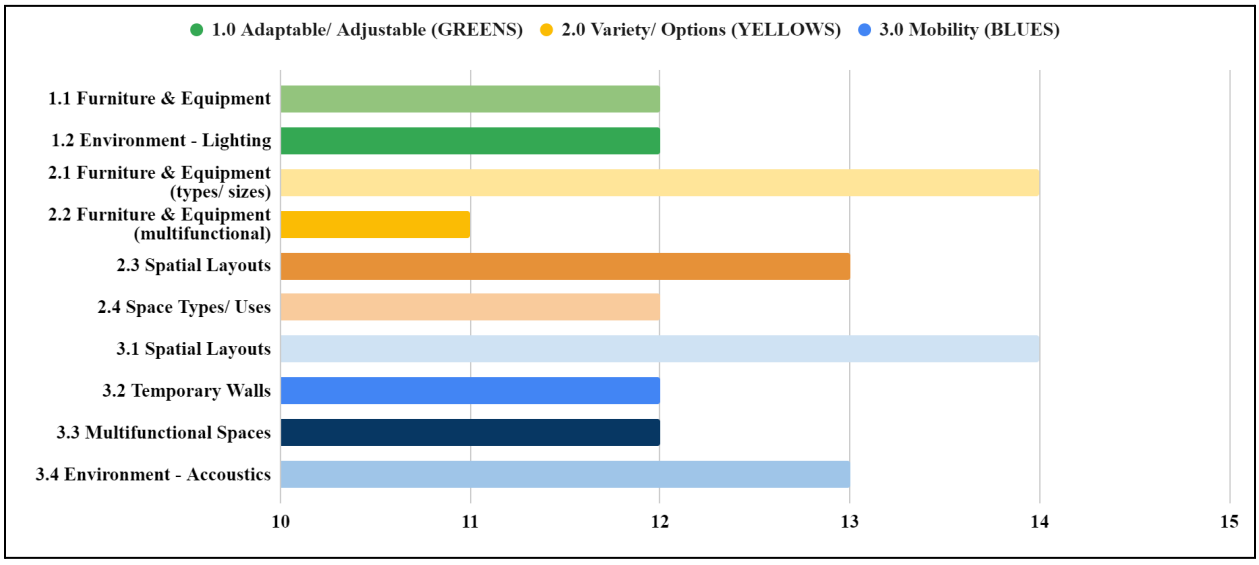
Scales quantifying the relative importance of each element vs approach have been calculated differently to accurately determine the weight of each. For Figures 1a-1e bar charts are showing the individual impact of each element within the approaches and have been represented simply by the sum of the three participants' impact scale ratings (each rated on a scale of 1-5 - total weighing on a scale of 1-15). In Figure 2a-2b the sum of data has been calculated and converted to percentages (shown as scale of 1-10). This is done to accurately summarize findings and compare approaches; since approach 1.0 tested only two elements, while approaches 2.0 and 3.0 presented four each.

FIGURE 1a
Impact of Design Elements - (A) Facilitating Learning



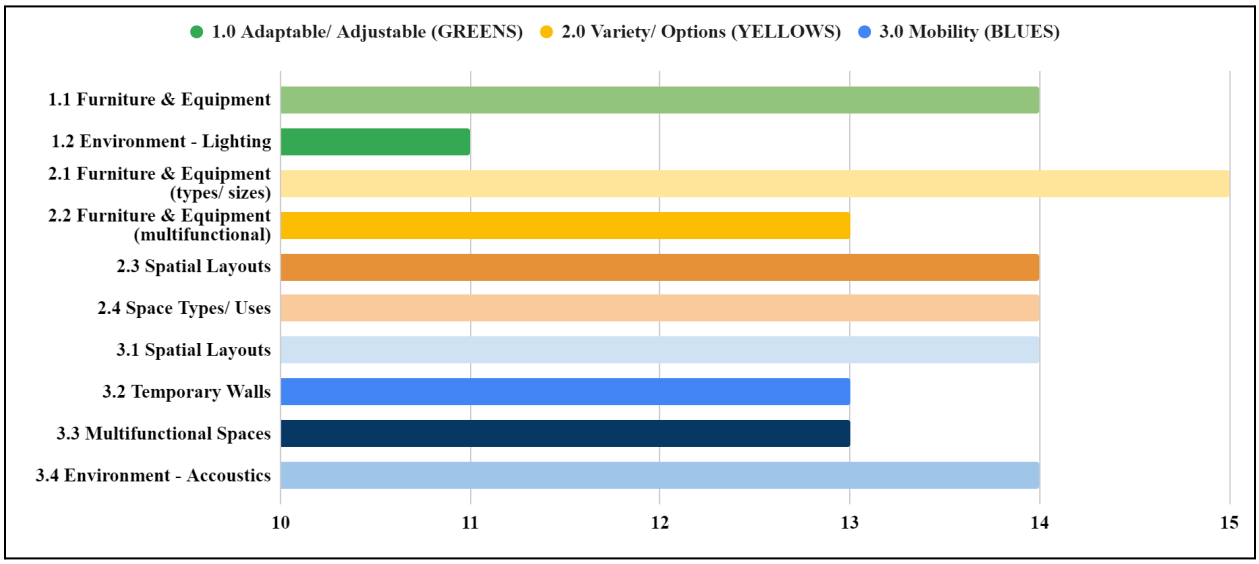
**Results in Figure 1 graphed starting at a total impact rating of 10 (none of the studied categories received below 10/15).*

FIGURE 1b
Impact of Design Elements - (B) Encouraging Socialization



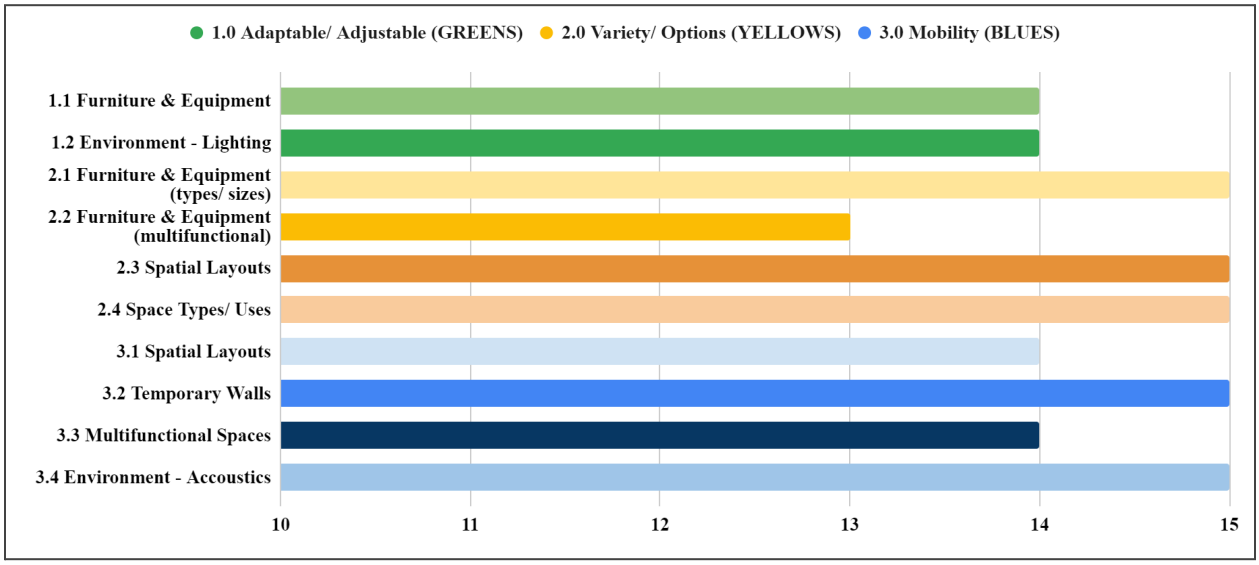
**Results in Figure 1 graphed starting at a total impact rating of 10 (none of the studied categories received below 10/15).*

FIGURE 1c
Impact of Design Elements - (C) Promoting Independence



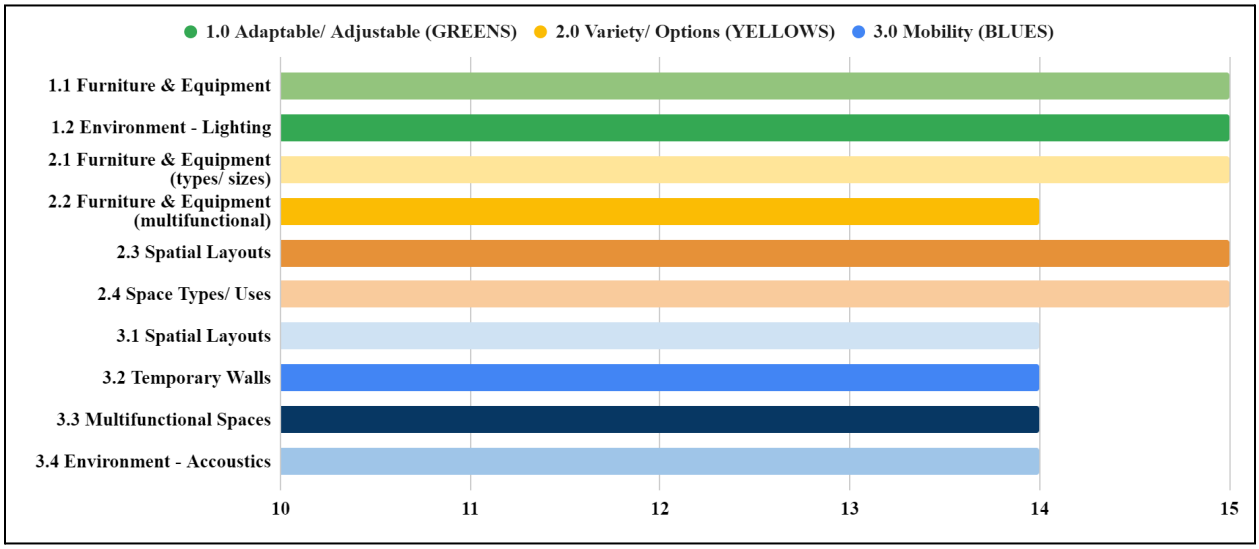
**Results in Figure 1 graphed starting at a total impact rating of 10 (none of the studied categories received below 10/15).*

FIGURE 1d
Impact of Design Elements - (D) Supporting Different Needs & Learning Styles



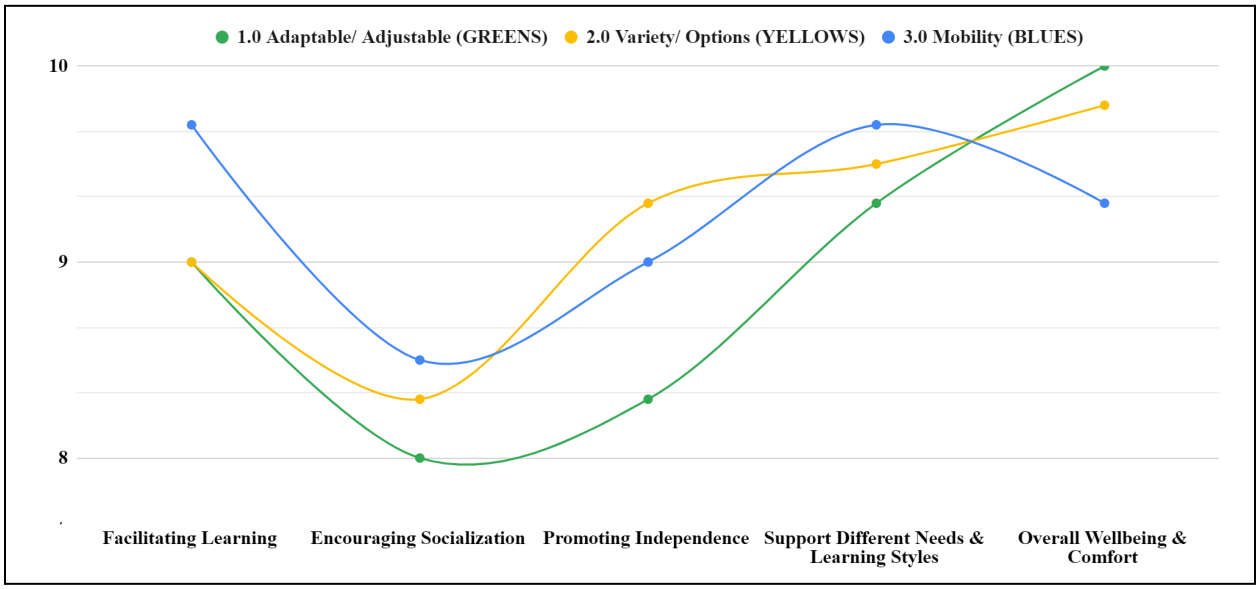
**Results in Figure 1 graphed starting at a total impact rating of 10 (none of the studied categories received below 10/15).*

FIGURE 1e
Impact of Design Elements - (E) Overall Wellbeing & Comfort



**Results in Figure 1 graphed starting at a total impact rating of 10 (none of the studied categories received below 10/15).*

FIGURE 2
Overall Impact of Design Approaches



**Results in Figure 2 presented starting at a combined impact rating of 8 (no approach being studied received below 8/10)*

Significant findings/ data shown in these bar graphs communicate a strong relationship between visual dividers and acoustic barriers (elements providing privacy control) and the facilitation of learning; while flexible furniture solutions weigh lowest across all approaches in this key area - Figure 1a. Additionally, a trend can be seen among flexible spatial layouts being ranked the highest for encouraging socialization - Figure 1b. In regards to promoting independence participants identified furniture and variety of value (ranked among the highest in this area) - Figure 1c.

When moving on to look at the overall impact of design approaches; a noticeable trend in this line chart is the lesser impact of flexibility on encouraging socialization when compared to other key areas. On the other end, is a clear correlation between flexible design approaches and the overall well-being and comfort of occupants; this general appreciation extends to the support of individual needs & learning styles.

4.2 Part Two - Utilization

Participants were asked after each series of impact ratings to answer Yes or No if they have seen the flexible design elements within the spaces they have worked. The data presented in the following pie charts reflect the utilization of flexible design elements within existing spaces. Based on the results it is evident that the value of adjustability and adaptability has been recognized through the PLE. Additionally, elements of variety and options are consistently utilized; whereas mobility approaches are applied at a lesser scale. *Note results speak only to participant experience of learning environments in Ontario.

FIGURE 3 *(1.0 Adaptable/ Adjustable)*
Flexible Design, Current Utilization

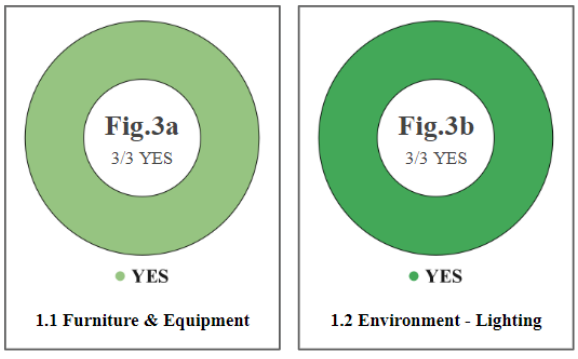


FIGURE 4 *(2.0 Variety/ Options)*
Flexible Design, Current Utilization

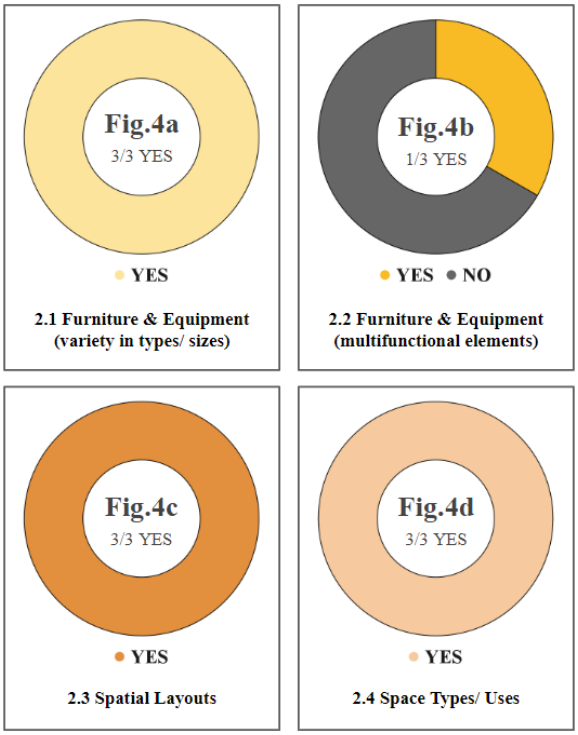
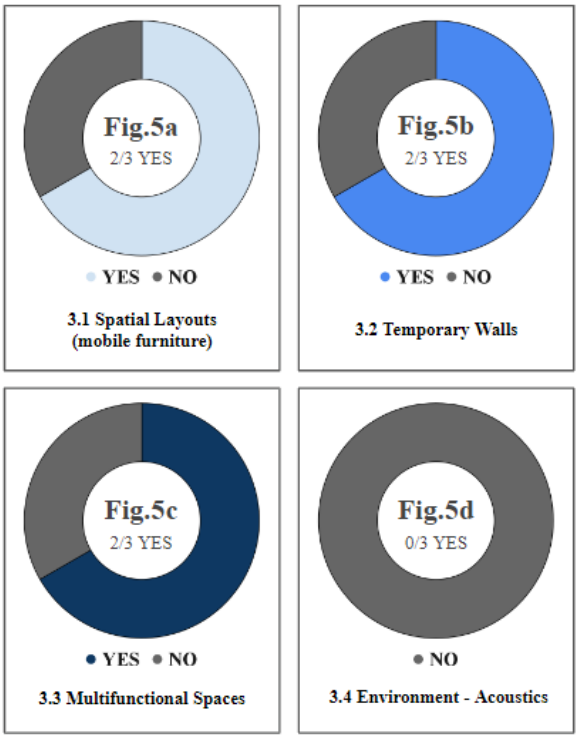


FIGURE 5 *(3.0 Mobility)*
Flexible Design, Current Utilization



4.3 Part Three - Recommendations

This final part looks at the supplemental qualitative statements given by participants; backing the survey. At the end of the online survey, subjects were asked to note any additional design recommendations they believe would make the physical environment more conducive for adults with ASD; as well as being invited to take part in an optional follow-up interview. Table 2 summarizes answers to this question at end of the survey (answered by all 3) and paraphrases statements given during follow-up interviews (conducted with 2/3 participants).

This table identifies new elements and expands on some of those discussed within the survey. Recommendations have been organized by theme and potential impact. A particularly interesting finding is the suggestion to use variety/options to facilitate learning over mobile elements; despite mobility being rated higher in the survey. When asked to expand, one of the participants cited how adults with autism's affinity for routine and familiarity can be accommodated with more variety in focused areas rather than mobile elements that might be distracting and impede learning. Another participant stated the importance of being able to look at how users learn best to support the need for variety/options. This participant gave the example; "If you are working with an individual at a standard desk and chair and they don't seem engaged it is valuable to have the option to change working environments to say a standing desk or sitting on exercise balls that provide more stimulation". These points reinforce their recommendation and the need for variety and options in such spaces; while mobile furniture is suggested to be more appropriate in independent development spaces where users can configure the space to meet their needs without distracting others or the learning activity taking place. It is also relevant to point out the lack of discussion related to adaptability/adjustability within qualitative research methods (similar to discourse within existing studies analyzed during the literature review).

TABLE 2
Summary of Findings from Follow-Up Questions & Interviews

Theme	Impact	Design Element (Example)
Furniture & Equipment	(A), (C), (D)	**Variety and options (2.0)** within shared learning spaces and **mobility (3.0)** within informal or independent areas.
Space Planning/ Layout	(A)	**Smaller rooms or additional dividers to break up open areas:** More focused environment created, does not have to be a standard wall but anything that will divide the space (e.g bookshelf).
	(D), (E)	**Sensory space type:** Incorporating areas for refuge for adults to use in times of stress or overstimulation. Space to listen to music, lay with a weighted blanket, etc.
		Minimize transition space: Organizing spaces (adjacency considerations for related rooms) in a way that makes it easy to get from one space to another. This is also applicable to space planning within individual rooms - making it easy to switch from one task to another (e.g group learning to independent work made possible with desks and chairs on wheels that can be separated easily).
Environment	(A)	**Added acoustic provisions:** Most spaces lack acoustic properties needed by those with autism. Reduction of noise is paramount to minimize distractions (especially within spaces that serve multiple users at a time) and prevent overstimulation.
	(D), (E)	**Variety in materials and finishes**: Different textures for sensory experiences as well as attention to how firm or soft elements are.

(A) = Facilitating learning, (B) = Encouraging socialization, (C) = Promoting independence, (D) = Supporting different needs & learning styles simultaneously, (E) = Overall Well-being & Comfort.

5.0 DISCUSSION

Throughout this report, the importance of flexibility in environments built for adults with ASD has been emphasized. The objective of my study was to determine how flexible design elements impact users' ability to perform specific tasks and develop different skills. By focusing on the spectrum aspect of this disorder my research has been positioned successfully to add to and fill gaps within existing studies.

In completing a literature review on 12 academic sources and conducting my own research study (survey + interview) I am able to confidently present flexible design approaches as tools for "student" success. I will be comparing findings obtained from both the secondary and primary research to develop a "Revised Flexible Design Criteria" in which existing design guidelines are re-evaluated and adapted to better fit the needs of adults specifically and support functions of learning environments (not built environment as a whole). My intention is for the criteria to be used as a precedent in the design of more responsive spaces (balance between flexibility and predictability). Additionally, I will be acknowledging the limitations of my own study and making suggestions for future research to promote further discussion. My hope is that this report will act as a catalyst encouraging others in the field to consider the needs of adults with ASD and explore how we as designers can empower this marginalised group through the built environment.

5.1 Summary of Key Findings

This report has been written around the hypothesis that flexible design approaches positively impact adults with ASD by supporting different needs/ learning styles, promoting independence, encouraging socialization, and facilitating learning. The results from my study and the relevant findings within existing research generally uphold this notion with unanimous support for adaptability/adjustability as well as variety/options, while discussion surrounding mobile elements is more ambiguous. Such partial support for flexible design approaches indicates a need for further research studying mobility more directly. In terms of their impact the overall consensus is positive; with more significant value found in the ability to support different needs and learning styles + overall well-being & comfort of occupants. A strong relationship was also found between flexibility and the facilitation of learning + independence, while its ability to encourage socialization was nominal. Overall, research validates a need for flexibility in autism-friendly spaces, while also highlighting areas where more consideration is needed (specifically for encouraging socialization) to either understand how to apply elements more effectively or suggest different approaches more relevant to this need.

Through my own research, I have been able to further connect recommendations for design with practical applications. Although we saw existing literature cover the benefit of flexible design approaches & elements (illuding to where they might be most beneficial), these texts force readers to make assumptions and form their own connections. This has led to inconsistency in the design of existing autism-friendly spaces which is made evident by the survey results seen in Part 2 - Utilization (Figures 3-5). These results show only consistent use of adaptable and adjustable design and speak to the tendency of designers to favour variety/options over mobility (aligning with views of scholars in secondary research).

Connections between approaches (defined in the review of existing literature) + elements (researched in my study) and the functions they best serve are outlined in Table 3. This table organizes findings by application (Column 1); identifying the recommended design criteria for each space/ function within a typical PLE (Column 2). Support for the proposed design criteria is also documented (Column 3), as such research provided the basis for these recommendations. The Revised Flexible Design Criteria not only summarizes key findings but can also be used by designers to determine where and how flexibility should be introduced to effectively support adults with ASD and the function of each space.

TABLE 3
Revised Flexible Design Criteria for Autism-Friendly Spaces

APPLICATION (Space Type - Use/ Function)	RECOMMENDATIONS/ DESIGN CRITERIA (Design Approaches & Elements)	KEY FINDINGS - SUPPORT (Primary & Secondary Research on Which Recommendations are Based)
A. General (Applicable to all space types)	**A.1 ADJUSTABLE/ADAPTABLE FURNITURE:** Included throughout all spaces in the facility to support a variety of needs + overall well-being.	**A.1 PRIMARY:** FDGS + **SECONDARY:** Clouse, 2019; Fehlandt, 2017; Gaines,2016; Öktem, 2010
	A.2 MULTIFUNCTIONAL ELEMENTS: Variety in use through furniture and equipment that serve more than one purpose (e.g storage units doubling as dividers in open spaces)- adding to spaces functionality + overall well-being of occupants.	**A.2 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Fehlandt, 2017
	A.3 MOBILE DIVIDERS/ TEMPORARY WALLS: Freestanding or retractable, to provide control over privacy and proxemics in shared spaces.	**A.3 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021
	A.4 ACOUSTICS: In the form of dividers (freestanding panels, curtains, etc.), structural assemblies and/ or finishes with added provisions.	**A.4 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Öktem, 2010; Patel et al., 2022; Sheykhmaleki et al., 2021; Tola et al., 2021
	A.5 ADJUSTABLE LIGHTING: In the form of dimmable fixtures & shades on windows - controls to be easily accessible to all occupants; allowing space to adapt on an individual level.	**A.5 PRIMARY:** FDGS + **SECONDARY:** Clouse, 2019; Fehlandt, 2017; Gaines,2016; Öktem, 2010
	A.6 MATERIALS & FINISHES: Variety of textures + firmness/ softness for different sensory needs.	**A.6 PRIMARY:** Follow-Up Interview
B. Sensory/ Focus Spaces - Self-Directed	**B.1 MOBILE FURNITURE:** Elements that allow for easy customization of space; to provide necessary sensory input + meet individual needs.	**B.1 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021
C. Classroom - Group Learning	**C.1 FURNITURE:** Focus placed on a variety of types and sizes, each offering different experiences (e.g sitting on an exercise ball to accommodate fidgeting and sensory needs vs. standard armchair for controlled experience).	**C.1 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Fehlandt, 2017; Martin, 2014; Patel et al., 2022
	C.2 LAYOUT + MULTIFUNCTIONAL SPACES: Options included to support different needs & learning styles, in the form of variety over mobility (e.g standard chairs around table, individual workstations, etc.). Also seen with the addition of designated areas for refuge within shared spaces.	**C.2 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Fehlandt, 2017; Gaines et al., 2016; Hosny & Anous, 2015; Sheykhmaleki et al., 2021; Tola et al., 2021
D. Experience Based Spaces (e.g Teaching kitchen & Model apartment) - Life Skills and Independence	**D.1 FURNITURE & LAYOUT:** Mobile furniture and equipment allowing users to adjust the space to meet individual needs and assist different activities (e.g utility cart, surfaces, and seating on lockable wheels).	**D.1 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021
E. Lounge/ Gathering - Socialization	**E.1 FURNITURE & LAYOUT:** Variety of different furniture and arrangements providing opportunities for choice-making and control over levels of social interaction (e.g personal spaces for 2-3 people vs. larger lounge seating arrangements).	**E.1 PRIMARY:** FDGS & Follow-Up Interview + **SECONDARY:** Fehlandt, 2017; Gaines et al., 2016; Hosny & Anous, 2015; Martin, 2014; Patel et al., 2022; Sheykhmaleki et al., 2021; Tola et al., 2021

**FDGS = Flexible Design Guidelines Survey*

5.2 Interpretation of Results & Significance

The results of this study are significant as they fill gaps within existing research and provide insight on the realized value of flexible design approaches for adults with autism. The objectives of my research have been met with findings that successfully answered each of the research questions presented at the beginning of this report:

1. How important is flexibility in the learning environment (specifically pertaining to adults with ASD) to the learning process and development of life skills?
2. To what extent are flexible design elements being utilized within existing spaces and are they effective/ appreciated?
3. Where in the PLE is the application of flexible design approaches most (or least) effective/ appropriate?

Results relevant to adaptable/adjustable approaches in design were as expected. The general benefits were recognized through high impact ratings in the ability to support different needs and overall well-being. In other impact areas of the survey (more specific to the learning environment) and qualitative responses, acknowledgement was low; similar to that within the existing literature. Based on current trends in design (substantiated by their consistent application within current spaces used by participants of this study) and high impact on general needs; results confirm the speculation made earlier in the report stating minimal discourse surrounding this approach is simply a reflection of new standards and is not to be interpreted as a lack of support. Appreciation for this approach (although not specific to the learning environment) indicates a need throughout all spaces as their benefits are universal. Adaptable and adjustable elements should be included when possible in the form of ergonomic furniture (e.g chairs with adjustable seats, arms, and backrests) and controls for the environment (e.g dimmable lighting or adjustable window coverings).

In terms of approaches impacting the PLE specifically; the overall consensus recognises variety/options as being preferred over mobility in most shared spaces. Despite mobile elements being rated high within the impact survey; during qualitative interviews, each participant expressed favouritism for variety/options in their recommendations for how/where approaches should be applied. Although the results of my study conflicted in these areas, such inconsistency was anticipated and aligns with the findings from existing research (specifically the debate around mobility). Previous studies debate the effect of mobility on individuals with ASD; weighing the importance of providing users autonomy through design (Clouse et al., 2019; Fehlandt, 2017; Gaines et al., 2016; Karbalaei et al., 2019; Öktem, 2010; Sheykhmaleki et al., 2021) over the predictability of a space (Altenmüller-Lewis, 2017; Henry, 2011; Hosny & Anous, 2015; Tola et al., 2021). In the beginning of this report, I expressed a need to consider how findings on flexibility may differ depending on the different users, activities, and levels of interaction expected in each program type. Since existing research failed to fully explore where flexible approaches are best applied (looked more at their overall impact and effectiveness) it is clear why scholars have failed to agree on the impact of mobility. Although Öktem (2010) began exploring how to balance these two views; it was the additional qualitative statements from my study that establish a clear directive on how balance can be created through more intentional applications (included at varying degrees/ within certain spaces/ to serve a specific function/need).

Results from my study determined balance between flexibility and predictability can be made by including variety/options in shared program spaces and mobility in more informal environments. Findings on variety/options show a strong connection to the facilitation of learning and independence in addition to supporting the varying needs and well-being of occupants. This is beneficial within learning spaces designed to serve many occupants participating in a shared activity/ goal (e.g classroom) where the addition of mobile elements would be distracting. Options can be implemented in three ways: (1) Variety of furniture types and sizes, (2) Variety of layouts/ furniture arrangements, (3) Addition of multifunctional elements. When considering where to introduce mobility in the PLE designers should take into account the expected occupancy (beneficial in areas with fewer users as this limits the number of individuals making changes and amount of people

being affected), intended function (better suited for informal spaces designed for self-guided activities or experience-based spaces where development relies more on confidence than focus). Mobility in the built environment can be introduced with individual furnishings and the addition of larger freestanding dividers/ temporary partitions (equipped with wheels or made of lightweight materials allowing for easy transportation). As discussed, these mobile elements have the potential to distract or overwhelm adults with ASD so designers can also choose to make a designated space in which mobility is expected (e.g a "hackable" meeting room).

The results discussed above all support my hypothesis, provide answers to the research questions, and add to our overall understanding of how flexible design approaches can be applied in the PLE to support adults with autism. The exception to this support is findings for the impact of flexibility on socialization. Previous studies highlight the potential of flexibility (specifically variety/options and mobility) to encourage social interaction by providing users control over privacy and proxemics. Unexpectedly, the results of my survey point to this relationship being less significant as it was consistently rated lower on the impact scale across all approaches. This presents the opportunity for more research to be done in the future; testing whether flexibility in the built environment is an efficient approach for encouraging socialization but is not yet realized or if a more appropriate solution can be found.

5.3 Key Implications for Designers

Findings from this study can be applied in the design of future learning environments for adults with ASD. The implications proposed below are based on findings from primary and secondary research conducted in this report.

1. Careful consideration of ergonomics and the overall comfort + well-being of occupants within all areas of the PLE. Elements with the built environment to be adaptable/adjustable when possible to accommodate a variety of different needs and abilities.
2. Introduce restorative escape spaces throughout the PLE that users can access for sensory relief or stimulation. The option to retreat is to be included along transition areas and in shared spaces intend to serve many users at one time. Escape spaces can be included as separate rooms within other areas or created with added provisions (dividers or collapsible "tents" that can be easily brought out/ put away).
3. Incorporate opportunities for choice-making in shared spaces with a variety of furniture types, sizes, and arrangements that support various needs and learning styles simultaneously. Options to facilitate learning and engagement with layouts for group work + leisure and promote feelings of comfort and safety through areas for small groups + personal spaces.
4. Include designated areas capable of customization through the addition of mobile elements. These spaces are to be easy to reconfigure, allowing the built environment to respond to changing needs of users with ASD and take on different functions (as needed).
5. Provide additional dividers (freestanding or retractable) that can be used to transform spaces for different needs and activities. Giving users the ability to subdivide rooms for added visual privacy and acoustic control.

5.4 Limitations

Limitations for this study are included to help inform researchers in designing future studies and provide readers with a better understanding of results and recommendations (in terms of their origin and relevancy).

The sample size of this study was small; including only three key informants with professional experience throughout Ontario, Canada. For this reason, opinions and utilizations reflect only the current practices and needs within east-central Canada. Despite this limitation, the proposed implications have been directed at supporting a wide range of needs and should be easily applied to all learning environments regardless of location. With this said, further research could replicate this study in another country to add to the repository of work and provide support for findings in this study (other researchers pursuing the same directive).

It is also relevant to note; the flexible design approaches discussed in this research study are only a portion of how designers can make

learning environments more conducive for adults with ASD. Although flexible elements are successful in meeting many needs and eliciting a range of behaviours; additional considerations must be made in regard to environmental factors impacting occupant experience (such as colour, finishes, textures, etc.). This report has focused primarily on elements of space planning and furniture to provide designers with a good foundation, but should not be the only design criteria considered. Participant responses began the discussion on how principles of flexibility may be applied throughout the environment (e.g recommended variety/options in the look and feel of materials/finishes); presenting an opportunity for future researchers to investigate this idea further.

ANNOTATED BIBLIOGRAPHY

Altenmüller-Lewis, U. (2017a). Expanding Inclusiveness –Integrating Students with ASD. *Architectural Research Centers Consortium*, 172–178.

This source explains the relationship between the autistic user and the built environment. The paper outlines the physical barriers to individuals with ASD as well as the mental barriers affected by the built environment to be considered and diminished in the design of autism-friendly spaces. The author provides excellent context/ background information on the disorder (Autism) and goes over the key symptoms of the disorder as well as the effect of ASD on the perception and experience of space. This information is important to the field and my future research as it acts as the foundation for all proposed design criteria/solutions and recommendations (helps to ensure they are research-based and appropriate/suitable for those with ASD).

Clouse, J. R., Wood-Nartker, J., & Rice, F. A. (2019). Designing Beyond the Americans With Disabilities Act (ADA): Creating an Autism-Friendly Vocational Center. *HERD: Health Environments Research & Design Journal*, *13*(3), 193758671988850. https://doi.org/10.1177/1937586719888502

This paper identifies and emphasises the shortcomings of the ADA and Universal Design Standards when it comes to addressing mental and cognitive disabilities. The authors go on to state the need for new policies and even provide their own comprehensive list of research-based recommendations for designers. The information and ideas provided by this source provide useful support for the importance of flexibility in the design of autism-friendly spaces.

Fehlandt, M. (2017). Flexible Classroom Design And Its Effects On Student-Centered Teaching And Learning. *School of Education and Leadership Student Capstone Projects*. https://digitalcommons.hamline.edu/hse_cp/6/?version=published%25253Fvisited=true

The text lacks information specific to those with ASD but has been used to understand the different flexible design implications that exist for classrooms/ learning environments. This article will be helpful in the culmination of broad design criteria that will be refined to meet the needs of Autistic users.

Gaines, K., Bourne, A., Pearson, M., & Kleibrink, M. (2016). *Designing for Autism spectrum Disorders*. https://www.routledge.com/rsc/downloads/9780415725279_chapter_1.pdf

This comprehensive textbook offers a great look into ASD and the human-environment interaction. Additionally, the authors made an effort to include a variety of practical applications along with theory used to back up the importance of flexibility in the design of autism-friendly spaces.

Henry, C. (2011, October 26). *Designing for Autism: Spatial Considerations*. ArchDaily. https://www.archdaily.com/179359/designing-for-autism-spatial-considerations

This article focuses on spatial considerations and outlines best practices with consideration of the proxemic needs of individuals with ASD. This article discussed either side of the mobility debate and has been referenced as a starting point in the journey to find a balance/ compromise through flexible design techniques (ref. 2.4 The Effectiveness/ Limitations of Flexibility in the Built Environment).

Hosny, I., & Anous, I. (2015). *The impact of Interior Design in educational spaces for children with Autism*. American International Journal of Research in Humanities, Arts and Social Sciences. http://iasir.net/AIJRHASSpapers/AIJRHASS15-329.pdf

This source was extremely thorough and covers everything from defining ASD, outlining the existing theories, and most importantly detailing the recent design approaches and design criteria for Autism Treatment Centers and Educational Spaces such as the one I plan to design at the end of my research.

Karbalaei, A., Ghiyasvand, H., Sattari, M., & Soltanzadeh, H. (2019). Presenting an Analytical Model for Increasing Social Interactions in Children's with Autism Presenting an Analytical Model for Recognizing and Evaluating the Environmental Indicators Influencing the Increase in Social Interactions of Children with Autism in Educational Centers Using Analytic Hierarchy Process. *Armanshahr Architecture & Urban Development*, *12*(28), 73–87. https://doi.org/10.22034/AAUD.2019.97361

Provides an extensive look into how individuals with autism socialize and propose different spatial considerations (design criteria) to help facilitate positive interactions. This author is on the opposing side of the mobility debate and was a good introduction to the potential negative effects of flexibility and even how to avoid/ prevent them.

Martin, C. S. (2014). Exploring the impact of the design of the physical classroom environment on young children with autism spectrum disorder (ASD). *Journal of Research in Special Educational Needs*, *16*(4), 280–298. https://doi.org/10.1111/1471-3802.12092

Extensive theoretical background and review of "outdated" literature that I may not have considered if not summarized here. I often avoid research older than a decade as it has a tendency to lose its relevance but the author did an excellent job of summarizing the past findings from before 2013 that acted as the foundation for more recent studies. This source also helped me determine the appropriate methodology for my study and explained the concepts discussed in class further in the context of the design for individuals with ASD. It is important to note that is focuses on young children whereas my research will be looking at adults aged 18+ (approx.).

Öktem, Z. (2010). *Design guidelines for special education schools for children with autism design and appraisal of private ilgi special education school*. https://open.metu.edu.tr/handle/11511/19504

This source aligns closely with my research topic and was beneficial in providing design criteria and research to support my claim that flexibility is of importance in the design of the physical learning environment.

Patel, T., Dorff, J., & Baker, A. (2022). Development of special needs classroom prototypes to respond to the sensory needs of students with exceptionalities. *Archnet-IJAR: International Journal of Architectural Research*. https://doi.org/10.1108/arch-07-2021-0196

This source/ these authors have included their own design criteria/ list of recommendations which I have used to support the need for flexibility in the PLE; Where this text differs is in their focus on designing for the senses.

Sheykhmaleki, P., Yazdanfar, S. A. A., Litkouhi, S., Nazarian, M., & Price, A. D. F. (2021). Prioritising public spaces architectural strategies for autistic users. *Archnet-IJAR: International Journal of Architectural Research*, *15*(3), 555–570. https://doi.org/10.1108/arch-07-2020-0142

Excellent combination of theory and application; authors have included sufficient information on the relationship between those with ASD and the built environment (more specifically public spaces). The authors' stance on mobility is positive but I appreciate how they acknowledged the challenges of mobility within their own findings as it helped me make connections between the opposing sides.

Tola, G., Talu, V., Congiu, T., Bain, P., & Lindert, J. (2021). Built Environment Design and People with Autism Spectrum Disorder (ASD): A Scoping Review. *International Journal of Environmental Research and Public Health*, *18*(6). https://doi.org/10.3390/ijerph18063203

Although this source focused on the built environment as a whole (not learning environments) it was still one of the sources I found to be most useful. Since this was a “scoping review” it helped me contextualise my research topic and develop a deeper understanding of its background. Furthermore, this article was crucial to my research as it helped open my eyes and identify the gaps within the existing research (which helped me to position my own research).

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Altenmüller-Lewis, U. (2017a). Expanding Inclusiveness –Integrating Students with ASD. *Architectural Research Centers Consortium*, 172–178.

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Fehlandt, M. (2017). Flexible Classroom Design And Its Effects On Student-Centered Teaching And Learning. *School of Education and Leadership Student Capstone Projects*. https://digitalcommons.hamline.edu/hse_cp/6/?version=published%25253Fvisited=true

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Martin, C. S. (2014). Exploring the impact of the design of the physical classroom environment on young children with autism spectrum disorder (ASD). *Journal of Research in Special Educational Needs*, *16*(4), 280–298. https://doi.org/10.1111/1471-3802.12092

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General Questions (Participant Data)

*Your Name Here:

*Qualifications; Please list all position title(s) held while working with or supporting individuals with autism (e.g Occupational therapist, Special education teacher, etc.) *Starting with current/ most recent role

*Age of Individuals with ASD that you have experience working with

Check all that apply

- [ ] 17 and under
- [ ] 18 and over
- [ ] Both (all ages)

Flexible Design Guidelines Survey

Please note, it's important that you answer all questions with the following in mind:

(1) Focus on the impact to adults ages 18+ with autism,

(2) When asked about specific design recommendations and the effect of the physical environment; give your best professional opinion based on experience, observations, and knowledge of autism spectrum disorder.

An explanation of each design approach has been provided below; along with examples of each design element included within the survey tables (reference as needed).

***Overview of Design Approaches (Definitions/ Explanations for Reference):**

1. **Flexibility for Different Users | Adaptable/ Adjustable:** Including elements within the design that can be adjusted and adapted to its users' body and needs (e.g Office chairs with adjustable components such as armrest position, seat height, and angle of back support, etc.).
2. **Flexibility for Different Uses | Variety/ Options:** Providing occupants with design elements (such as furniture) in various sizes, types, functions/ uses, as well as spatial layouts/ furniture arrangements. Such options create opportunities for choice-making and control; for example, a space with both individual workstations and large tables surrounded by chairs allows independent and group work to take place simultaneously.
3. **Flexibility for Different Needs | Mobility:** Mobility in design can include various products ranging from furniture/ equipment to the addition of freestanding dividers (temporary partitions); all of which are either equipped with wheels or made from lightweight materials to allow for easy transportation. This offers occupants autonomy through design by allowing a space to be easily reconfigured to meet the changing needs of its users and functions.

*Flexible Design Approach 1

Flexibility for different users - Adaptability and Adjustability of the built environment

Rate on a scale of 1-5: The perceived effectiveness and positive impact of the following design elements on adults with ASD

	Facilitating Learning	Encouraging Socialization	Promoting Independence	Ability to Support Different Needs & Learning Styles Simultaneously	Overall Wellbeing & Comfort
Adaptable/ adjustable furniture and equipment  (e.g adjustable height tables and chairs with adjustable armrests + seat heights)	...	...	...	...	...
Adaptable/ adjustable lighting  (e.g Top down/ bottom up window shades & dimmable light fixtures)	...	...	...	...	...

***Have you seen any of the above design elements within the spaces you have worked (doesn't have to be the specific elements included in the examples)?**

	YES	NO
Adaptable/ adjustable furniture and equipment	○	○
Adaptable/ adjustable lighting	○	○

*Flexible Design Approach 2

Flexibility for different uses - Variety and Options in the built environment

Rate on a scale of 1-5: The perceived effectiveness and positive impact of the following design elements on adults with ASD

	Facilitating Learning	Encouraging Socialization	Promoting Independence	Ability to Support Different Needs & Learning Styles Simultaneously	Overall Wellbeing & Comfort
Variety in types and sizes of furniture and equipment  (e.g seating options with a single room including rolling office chairs, standard plastic school chairs, a couch, bean bags, and floor cushions)	...	...	...	...	...
Multifunctional and dual-purpose furniture and equipment  (e.g storage units that act as dividers in open spaces)	...	...	...	...	...
Variety in spatial layouts within a single space  (e.g a variety of furniture arrangements such as chairs arranged around a table, lounge seats side by side, individual workstations with built-in privacy screens, etc.)	...	...	...	...	...
Variety of space types/ functions within a single room  (e.g additional escape spaces within larger rooms that individuals can retreat to)	...	...	...	...	...

***Have you seen any of the above design elements within the spaces you have worked (doesn't have to be the specific elements included in the examples)?**

	YES	NO
Variety in types and sizes of furniture and equipment	○	○
Multifunctional and dual-purpose furniture and equipment	○	○
Variety in spatial layouts within a single space	○	○
Variety of space types/ functions within a single room	○	○

*Flexible Design Approach 3

Flexibility for different needs - Mobility within the built environment

Rate on a scale of 1-5: The perceived effectiveness and positive impact of the following design elements on adults with ASD

	Facilitating Learning	Encouraging Socialization	Promoting Independence	Ability to Support Different Needs & Learning Styles Simultaneously	Overall Wellbeing & Comfort
Flexible spatial layouts as a result of mobile furniture and equipment  (e.g chairs and tables on lockable wheels that allow a space to be easily rearranged)	...	...	...	...	...
Addition of temporary walls/ dividers  (e.g freestanding dividers on wheels - can be made multifunctional with whiteboard surface)	...	...	...	...	...
Multifunctional spaces  (e.g divisible rooms with built-in dividers like folding panels or accordion walls)	...	...	...	...	...
Environment - Acoustics  (e.g mobile acoustic barriers such as acoustic panels on wheels or acoustic fabrics on curtain tracks)	...	...	...	...	...

***Have you seen any of the above design elements within the spaces you have worked (doesn't have to be the specific elements included in the examples)?**

	YES	NO
Flexible spatial layouts as a result of mobile furniture and equipment	○	○
Addition of temporary walls/ dividers	○	○
Multifunctional spaces - divisible rooms	○	○
Environment - Added acoustics	○	○

***Note below any additional design recommendations (not included in the survey) that you belive would make the physical environment more conductive to the development of adults with autism:**

Request for Follow-Up Interview

Optional follow-up interview (10-15 minutes): To learn more about the "why" behind your survey responses, and discuss some of the barriers in the physical environment for those with autism (based on your expertise and observations).

If interested; schedule your interview below (will receive confirmation from McKenna Ansara shortly)

*Are you interested in participating in a follow-up interview (details above)

Choose one of the following answers

Please choose...

- Please choose...
- YES, will schedule below!
- NO
- MAYBE, will email ansaram@sheridancollege.ca if availability opens up (before Tuesday, November 15th)

IF SELECTED YES: Schedule an interview below - PREFERED DAY? (before Tuesday, November 15th)

Format: mm-dd-yyyy

IF SELECTED YES: Schedule an interview below - PREFERED TIME?

IF SELECTED YES: Schedule an interview below - PREFERED FORMAT?

Choose one of the following answers

Please choose...

- Please choose...
- Phone Interview
- Zoom Call

IF SELECTED YES: Please input your contact information below

Phone #:

Email: