International Journal of Architectural Engineering & Urban Planning, Volume 34, Number 1, 2024
DOI: 10.22068/ijaup.844

Research Paper

Designing Autism-Friendly Schools: Bridging the Perspectives of Children with ASD and the Perspectives of Adult Stakeholders

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Received: April 2024, **Revised:** May 2024, **Accepted:** May 2024, **Publish Online:** May 2024

Abstract
Children with Autism Spectrum Disorder (ASD) frequently encounter sensory sensitivities in school settings that diverge from those experienced by adult stakeholders, such as parents, teachers, and professionals. This research examines the disparities and commonalities in spatial preferences between children with mild ASD and adult stakeholders, aiming to utilize these insights to guide the design of autism-friendly educational environments. Employing a two-phase mixed-methods approach comprising interviews and questionnaires, this study engaged 210 participants: 80 children aged 9-18 with ASD (14 in Phase 1 and 64 in Phase 2) and 130 adult stakeholders (32 in Phase 1 and 98 in Phase 2). Thematic analysis conducted in Phase 1 and factor analysis in Phase 2 identified several critical spatial factors, including stability and constancy, a calm and subdued atmosphere, prominent classroom views, spacious learning environments, familiarity and predictability, large classroom windows, and gradual exposure. While there were some areas of overlap with adult perspectives, notable differences highlighted the necessity of incorporating children's viewpoints in school design. Based on this premise, the study introduces an integrated model for designing autism-friendly schools informed by these findings. This model aims to propose strategies for creating learning environments that support the well-being and educational needs of children with ASD.

Keywords: *Autism-friendly design, Children with ASD, Design model, School environment, Spatial preferences.*

1. INTRODUCTION

Autism Spectrum Disorder (ASD) is a globally prevalent and complex neurodevelopmental disorder that adversely impacts the quality of life of children with autism and their families (Harrop et al., 2016). ASD is characterized by a range of symptoms, including delayed development of verbal and social skills, restricted interests, sensory sensitivities, repetitive behaviors, and resistance to change (Martin, 2014; Anderson, Smith, & Wilczynski, 2018; Christensen et al., 2018; Bonnet-Brilhault et al., 2018; Itoi, Kato & Kashino, 2019; Hwang et al., 2020; Rodgers et al., 2017; Uljarevic et al., 2017). These symptoms often arise as reactions to environments that do not adequately accommodate the unique needs of individuals with ASD. Therefore, identifying the perceived needs of individuals with ASD in specific environments is essential for transforming these settings into autism-friendly spaces (Deochand, Conway, & Fuqua, 2015; Nagib & Williams, 2018). Educational environments, particularly schools, are critical contexts for understanding and addressing the perceived needs of individuals with ASD.

Schools play a vital role in the daily lives of children with ASD, as they spend a significant portion of their formative years in these environments. However, educational settings have been identified as sources of considerable challenges, stress, and anxiety for children with ASD (Adams, Simpson, & Keen, 2018; Roberts & Simpson, 2016; Ghazali, Sakip, &

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Samsuddin, 2019; Uherek-Bradecka, 2020). The spatial and physical characteristics of schools frequently fail to create an inclusive and supportive atmosphere, often due to design processes that neglect the unique needs and preferences of these students. Instead, design decisions are usually driven by the perspectives of adult stakeholders (Cunningham, 2022; Sciutto et al., 2012; Fayette & Bond, 2018; Martin, 2014). While adults can provide valuable insights into the difficulties faced by students with autism, their perspectives do not necessarily capture the actual experiences and needs of the students themselves, who are the most directly affected by these challenges. Consequently, there is a pressing need for research that investigates the specific needs and preferences of children with ASD in school environments, while also taking into account the viewpoints of adult stakeholders.

This study aims to explore the spatial concepts and characteristics that contribute to the design of an autism-friendly school environment, with a primary focus on the perspectives of children with mild ASD, alongside those of adult stakeholders, including teachers, parents, and experts. Ultimately, based on these diverse perspectives, the study proposes a model for designing an autism-friendly school. Within this framework, the following research questions guide the study:

RQ1. What issues must be addressed when designing a school environment that accommodates the preferences of children with ASD?

RQ2. To what extent do children's spatial preferences align with those of adult stakeholders?

The current study is structured into several sections. It begins with an introduction that outlines the essential aspects and existing gaps in the research. Section 1 explores the spatial characteristics of autism-friendly school environments. Section 2 describes the methods used for collecting and analyzing both quantitative and qualitative data from students with ASD, parents, teachers, and autism experts. In Section 3, the findings from both children and adults are presented, along with a comparative analysis. Section 4 discusses the results in relation to the research questions and within the context of previous studies. Based on the research findings, a model for autism-friendly school architecture is proposed, emphasizing three key design concepts to create an optimal learning environment for children with autism: stability, subtlety, and visibility.

1.1. Spatial considerations of autism-friendly schools

Designing schools that cater to the needs of students with autism necessitates careful attention to spatial characteristics (Shan and Mei, 2020). Creating such supportive environments presents challenges due to the unique manifestation of symptoms in each child (Landrigan, 2010; Woodcock et al., 2020). These symptoms can range from mild to severe, with the Diagnostic and Statistical Manual (DSM-5) offering a framework for categorizing the severity levels, which can then guide the customization of support within these environments (American Psychiatric Association, 2013). Despite the diverse needs of students with ASD, research underscores the significance of specific spatial characteristics (Anderson, 2020; Black et al., 2022; Gains et al., 2016; Howe & Stagg, 2016; Roberts & Simpson, 2016). Implementing clear zoning, controlled sensory input, and strategic use of light and color can promote positive interactions, increase predictability, and ultimately facilitate a successful learning experience. The subsequent discussion addresses these considerations and their associated design debates for both indoor and outdoor school environments.

Children with ASD experience significantly higher stress and more repetitive behaviors in unfamiliar and unpredictable environments compared to familiar, predictable, and structured environments (McAllister & Maguire, 2012; Deochand, Conway, & Fuqua, 2015; Hodgson et al., 2017; Wigham et al., 2015). Implementing a purposeful and distinct zoning strategy helps students with ASD understand and navigate different spaces, allowing them to familiarize themselves with the environment, maintain control, and predict their surroundings (Bogdashina, 2016; Gaines et al., 2016; Grandin, 2009). In this strategy, clear visual boundaries are essential to reduce visual and auditory distractions (Scott, 2009). For instance, large spaces can be divided into distinct zones using furniture placement or boundary markers such as different floor materials, colored strips, or curtains (Mesibov, 2018).

Many individuals with ASD exhibit sensitivity to environmental stimuli. Background noise, glare, clutter, and crowded spaces can lead to distraction and sensory overload (Shabha & Gaines, 2013). Poorly designed schools characterized by high levels of noise, brightness, and overly stimulating color schemes can be bewildering and overwhelming for children with ASD, impeding their ability to fully engage in the intended learning activities (Benedyk, Woodcock, & Woolner, 2009). Numerous studies have highlighted the benefits of natural light or its simulated equivalent over artificial lighting, positively impacting the stress levels and performance of individuals with ASD (Beaver, 2011; Mostafa, 2008, 2014). Reactions to colors vary among children with ASD, with some studies indicating that both highly saturated and

monotonous, colorless environments can be bothersome to them (Gaines & Curry, 2011). Other research suggests that individuals with ASD tend to respond favorably to warm, natural, soft, and occasionally neutral colors (Beaver, 2011; Vogel, 2008). Furthermore, recommendations propose painting surfaces directly visible to students with medium hues, while employing neutral colors for the rest of the surfaces (Gaines et al., 2014). By minimizing sensory distractions such as noise, glare, clutter, and harsh colors, and by integrating natural light with soothing color palettes, schools can significantly enhance the learning experience and alleviate stress for children with ASD.

Openings in walls, particularly windows, are vital spatial elements for capturing light and offering views, but they can also serve as sources of distraction (Tufvesson & Tufvesson, 2009). While visibility through windows can be managed through techniques like installing windows above eye level (McAllister, 2010; Mostafa, 2018), more radical proposals have been suggested, such as eliminating external views and restricting natural light (McAllister & Maguire, 2012). These studies propose that achieving balance is crucial when incorporating natural light into schools for individuals with ASD. Strategic window placement can optimize benefits while minimizing distractions, thereby fostering a focused learning environment.

2. MATERIALS AND METHODS

The study employed a two-phase mixed-methods approach to collect and analyze data. Initially, semi-structured interviews were conducted to gather qualitative data, which subsequently informed the design of a questionnaire for the collection of quantitative data in the second phase. Thematic analysis was utilized to analyze the interviews, while Exploratory Factor Analysis (EFA) was employed for the questionnaires. Data collection took place between September 2022 and January 2023, spanning four months. A total of 212 participants were recruited for the study. The first phase involved 46 individuals (14 children and 32 adults), while the second phase included participation from 162 individuals (64 children and 98 adults). Participants were recruited using purposive sampling and snowball sampling methods to ensure a diverse range of viewpoints. Purposive sampling enabled the recruitment of participants who met the core criteria, while snowball sampling, leveraging existing social networks, facilitated the inclusion of a broader spectrum of experiences within the target population, enriching the data collection process.

2.1. Phase 1: Qualitative study

2.1.1. Participants

The interviews comprised forty-six participants, consisting of 14 children, 15 parents, 11 teachers, and 6 experts, selected according to specific core criteria. Children, primarily diagnosed with ASD Level 1 or Level 2, were chosen based on their capacity to engage with interview questions and their relevant school experience. Parents were selected for their active engagement in school affairs, including membership in the parent-teacher association. Teachers and experts were required to possess a minimum of five years of experience in teaching children with ASD. Participants were afforded flexibility in arranging the location and time of the interviews.

2.1.2. Interviews

The interviews were carried out across six educational centers for children with ASD situated in various Iranian cities: Tehran (north-central region; 10 interviews), Sanandaj (west; 9 interviews), Saqqez (west; 7 interviews), Tabriz (northwest; 6 interviews), Isfahan (central; 7 interviews), and Mashhad (east; 7 interviews). These centers were identified through collaboration with individuals actively involved in the ASD community, possessing connections, knowledge, and expertise. Interviewees were questioned about various aspects of the school environment. Prior to commencing each interview, a thorough review of the previous interview was conducted to address any unresolved issues. Subsequent interviews incorporated these issues as new questions, along with additional tailored questions based on the interviewees' responses. At the conclusion of the interviews, facilitators encouraged participants to provide further comments or perspectives. The researchers continued conducting interviews until data saturation was achieved. All interviews, conducted in Iran's official language, Farsi, were recorded and transcribed using Microsoft Word. Each interview had a duration of 45 to 60 minutes, depending on participant engagement.

2.1.3. Analysis

A thematic analysis approach was employed to comprehend the spatial characteristics emphasized in the interviews. This entailed an iterative coding process where patterns in the data were identified and categorized. To ensure the robustness of our analysis, several strategies were implemented to enhance

reliability and credibility. Firstly, consensus was reached among all authors on the seven distinct spatial themes that emerged from the data. Secondly, a multi-layered review process was undertaken. This involved weekly group discussions where all authors analyzed and deliberated on emerging themes, as well as individual examinations by the authors to provide feedback during group revisions. This collaborative approach, incorporating diverse perspectives, bolstered the overall reliability, accuracy, and credibility of the thematic analysis.

2.2. Phase 2: Quantitative study

2.2.1. Participants

This phase involved 162 individuals. Among them, 20 were the same individuals who had participated in the first phase (children=6; parents=5; teachers=6; and experts=3), while the remaining participants were new. The participants were divided into four target groups. Group 1 included students with ASD (N=64; girls=30; boys=34) ranging in age from 9 to 18 years old (M = 13.5 years old; S = 2.87). The most frequent age group was 17-year-olds, with 9 participants. Ages were evenly distributed around this peak, with all groups between 10 and 18 years old having at least 4 participants. The study also involved 48 teachers (Group 2), 35 parents of children with ASD (Group 3), and 15 experts (Group 4) including 5 psychiatrists, 5 clinical psychologists, and 5 occupational therapists.

2.2.2. Questionnaire

We devised a questionnaire to gather data regarding participants' preferences on seven spatial matters, which were derived from the interview themes. These matters encompassed light, color, spatial awareness, space size, classroom windows, changes in the environments, and transition (refer to Table 1). Initially, a questionnaire draft comprising 29 questions (25 on a 5-point Likert scale and 4 open-ended questions) was formulated. To ensure content validity, two psychologists and three architects reviewed the draft. Subsequent to their feedback, seven questions (4 Likert scale and 3 open-ended) were eliminated. Consequently, the final questionnaire consisted of 21 Likert scale questions (ranging from 1 for completely disagree to 5 for completely agree) and one open-ended question. Ultimately, two questionnaire formats were designed, each containing identical questions but with distinct graphics and tone. One format was tailored for children, featuring a child-friendly tone and graphics, while the other was crafted in a more formal manner for the three adult groups. The reliability of the questionnaire and its factors was assessed by calculating Cronbach's alpha, demonstrating a satisfactory level (α=0.78). Moreover, the acceptability of Cronbach's alpha was confirmed for each of the seven questionnaire components (see Table 3).

2.2.3. Analysis

We utilized Exploratory Factor Analysis (EFA) with the Maximum Likelihood and Varimax with Kaiser Normalization Rotation method to analyze the questionnaire responses of children with ASD. This method enabled us to elucidate the relationships among their responses to the questions. EFA is commonly employed to identify underlying latent factors that contribute to the observed variables by grouping them into factors that elucidate the shared variance in the data. The results yielded seven factors with eigenvalues greater than one, elucidating a total variance of 69.08% for the solution. The Kaiser-Meyer-Olkin measure (KMO) of 0.68 and Bartlett's test (df=210; x2=1479.75; sig=.000) validated the scale's suitability for measuring the extracted factors, thereby allowing us to proceed with the factor analysis. However, at this stage, seven questions with no significant factor loading were excluded from further analysis. Subsequently, 14 questions remained and were categorized into seven factors (*see* Table 2).

2.3. Ethical Issues

Ethical approval for the study was obtained from the University of [removed for peer review]. The study adhered to rigorous ethical guidelines, safeguarding participant confidentiality and autonomy throughout the research process. Participants were provided with comprehensive information regarding the research purpose and the voluntary nature of their participation, and they provided their informed consent to participate. Additionally, parental consent and children's assent were obtained. Teachers played a vital role in both data collection and establishing rapport with children with ASD. Written notes were taken when recording permission was not granted. When engaging with the children, we communicated in a child-friendly tone, respecting their independent opinions and agency, while refraining from conveying our expertise as experienced adults.

3. RESULTS

This section is divided into two parts: qualitative and quantitative. The qualitative results are derived from the interviews, whereas the quantitative results originate from the questionnaires.

3.1. Qualitative results

The qualitative analysis of interviews revealed seven overarching spatial matters, as outlined in Table 1.

3.1.1. Light

Participants exhibited a clear preference for natural and gentle light. Children interviewed expressed a strong inclination toward subdued lighting rather than bright illumination. For instance, an 11-year-old girl stated, "I like the light in my room or class to be soft and dim." Both teachers and children favored natural light over artificial sources, with some children expressing a desire for large windows in classrooms to allow more sunlight. Teachers emphasized the importance of providing adequate light for good visibility, noting the positive response of children with ASD to natural light and their sensitivity to artificial lighting. Mothers also highlighted their children's heightened anxiety in response to changes in lighting, underscoring the significance of considering light preferences in both school and home environments.

3.1.2. Color

In interviews, children overwhelmingly expressed a preference for soft colors over intense ones. For example, a 17-year-old boy exemplified this preference by stating, "I like all colors, but mild colors make me feel more relaxed." Interestingly, participants rarely mentioned specific colors, instead focusing on color hue and intensity. However, a few did mention preferences for pale blue, pale green, and white. As a 14-year-old girl explained, "I like white, pale blue, and very pale green. Bold colors bother me." Teachers and experts echoed these findings, suggesting that soft colors might be more suitable for both children with hypersensitivity and hyposensitivity.

3.1.3. Spatial awareness

During interviews, children emphasized their preference for a clear view of their surroundings. For instance, an 11-year-old boy explained, "I like to know what's happening around me when I sit somewhere. For instance, I don't like being in an L-shaped room." This desire for openness and predictability extended to the classroom environment. The children suggested that large windows would make the space feel more open, leading to a more relaxed atmosphere.

3.1.4. Space size

The children expressed a preference for large spaces, with an interesting caveat: they wanted to maintain a clear view of the entire area. For example, a 15-year-old boy explained, "I like large spaces, but not like a desert where you cannot see the other side." Many participants disliked crowded areas and preferred rooms that were sufficiently spacious for them to comfortably engage in activities. Additionally, they expressed a desire for large windows in the classroom, likely to create a sense of openness and relaxation.

3.1.5. Classroom window

Children overwhelmingly expressed a preference for large windows, noting that they felt at ease when they could easily see outside. For instance, a 15-year-old girl echoed this sentiment, stating, "I don't feel comfortable when my classroom window is small, and I can't see outside." Interestingly, participants also mentioned that looking out at green spaces had a calming effect on them, while crowded views made them feel nervous.

3.1.6. Changes in the environment

The children interviewed emphasized the importance of a stable environment. Many participants noted that transitions to new environments can be challenging for children with ASD. As they become accustomed to their surroundings, changes or disruptions can provoke discomfort and anxiety. For example, a 17-year-old girl shared a personal experience: "When my school changed classrooms, I didn't return for 3 months. I just preferred the old one, even though everyone said it was silly."

3.1.7. Transition

Many participants, including an occupational therapist, underscored gradual exposure as a crucial strategy for managing children's sensitivities. The research findings supported this perspective, indicating that gradual exposure effectively reduced children's sensitivity to change. Children themselves

reported feeling less perturbed by changes introduced gradually. This approach facilitates familiarization with new activities and environments, as elucidated by the occupational therapist: "It is better to give them a view of the situation before making any changes or starting any activity; familiarity with the situation and small and continuous actions are very important."

Table 1. Spatial matters were extracted from the interviews

Spatial/environmental matters	Quotes (examples)
Light	• I used to get very nervous when the lights were on in the classroom, and I couldn't concentrate. But I was not bothered by daylight (14-year-old boy). • I like the light in my room or class to be soft and dim (11-year-old girl). • I like my classroom to have a large window so that it can get better sunlight (15-year-old boy). • My son gets quite anxious when it gets dark because he knows we might turn on the lights and he keeps turning them off (Mother of a 7-year-old boy). • My daughter screams when the classroom lights are turned on (multiple bulbs) (Mother of a 7-year-old girl). • Intense lights are completely nerve-breaking for my son (Mother of a 10-year-old boy). • children with ASD are calm when there is sunlight in the classroom, but they are sensitive to lamp light (teacher). • My classroom has a frontal window, and the children feel good about the sunlight (Teacher). • Children are against turning on the lights in the evening shifts and during autumn when it gets dark earlier; they want just enough light to see (Teacher).
Color	• I like my room to have pale colors. I get very nervous when the color of a wall is bright orange (13-year-old girl). • I like soft colors. Intense colors make me unable to concentrate. For example, the intense color of the wall of my classroom annoys me (16-year-old boy). • I like white, pale blue and very pale green. Bold colors bother me (14-year-old girl). • I like all colors, but I feel more relaxed with pale colors (17-year-old boy). • At home, the walls are white; but when we go to a place where the wall is rough or has a bold color, she only pays attention to the wall (Father of a 10-year-old girl). • In my opinion, light colors should be used so that neither hyper-sensitive nor hypo-sensitive children are bothered (Teacher).
Spatial awareness	• I like to know what is going on around me when I sit somewhere. For example, I don't like to be in an L-shaped room (11-year-old boy). • I like to sit somewhere in the classroom where I can see everything and notice if someone enters the room (12-year-old girl). • I like to know what is going on inside a room like a classroom before I enter it; this reduces my stress (18-year-old boy). • In the classroom, I liked to sit in the last row because that way I could see everyone and there was no one behind me. I felt more secure like this (15-year-old girl). • When we go to the bank, my son gets so happy because the door is made of glass, and he can see inside from the outside (Mother of an 8-year-old boy). • Our previous house had an open kitchen; when we moved to another house, where the kitchen was a closed room, she was constantly going back and forth saying that the other house was better (mother of a 10-year-old girl).
Space size	• I like my environment to be not cramped so that I can be comfortable in it (13-year-old girl). • I like large spaces, but not like a desert where you cannot see the other side (15-year-old boy). • My boy doesn't like cramped or boundless spaces; he likes to have a dominant view of the environment (Mother of a 9-year-old boy). • My daughter prefers to be in open spaces (Mother of an 8-year-old girl). • The space should be large enough for students to have freedom of action (Teacher). • I have noticed that my students don't like cramped spaces and are more relaxed in large classes. (Teacher)

Spatial/environmental matters	Quotes (examples)
Classroom Window	• I like the window of my classroom to be large so that I can easily see outside (14-year-old boy). • I don't feel comfortable when my classroom window is small, and I can't see outside (15-year-old girl). • I would like to see a tree instead of that ugly cement wall behind the window when I sit in class (11-year-old girl). • My classroom window is small, and I feel that the space is cramped; It makes me feel like I'm being suffocated (12-year-old girl). • My daughter says that she likes the trees to be tall so that she can see them from the room's window (Mother of a 15-year-old girl). • I teach in two classrooms. One of these classrooms has a big window and the other has a small window on the top because there is a street on the other side. I can feel the difference between the children in those two classes. In the classroom with the top window, the children always look at the window with a curious and fearful look as if they want to know what is behind it (Teacher). • One of my students goes to the window and stares outside whenever he becomes anxious; it is like he goes to another world for a few minutes; this seems to calm him down (Teacher). • They get very nervous when they see the busy yard from the classroom window' but they are very calm in the classroom facing the backyard (Teacher).
Changes in the environment	• When my school got changed, I didn't go back to school for three months just because I liked the previous class. Everyone says it's a bad habit (17-year-old girl). • I would rather drop out than go to a new school (13-year-old boy). • I get very annoyed when I have to change classes. I feel like my first class is mine, I get used to it (11-year-old boy). • It would be very distressing for me to change my study position, like going to the other side of the room (18-year-old girl). • I used to go to a low-level middle school, but when I got accepted into a better high school, I still wanted to go to the same school, because I was used to it with all of its problems (16-year-old girl). • She is even sensitive to her bed sheets, let alone the environment, walls, table and chairs. She gets used to things very badly (Mother of an 8-year-old girl). • It's hard to calm him down when his environment changes. He gets used to where he is (Mother of a 9-year-old boy). • He doesn't like to change where he sleeps, the direction of his bed, and even the location of his pillow. He gets used to them and does not like to change them (Mother of an 8-year-old boy). • Many of my clients complain that their children cannot handle the challenge of any kind of change in the environment (Psychologist).
Transition	• Sudden things are very distressing for me and make me nervous (13-year-old boy). • My child resists new activities if the change is abrupt but not when he gets exposed to it gradually (Mother of a 10-year-old boy). • They tend to get very upset when we must change classrooms, so I change their classrooms now and then to get them used to it; it has given good results (Teacher). • We usually expose them to the issue little by little to reduce their sensitivity. For example, I managed to remove a student's cold sensitivity by gradually placing ice in his hand (Teacher). • It is better to give them a view of the situation before making any changes or starting any activity; familiarity with the situation and small and continuous actions are very important (Occupational therapist). • To teach these children, we should patiently and gradually help them reduce their sensitivities (Psychologist).

3.2. Quantitative results

3.2.1. Spatial preferences of children

The spatial preferences of children for a child-friendly school are outlined as design factors, as shown in Table 2. Each factor, grouped by similar loading values, is named based on the common theme inferred from its measurement(s). Children prioritized a consistent environment, expressing anxiety with changes in their surroundings. Regarding light and color, they preferred soft tones. They valued a dominant view of their surroundings, mentioning that seeing green spaces calmed them. In terms of space and windows, larger classrooms with bigger windows were preferred. Finally, children ranked gradual exposure to change as a way to manage their sensitivity and anxiety.

3.2.2. Spatial preferences of children compared with adult stakeholders

Table 3 juxtaposes the preferences of children diagnosed with ASD and adult stakeholders concerning the design factors. The table elucidates discrepancies in preferences across these cohorts, underscoring the possibility that professionals and educators may emphasize distinct design elements compared to children with ASD and their guardians.

Table 2. Key Design Elements for Children with ASD: A Factor Analysis of Interview

Factor	Varianc factor	α factor	Measure (question)	Loading values
Stability and constancy	22.01	0.97	I don't want to change my school.	0.95
			I like that the space in which I am to do something remains constant.	0.94
Calm and subdued atmosphere	12.45	0.88	I like soft lights more than intense lights.	0.89
			I like soft colors more than intense colors.	0.83
Dominant view from the classroom	9.01	0.72	Seeing the green space from the classroom window relaxes me.	0.80
			I like to see the activities that are happening around me in the classroom.	0.69
Spacious learning environments	7.58	0.89	I like my schoolyard to be vast.	0.97
			I like my classroom to be large.	0.79
Familiarity and predictability	7.06	0.75	I get used to specific spaces to concentrate, so I get anxious when they change or don't exist.	0.81
			I don't like any change in the classroom environment (arrangement of tables and chairs, wall color, etc.).	0.55
			I don't like to transfer from one class to another.	0.43
Large window in the classroom	5.66	0.75	I like classroom windows to be large.	0.98
Gradual exposure	5.30	0.70	My sensitivity to the changes happening around me has decreased over time.	0.98
			I have abandoned some of my habits over time.	0.54

Note. Minimum accepted: Loading value > 0.4 and α>0.6.

Table 3. Comparison of spatial preferences of children with ASD regarding design factors with those of adult stakeholders

Factor	Reference group*		Comparative group	Sig.	M	SD
	M	SD				
Stability and constancy	4.51	0.88	experts	.017	4.05	.93
			parents	.345	4.27	.60
			teachers	.000	3.79	.92
Calm and subdued atmosphere	4.50	0.74	experts	.017	3.93	1.00
			parents	.000	3.22	.94
			teachers	.002	4.02	.73
Dominant view from the classroom	4.42	0.72	experts	.000	3.19	1.02
			parents	.082	4.11	.81
			teachers	.927	4.40	.57
Spacious learning environments	4.49	0.72	experts	.002	3.95	.86
			parents	.448	4.34	1.05
			teachers	.058	4.00	1.13
Familiarity and predictability	4.33	0.86	experts	.406	4.16	.39
			parents	.403	4.13	.39
			teachers	.000	3.57	.89
Large window in the classroom	4.48	0.65	experts	.013	4.12	.68
			parents	.218	4.28	.96
			teachers	.191	4.20	.59
Gradual exposure	4.33	0.80	experts	.250	4.10	.39
			parents	.345	4.25	.59
			teachers	.390	4.21	.49

*Notes. P<0.05 indicates a significant difference between the comparative group and the children with ASD (H0 is rejected); *: Reference group=children with ASD.*

4. DISCUSSION

This study delves into how architectural design can facilitate the creation of autism-friendly schools tailored to meet the specific requirements and inclinations of students diagnosed with ASD. To accomplish this, we juxtapose the spatial preferences of children with ASD against those of adult stakeholders, comprising teachers, parents, and experts. The ensuing discourse is organized around the research inquiries.

4.1. Design issues according to the preferences of children with ASD

4.1.1. Stability and constancy

Our research outcomes furnish substantiation corroborating the importance of stable environments for children with autism, aligning with prior investigations (Hwang et al., 2020; Rodgers et al., 2017; Uljarevic et al., 2017). Individuals diagnosed with ASD frequently exhibit a predilection for familiarity, evident not only in routines and personal pursuits but also in their physical surroundings. This inclination towards environmental constancy can be ascribed to disparities in sensory processing, as expounded upon by Itoi, Kato, and Kashino (2019).

4.1.2. Calm and subdued atmosphere

Our investigation uncovered that children diagnosed with ASD evinced a pronounced predilection for soft and natural lighting, a finding congruent with extant literature positing that such lighting is often more amenable to individuals on the spectrum (Habbak & Khodeir, 2023). Scholarly inquiry suggests that children with ASD typically favor indirect natural and artificial lighting devoid of glare (Mostafa, 2008, 2014; Beaver, 2011). Concerning color preference, while certain studies have indicated variability among individuals with autism (Ludlow & Wilkins, 2009), our study unveiled a consistent inclination towards pale colors among all children. This discovery aligns with previous research indicating a preference for soft and natural colors among individuals with ASD (Vogel, 2008).

4.1.3. Dominant views from the classroom

Our study reveals that children diagnosed with ASD exhibit a preference for classrooms characterized by high visual permeability and unobstructed views, particularly of activities and surroundings. This inclination contributes to their yearning for control over their environment. While the majority of prior investigations suggest restricting exterior views to mitigate distractions for children with ASD (Tufvesson & Tufvesson, 2009; McAllister & Maguire, 2012), our findings advocate for enhancing a dominant view of the surroundings within classrooms to foster a sense of control (Gaines et al., 2016; Norouzi & Garza, 2021).

4.1.4. Spacious learning environments

Our study indicates that children diagnosed with ASD exhibit a preference for spacious environments. These settings afford them a sense of privacy and unhindered movement, diverging from conventional wisdom that often advocates for smaller spaces (Myler et al., 2003). Nonetheless, some researchers propose an alternative approach of subdividing larger spaces into smaller zones based on their specific functions (Gaines et al., 2016). The layout of educational spaces and their components should also be contemplated from the standpoint of facilitating easy navigation and exploration by children with ASD. Consistent with this consideration, Martin (2014) posits that embracing more generous dimensions for educational spaces, rather than adhering strictly to minimal requirements, can yield benefits.

4.1.5. Familiarity and predictability

Our findings indicate that children diagnosed with ASD gravitate towards environments characterized by familiarity and stability, exhibiting resistance to change and transition, whether environmental or educational. This observation aligns with prior research illustrating how structure and routine, constituting elements of predictability, can mitigate anxiety and problematic behaviors while nurturing positive interactions with physical and social environments (e.g., Favre et al., 2015). Additionally, these attributes have been associated with enhanced daily functioning in children with ASD (Chamberlain et al., 2013).

4.1.6. Large window in the classroom

In our investigation, children diagnosed with ASD articulated a preference for large windows in the classroom, facilitating natural light ingress and affording views of the exterior. They also noted that having a vista of green spaces through the window would induce a greater sense of relaxation. Previous

studies have deliberated on the positioning of windows in educational settings to mitigate distraction and provide indirect lighting (Mostafa, 2020). While some recommend against the incorporation of multiple doors and windows within a single space (Tufvesson & Tufvesson, 2009), others advocate for situating windows at elevated heights (McAllister & Maguire, 2012). However, these suggestions are incongruous with our findings. Our results unequivocally demonstrate the importance of visual oversight over the surrounding environment for these children. Consequently, positioning windows above children's eye level is deemed undesirable. Instead, optimal windows afford both visual supervision of the external milieu and vistas of green spaces. These green spaces, positioned as a vegetative barrier between the classroom and outdoors, effectively attenuate external visual stimuli, light, and distractions.

4.1.7. Gradual exposure

The study outcomes affirm gradual exposure as a pivotal strategy for managing sensitivities and mitigating distress among children diagnosed with ASD, who grapple with abrupt changes. Prior investigations have similarly underscored the potential efficacy of graduated exposure in ameliorating sensitivities and enhancing outcomes for these individuals (Kalkbrenner et al., 2015; Maskey et al., 2014; Mostafa, 2020). These findings underscore the significance of integrating gradual exposure strategies to facilitate smoother transitions and augment the overall learning experience in autism-friendly educational settings.

4.2. Comparing children's spatial preferences with those of adults

This study scrutinized the spatial preferences of children diagnosed with ASD and juxtaposed them with those of parents, teachers, and experts. The findings unveil both convergent and divergent perspectives among these cohorts.

4.2.1. Shared Understanding of Gradual Exposure

All four cohorts (children, parents, teachers, experts) unanimously underscored the significance of "gradual exposure" to changes. This consensus underscores a collective recognition of the pivotal role of manageable transitions in aiding children diagnosed with ASD to acclimate and alleviate anxiety in novel circumstances.

4.2.2. Alignment Based on Experience

Children diagnosed with ASD exhibited the highest concordance with their parents across all aspects, except for "gentle & subtle ambiance." This indicates a robust parent-child alignment regarding spatial requirements. Parents likely accrue invaluable insights through daily interactions and by observing their children's reactions to various environments.

4.2.3. Teachers' Understanding Through Daily Interaction

Interestingly, children's preferences exhibited a closer alignment with teachers on factors pertaining to the school setting, such as "visual engagement in the classroom," "spacious learning environments," and "large classroom windows." This underscores the valuable insight teachers glean through their daily interactions with children within the school milieu. Teachers witness firsthand how these spatial attributes can influence a child's concentration, comfort, and capacity to engage with the learning environment.

4.2.4. Discrepancy Between Children and Experts

Experts' Knowledge Gap: The most notable disparity surfaced between children and experts. Children diverged from experts on all aspects except "familiarity and predictability" and "gradual exposure." This indicates that experts' expertise, potentially centered on therapeutic interventions, could benefit from integrating real-world classroom observations. Experts may not possess a comprehensive understanding of the precise spatial elements conducive to fostering a sense of serenity and agency for children diagnosed with ASD within a school milieu.

5. CONCLUSION

This study elucidates several design considerations for crafting autism-friendly schools that cater to the spatial requirements of children with mild autism. By scrutinizing spatial preferences among these children and contrasting them with the viewpoints of adult stakeholders—comprising teachers, parents, and experts—the study has been organized around two focal points.

Firstly, the study pinpoints design challenges pertaining to classrooms and courtyards within schools, encapsulating stability and constancy, subdued ambiance, prominent vistas, expansiveness, predictability, and expansive windows. The

assessments and preferences of children diverge from those of adults concerning these matters. Nonetheless, by identifying shared attributes between them, a blueprint for constructing an autism-friendly school can be formulated as follows. To engender a nurturing and inclusive educational setting for children with ASD, schools should prioritize three fundamental spatial requisites: stability, subtlety, and visibility. These requisites are delineated by pairing to delineate three design concepts and eight spatial attributes for cultivating an autism-friendly school environment (see Figure 1 & Table 4). Firstly, tranquil spaces address the need for stability by mitigating sensory overwhelm and establishing serene locales that mitigate apprehension. Secondly, demarcated spaces, through explicit demarcations and foreseeable arrangements, afford a sense of command and clarity, consonant with both stability and visibility. Lastly, verdant expanses proffer a pacifying fusion of subtlety and visibility.

Overall, the study underscores the significance of incorporating multiple viewpoints, particularly those of children with ASD, in crafting autism-friendly school environments. While this investigation unveiled certain disparities between the preferences of children and those of adults, a more profound examination of these distinctions can yield invaluable insights for customizing school design. By integrating the perspectives of children with ASD alongside the expertise of educators and parents, educational settings can be more adeptly prepared to address the varied needs of this demographic. This multifaceted approach will ultimately cultivate nurturing and inclusive learning environments conducive to the flourishing of all students.

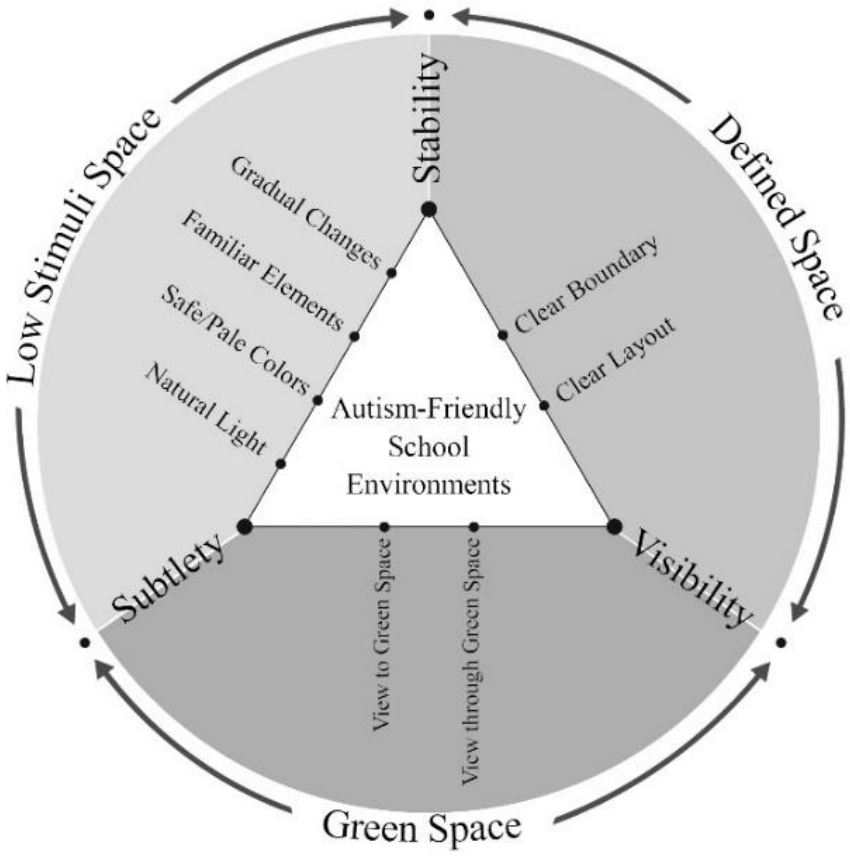

Figure 1. An autism-friendly school environment: three design concepts, three spatial needs, and eight spatial characteristics (*see* Table 4).

Table 4. Design issues according to the preferences of children with ASD

Design Concept	Spatial Needs	Spatial Characteristics	Design Implications
Low-Stimulus Spaces	Stability and Subtlety	- Gradual Changes - Familiar Elements - Safe/Pale Color - Natural Light	1. Create a Calming Environment: - *Use muted color palettes and natural light.* - *Minimize clutter on walls and surfaces*. 2. Ensure Predictability and Control: - *Introduce changes slowly and in a controlled manner.* - *Minimize layout and furniture changes.* - *Implement visual cues for predictable routines.* 3. Maximize Natural Light: - *Install large windows for natural light*.
Defined Spaces	Stability and Visibility	- Clear Boundary - Clear Layout	1. Spatial Definition: - *Utilize distinct flooring materials, paint colors, and furniture arrangements to define different areas within a classroom or common space* - *Implement clear signage with consistent visuals and simple language to aid navigation.* 2. Consistent Layout: - *Maintain consistent furniture placement within classrooms and common areas to avoid unexpected changes*. 3. Predictable Routines: - *Design predictable routines for transitions between activities to minimize anxiety.* - *Implement visual schedules using pictures or symbols to help students anticipate upcoming events.*
Green Spaces	Visibility and Subtlety	- View to green space - View through green space	1. Calming Environment: - *Implementing water features, greenery, natural light.* *2. Nature Connection:* - *Installing large windows with a view of green spaces and activities outside the classroom.*

6. RESEARCH LIMITATIONS AND FURTHER RESEARCH

This study targeted children with higher-functioning autism capable of verbal communication and engagement in research activities. Nonetheless, data collection encountered obstacles as some participants exhibited discomfort with face-to-face interviews, a common trait among individuals with autism. While children favored completing questionnaires independently, parents, teachers, and experts demonstrated greater receptiveness to interviews. Moreover, societal stigma and inadequate awareness about autism prompted numerous families to decline participation.

Our study involved children with ASD aged 9 to 18, recognizing their diverse developmental and educational requirements across different stages. To deepen understanding, we propose future investigations concentrate on either primary schools (ages 9-12) or secondary schools (ages 13 and older). By honing in on specific age cohorts and their distinct learning milieus, forthcoming research stands to yield more nuanced and pertinent insights into crafting autism-friendly educational settings. Moreover, future inquiries should explore innovative methodologies for gathering data from individuals with lower-functioning autism, such as alternative communication channels or observational techniques. Additionally, efforts to raise public awareness about autism and underscore the importance of research participation could address societal hurdles and encourage family engagement in studies aimed at enhancing the well-being of all children with ASD.

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HOW TO CITE THIS ARTICLE

Bahrami, B,. M. H. Nejad, N. (2024). Designing Autism-Friendly Schools: Bridging the Perspectives of Children with ASD and the Perspectives of Adult Stakeholders. *Int. J. Architect. Eng. Urban Plan*, 34(1): 1-15, https://dx.doi.org/ijaup.844.

URL: http://ijaup.iust.ac.ir