The role of architectural and interior design in creating an autism-friendly environment to promote sensory-mitigated design as one of the autistic needs

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Abstract:
Autistic children have delayed verbal and social skills, restricted movements, and motor interests. This research explores the impact of design features on autistic children in school classrooms. Design features can create an autism-friendly environment, with general best practices including avoiding vibrant, highly saturated colors and minimizing dramatic contrast. Research suggests blue to green is preferred, with yellow being aversion due to potential over-stimulating effects. Gradual transitions of color and complementary colors in soft gradients are preferred, with contrast limited to functional purposes like boundary definition. The research also explores the use of smart sensors in interior design to achieve independent living for autistic people. The study aims to promote sensory-mitigated design as one of autistic children's needs in building environments. It supports autistic students and aims to highlight the value of sensory design to a larger population. The research also aims to prove that sensory-friendly spaces are comfortable for all while avoiding appropriation to typical users. This aims to raise awareness and alleviate discrimination around autism. Implications for practice or policy: 1-explore the impact of design features on autistic children in school classrooms. 2-Design features can create an autism-friendly environment, with general best practices including avoiding vibrant, highly saturated colors and minimizing dramatic contrast. 3-explore the use of smart sensors in interior design to achieve independent living for autistic people. 4- promote sensory-mitigated design as one of autistic children's needs in building environments. 5- prove that sensory-friendly spaces are comfortable for all while avoiding appropriation by typical users.

Keywords:
Autism, autism-friendly environment, smart sensors, acoustic, Sensory Economics, Universal design

Paper received November 2, 2023, Accepted January 10, 2024, Published on line January 1, 2024

1. Introduction:
All autistic people are different, and the research confirms that each person may have different demands and priorities at different times. Over time, talents, interests, and views change, and autism is not a static condition. The majority of the community will profit from and not be harmed by spatial assistance, according to the writers. In terms of encouraging inclusion and attending to individual needs, the authors think that spatial assistance will help the majority of the population and pose no damage.[2]

As a continuum of distinct perceptual understandings of the world, neurodiversity and ability are seen in the research as supporting a spectrum approach to design. It supports an increasingly hazy line between "normal" and "special" users, seeing them all as fellow human beings entitled to the same chances and privileges. Spatial assistance, according to the authors, ought to benefit the majority of the population and do no harm. In contrast to conventional norms centered on autism spectrum disorder and seeing shapes, the study promotes usable design as a basic human entitlement. It implies that to guarantee equitable access and practical design, regardless of an individual's degree of autism spectrum disorder, the design must be inclusive and accessible to all, irrespective of their capabilities or perspectives. [3] [4]

2. Universal Design:
Universal design, developed by architect Ronald Mace in 1977, ensures equal access to buildings, products, and information regardless of age, size, language, or ability. The seven universal design principles, which focus on usability, preference for certain user groups, and providing solutions for all, are increasingly used in architectural settings. This approach is particularly relevant for individuals with autism, as research specifically demands this to ensure accessibility and inclusion in architectural environments. [5] [4]

3. Seven Principles of Universal Design [6]
3.1. Equitable Use:
The design is useful and marketable to people with diverse abilities—for example: Automatic doors.
3.2. Flexibility in Use:
The design accommodates a wide range of individual preferences and abilities.
3.3. Simple and Intuitive Use:

Citation: Amira Almaz, Islam Mohamed (2024), The role of architectural and interior design in creating an autism-friendly environment to promote sensory-mitigated design as one of the autistic needs, International Design Journal, Vol. 14 No. 2, (March 2024) pp 239-255

The design is user-friendly, regardless of the user's experience, expertise, language proficiency, or current focus, using universal symbols on signs and infographics.

3.4. Perceptible Information:

The design effectively communicates information to users, regardless of ambient conditions or sensory abilities.

3.5. Tolerance for Error:

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

3.6. Low Physical Effort:

The design can be used efficiently and comfortably and with minimal fatigue.

3.7. Size and Space for Approach and Use:

Appropriate size and space are supplied for approach, reach, manipulation, and use regardless of the user's body size, posture, or mobility.

Fig (1) The 7 principles of universal design[1]

Universal design, which views the human condition as a spectrum of varied emotions and skills, is supported by the study. Though they frequently clash with practical design solutions that might provide challenges, universal design principles seek to be inclusive and equitable. To prevent damage, designers need to resolve intersectional disagreements through open communication. For instance, rough materials might make it more difficult for wheelchair and walker users to move around. [7]

For those with autism in particular, architecture may improve boundaries and social engagement.

A well-designed architecture can help us acquire patterns and hone social skills by creating a microcosm of adult life. Future lives can be influenced by educational tactics, giving pupils the ability to effect change. [8]

4. Therapeutic and educational spaces for the autism spectrum.

The research proposes reorganizing spatial structures to eliminate disparities between autistic and non-autistic spaces and blur user-group borders. It encourages shared spaces and social contact, recognizing users as a spectrum. The test case aims to prioritize the needs of people with autism and provide diverse spaces for a diverse society. The objectives include making friends, appreciating autism perspectives, and reducing the stigma associated with autism. [9]

4.1. Reverse Inclusion:

Reverse inclusion is the concept where the typical minority group becomes the majority, with special needs becoming typical needs becoming special. This shift in spatial paradigm can help meet everyone's needs, especially in autistic contexts. The Autism ASPECTSSTM Index can be used to prioritize sensory requirements, such as zoning around sensory quality, safety, escape space, spatial sequencing, acoustical control, and compartmentalization. This approach can be applied to interface spaces like social communal spaces, sensory gardens, divided urban streetscapes, and escape and sensory respite spaces. [10] [11]

5. Using architecture and interior Design as a Tool for Social and Environmental Management:

Lessening the in-out distinction minimizes heat exchange and fosters the development of social skills, which is the requirement for case study rooms. Entryways, hallways, and building approaches are examples of ideal places. They establish microclimates of sensory mitigation and sanctuary, facilitating social contact and exchange in a controlled and sensory-friendly manner. Controlling the environment and developing skills need this strategy. As a result, the constructed environment becomes more cozy and familiar. [12]

5.1. Introverted design:

Introverted design is a design principle that focuses on inward-oriented areas around open spaces, such as courtyards. This approach creates distinct identities, and social interaction areas, and manages the atmosphere. It integrates natural components at various scales, creating smaller, more controllable habitats. This approach is particularly useful for transitional spaces, particularly for learning settings and autism treatment, as it ensures a safe and easy-to-navigating environment. [13]

5.2. Integrating Natural Elements with Open Space Design:

The study proposes a shift in the spatial organization of functions and services, blurring lines between user groups and eliminating distinctions between autistic and non-autistic spaces. This is intended for retrofit solutions,

facility management reconfigurations, and future builds in autistic places. The test case aims to reduce autism stigma, prioritize autistic needs, and create diverse spaces. Structures should be arranged in natural settings, incorporating elements that appeal to multiple senses. Using Universal Design Research principles, the study ensures accessibility and inclusion for other groups. [14] [15]

Architecture and interior design play a crucial role in our daily lives, especially for autistic individuals. If designed thoughtfully, autistic spaces can reduce stigma, promote social interaction, and celebrate special needs and idiosyncrasies. These spaces can be seen as a microcosm of adult life, where social skills are honed, and patterns are developed. By creating an architectural backdrop that allows for dignity and respect for all, far-reaching social change can occur as these individuals enter the workforce, creating ripple effects in their communities. Strategies incubated in autistic places can inform and infiltrate their later lives, allowing them to become future agents of change toward a more autism-friendly world. [16]

6. Using integration and space as a method for alignment to reduce discrimination:

Sensory gardens can be used to create a more inclusive environment for individuals with autism. By focusing on spatial needs and integrating typical users, these gardens can promote inclusivity and understanding among neurotypical individuals. They can be applied to interface spaces in autistic areas, such as streets and social collective spaces, and extend to residential areas, providing safe, stimulating outdoor spaces that cater to specific sensory needs. This approach aligns with the notion of users as a spectrum, fostering a more inclusive and supportive environment for individuals with autism. [17, 18]

7. Natural Elements and Design Integration in Open Spaces:

Buildings should be designed with a spatial hierarchy that integrates natural environments, such as water, aromatic gardens, and textural materials, to supply therapeutic experiences for occupants. Research shows that exposure to natural environments can have equal or better results than internal environments. Incorporating natural elements into the spatial hierarchy can enhance overall well-being and productivity, as exposure to nature can reduce stress levels and improve cognitive function for autistic and non-autistic users. Therefore, architects and designers must prioritize the integration of natural environments in building design to create healthier and more sustainable spaces for occupants, including sensory gardens and other natural sensory networks embedded as part of the sensory escape network. [3] [18]

7.1. The Six Feelings Framework:

The Six Feelings Framework is a tool that encourages adults with autism to be involved in planning processes. It includes six emotions: peaceful, safe, clear, linked, and free. This approach helps planners design more comfortable, useful, and advantageous environments for all stakeholders, including individuals with autism. Understanding autism can lead to more beneficial and comfortable environments and facilities.

Autism Spectrum Disorder (ASD) affects millions, causing challenges in housing, transportation, and the built environment. City planners and interior architects often overlook the needs of adults with ASD, who face stress, anxiety, sensory overload, sleep problems, and learning issues. Research suggests a planning and design framework to improve the built environment for adults with autism to thrive, promoting better communication and support. Improving architecture and interior architecture knowledge and tools is crucial for creating environments where autistic adults can thrive, varying in typology and type. [10] [19]

Table (1) Using Site Planning and Building Design as a Tool for Social and Environmental Management. [20]

Layering:	**Introverted Design :**	***Creating Microclimates and Buildings within Buildings :***
The ideal spaces for individuals with autism should blur the boundaries between inside and outside, creating microclimates of sensory refuge and transition spaces that facilitate controlled social engagement and exchange. This can be achieved through entrance sequences, interstitial spaces, and construction methods.	The criterion focuses on organizing spaces and zones around open spaces like courtyards, with primary orientation inward, for environmental control, daylight infiltration, and social exchange spaces. It suggests integrating natural elements at different scales and incorporating discrete identities and social exchange spaces.	The Buildings within Buildings approach, which involves creating microclimates and transitional spaces, is effective in creating smaller, manageable environments, particularly beneficial in autism and learning settings, ensuring climatic control, privacy, and acoustical management.

8. The ASPECTSS™ Autistic Viewpoint in Universal Design:

The ASPECTSSTM design index is a set of recommendations developed by autism specialists to help designers create spaces that cater to the comfort, security, and well-being of individuals with autism spectrum disorder. It addresses issues like sensory stimulation, visual aids, spatial arrangement, and acoustics. The index identifies seven characteristics: sensory control, safety, social support, predictability, legibility, engagement, and appropriateness. It can be used as an assessment and design development tool to create supportive environments, ensuring independence, reduced anxiety, and overall well-being. [21]Fig (2)

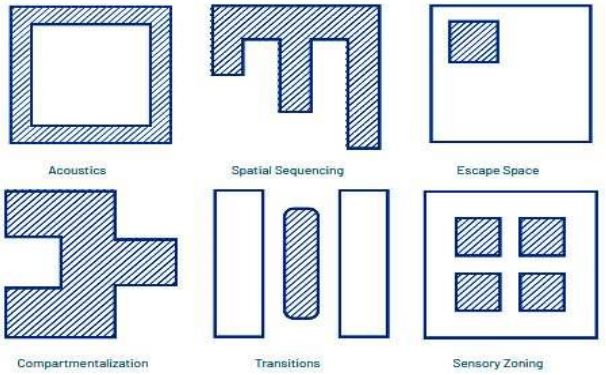

Fig (2) The Autism ASPECTSS™ Design Index is a global set of evidence-based guidelines for designing environments for individuals with Autism Spectrum Disorder, utilizing six criteria for assessment and development.

8.1. Acoustics
8.2. Spatial Sequencing
8.3. Escape Space
8.4. Compartmentalization
8.5. Transitions
8.6. Sensory Zoning
8.7. Safety

8.1. Acoustics:

Acoustic control is crucial for autistic users to minimize background noise, echo, and reverberation. Activities with higher focus should be allowed to have higher acoustical control and be part of low-stimulus zones. Gradually transitioning to a typical environment is essential. [22]

The design process involves autistic individuals and their careers in creating acoustical control measures that promote comfort and reduce sensory overload. Continuous feedback ensures the control measures remain effective over time. A K-12 study found that decibel levels below 55 dB reduce distress in autistic students, while distress behaviors increase at 55-70 dB, marking the first empirical research on specific decibel levels for learning environments and autistic comfort. Fig (3) shows the Noise Level Decibels Chart. [23, 24]

Master planning involves identifying low-stimulus zones, particularly in learning environments, away from noise sources. Sensory qualities, particularly acoustical, should be considered when zoning and managing facilities. Proper acoustical mitigation measures like insulation, acoustic-block use, sound-absorbent materials, double glazing, and sound-absorbent blinds can reduce noise. [25]

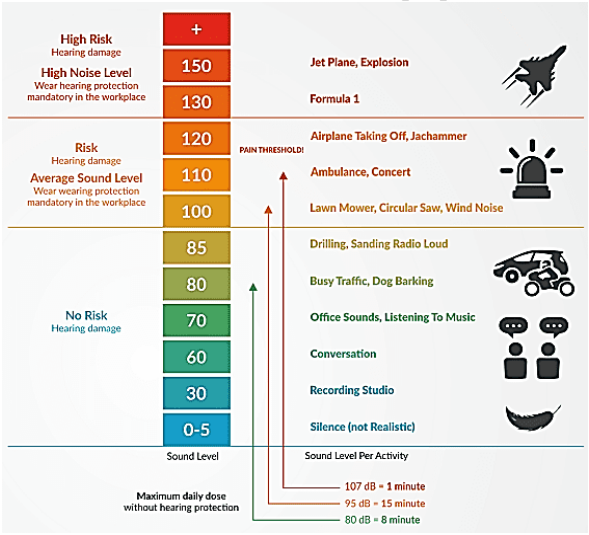

Fig (3) Noise Level Decibels Chart: autistic students experience reduced distress at decibel levels below 55 dB, while distress behaviors increase at 55-70 dB, marking the first empirical research on autistic comfort.

Acoustical regulation is crucial for large open-plan interior spaces, which can be classified into low-stimulation spaces (library, study, residences, and classrooms), high-stimulation spaces (dining halls, and student commons), and transition spaces (corridors, foyers, entrance lobbies, and atriums). These spaces require moderate to high mitigation, depending on their sensory environment. Global solutions at the macro level include using wall-mounted sound-absorbent materials in teaching spaces and corridors, using sound-absorbent flooring systems like carpet tiles or vinyl, and using acoustic ceiling treatments in new construction or retrofit scenarios. Interior geometry and spatial arrangements can cause reverberation and echoes, so space partitioning and panel placement can minimize echo. Attention should be paid to ceiling heights, proportions, and parallel surfaces. . [26] [27] Fig (4)

Fig (4) Acoustic panelling, flexible and free-standing, can create adaptable spaces for various group sizes and activities, including study, escape, and socializing.

The design of autistic spaces should incorporate natural elements and spatial hierarchy for accessibility and learning, ensuring therapeutic opportunities for both autistic and non-autistic users, with key features including fair use, flexibility, and proper space.[28]

Universal Design principles and Universal Delight require autistic design interventions to be agile, flexible, and adaptable. This includes creating sensory-rich landscapes parallel to pedestrian traffic, adjusting lighting levels and furniture layouts, and using RGB light to create temporary color on neutral paint walls. These principles ensure accessibility and adaptability for all users, including mobility-assisted pedestrians and those with sensory alcoves.[3]

8.2. Spatial sequencing:

Spatial sequencing is a method that aims to create routine and predictability in spaces for autistic individuals. It involves organizing spaces logically based on their scheduled use and sensory flow, ensuring seamless flow from one activity to the next. This approach can reduce anxiety by providing relief from anticipation of unexpected events. It is particularly useful in general-use spaces like cafeterias, libraries, and student commons, as well as across autistic places. The sequence of activities should be mapped across autistic places throughout the day, from sensory playscapes to quieter study spaces, and finally to secluded isolation and sensory escape spaces. Access to start and end points should be open. [25, 29]

8.3. Escape Spaces:

Escape spaces are designed to offer respite for users, especially those with autism and neurodiverse conditions, by providing a neutral sensory environment with minimal stimulation. These spaces are customizable and support proprioceptive, physical orientation, and vestibular input. They should be easily accessible, adaptable, and meet community sensory needs while respecting individual needs. Acoustically controlled spaces use sound-absorbent materials, partitioning, sound masking technology, and soft finishes.

The use of a gradient of spaces for autistic users helps them develop sensory filtering, management, and social skills. This gradual approach allows less enclosure and more sensory input, promoting skill development and avoiding the "greenhouse effect." Spaces initially designed for escape and transition can later be used for self-initiated conversation, socialization, and reward. Prioritizing both escape and transition spaces is crucial for autistic users. [29] [30]

8.4. Compartmentalization:

Compartmentalization is a design concept that organizes spaces into sensory cells, each with a distinct function and sensory quality. This separation can be achieved through intangible design features like spatial layering, softscapes, color changes, and lighting variances. The sensory qualities of each space should define its function and differentiate it from its neighboring compartment. This criterion, combined with consistency in activity, supplies sensory and social cues to users, ensuring minimal ambiguity in each space.[31]

Autism-friendly spaces must be designed to cater to the unique needs of the autistic community, promoting inclusivity and adaptability. These spaces should be accessible to all, fostering ownership and domain. Compartmentalization in internal spaces can demonstrate agility and flexibility. Classrooms supporting progressive pedagogies can be categorized into discrete spaces for each activity, allowing autistic students to manage their spatial needs, and allowing students and instructors to arrange modules easily. This approach provides autistic students with control over their spatial needs, with options for interior prompts like carpet lines, color blocking, or painted walls.[32] Fig (5-6-7)

Fig (5) These spaces promote the autistic perspective and environment, supplying benefits for others while respecting ownership, and offering calm, respite, and beauty

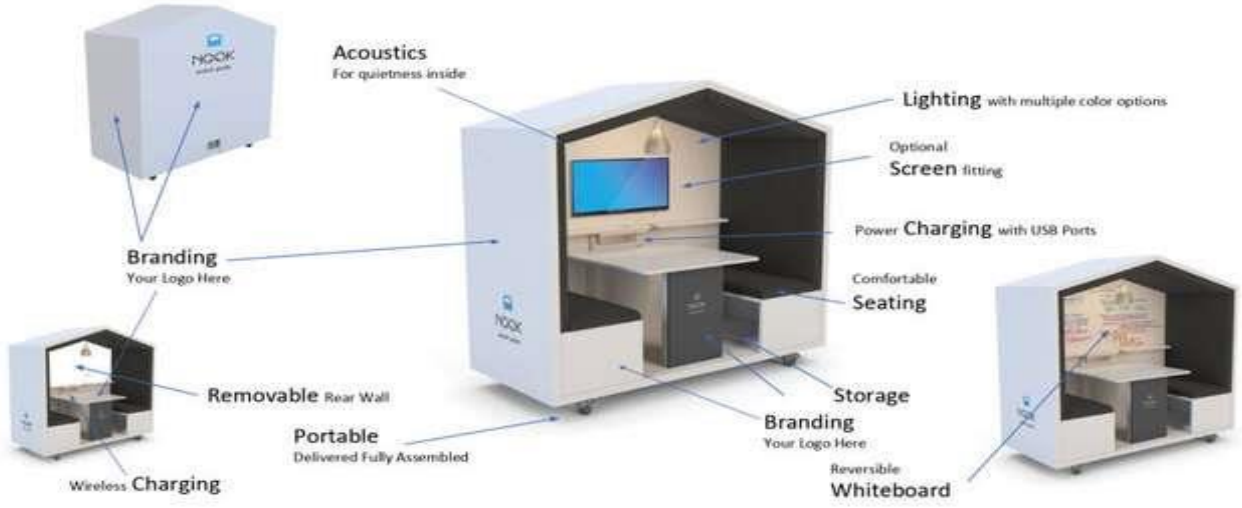

Fig (6) The innovative design of this multi-purpose mobile pod enhances focus and wellbeing, while also maximizing space for autism

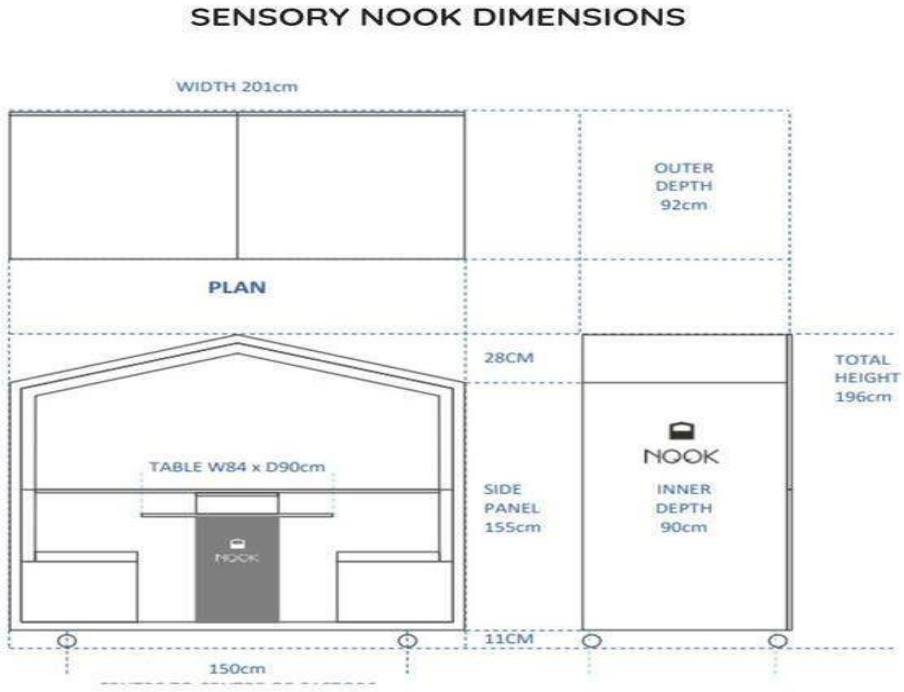

Fig (6) Perfect Furniture Shape for networking and relaxing and supplies solitude to find privacy and comfort

8.5. Transitions:

Transition zones are crucial in autistic spaces for spatial sequencing and sensory zoning, helping users recalibrate their senses as they move from high to low stimuli. They can take various forms, from distinct nodes to full sensory rooms. A network of transition spaces should be planned across autism spaces, ensuring a smooth transition

from high to low stimulation. The most effective solution is to create transition spaces at all entry sequences to buildings, especially in educational buildings, and at the public entrance to autistic spaces. [10]

Public transportation and Urban Scape can be stressful for the autistic community due to sensory overload from sounds, movement, smells, lights, signage, and pedestrians. To alleviate this, a sensory-neutral recalibration transition zone should be provided at major access points, providing respite, creating calm, and calibrating sensory levels. These spaces should be shaded, comfortable, and integrate natural elements. [33]

Transition zones in autistic individuals help ease spatial sequencing and sensory zoning, requiring a network of distinct nodes and sensory spaces, especially in educational buildings for a calm atmosphere.

Sensory-neutral transition zones at major autistic access points can supply respite, calm, and calibrate sensory levels. These spaces should be shaded, comfortable, and integrated with natural elements, supplying different transition levels at different scales. [23] Fig (8)

Fig (8) The sensory-neutral transition zones at major autistic access points should be shaded, comfortable, and complemented by natural elements to offer varied transition levels

8.6. Sensory Zoning:

Sensory zoning is a design theory that suggests environments for individuals with autism should be arranged based on their sensory qualities rather than functional zones. Spaces are divided into high- and low-stimulus zones, with transition zones for easy transitions. This standard can be applied to various sizes, from large organizations to single open-plan areas. Low-stimulation environments should be separated from high-stimulus ones.

Transition zones are crucial for autistic individuals to maintain concentration and participation in activities. They should be separated from high-stimulus areas, such as sports facilities and utility buildings, and provide a place to withdraw. These zones help individuals navigate and adjust to sensory stimuli, ensuring seamless movement between different sections and supporting balanced learning environments. They also ensure activities live peacefully within the organization's framework. [34] [35] Fig (9)

8.7. Safety:

Safety is a crucial consideration in designing environments, especially for autistic students who may have sensory and mobility challenges. All design interventions developed must be coordinated and approved by in-house Health and Safety. [10]

Fig(9) Sensory zoning categorizes autism-specific spaces based on sensory quality, separating high-stimulus and low-stimulus zones with transition zones, suitable for various scales and scales.

Materials for settings designed for people with autism should prioritize safety and promote graceful aging. Textures in circulation zones should reduce physical injury, while soft edges and non-slip surfaces are essential. Tactile surfaces can enhance sensory engagement in outdoor areas. Safety and mobility requirements of other user groups should be considered. Photosensitive and visually sensitive epilepsy are common challenges that can cross into autism, and certain visual and light aspects may cause these conditions. [36]

The proposed hierarchy of control zones in autistic spaces prioritizes safety and security, distributing levels from fully accessible to semi-accessible, and

recommends electronic key card access, human security, and digital surveillance. [37]

To reduce sensory and behavioral challenges in autistic students, responsible support and respectful observation are needed, balancing sensory escape, isolation, and physical separation with potential harm. [38]

9. Material

When choosing materials for environments with autism, comfort, durability, and safety are given priority to avoid mishaps. Textures, soft edges, and low-slip surfaces lessen physical damage. Unique features like extra-wide passageways, shutters, and cork floors offer a respite from overpowering conditions, while tactile materials improve sensory engagement. For autistic settings, natural materials are preferable, such as wood floors and upholstery made of natural fabrics. Material selection should be based on tactility, with neutral textural qualities being best for in-person interactions with users. Textural stimulation can be provided via loose furniture and sensory swatches. [23]

Tactile stimulation can be added to autistic spaces, but it's uncomfortable for some users. Safety is crucial, with robust materials and stable fixation, especially for single autistic users. Maintenance is also important, with materials being easy to clean and inexpensive. Customizable materials, such as profiles and shapes, may be used in some cases. [39]

10. Colors:

Autistic children's color sensitivity impacts mood, learning, and behavior. To enhance accessibility, use colorful mat boards to create uniform patterns on the floor and doors. Judicious color indices should be chosen.

Color therapy is crucial for autistic children to function comfortably and correct behavioral abnormalities, using palette colors like pastels, neutrals, and muted tones for a soothing sensory experience.

Research indicates that autistic users prefer blue to green colors, with a preference for blue to green, as yellow may be perceived as overstimulating. The primary use of vibrant colors is best avoided due to polarizing preferences, limiting their use to minimal elements like visual orientation maps and signage. [40]

The autistic perspective Favors gradual transitions of color and complementary colors in soft gradients, with contrast limited to functional purposes. Color can be used to define spatial boundaries and relationships, and with Compartmentalization to create discrete spaces without tangible boundaries. It can reinforce navigational pathways, either as continuous fluid-colored pathways on the ground plane or with minimally color-contrasting edge detailing, visually rooting the autistic user. [41] Fig (10)

11. Lighting:

The study investigates the impact of lighting on autistic children's sensory systems, focusing on diffuse light effects on surfaces. It suggests that adjustable lighting settings can help autistic individuals cope with light sensitivity, and artificial lights should be fitted with dimming controls. Natural light effects, such as sunlight and staircase lights, can stimulate autistic users but should be balanced against distractions and potential hazards. Creating organized photo stimulation opportunities in landscape spaces can also help. [42]

Artificial lighting systems should have dimming capabilities for areas requiring low stimulation and focus, and smart systems can track these levels for further study. Individualized temperature controls, especially in student residences, can inform future planning for sustainable, autism-friendly building systems. Research shows autistic individuals prefer higher Kelvin LEDs for focus- and attention-requiring activities. Automated circadian rhythm LED lighting modulation, ranging from 2700 K to 6500 K, is recommended in healthy built-environment systems. Smart systems can track color temperature levels, providing better control over lighting preferences. Lighting temperature modulation throughout the day supports natural circadian rhythms, promotes attention during peak work hours, and supports regular sleep patterns. Automated circadian rhythm LED lighting modulation is recommended in healthy built-environment systems, but manual overriding can add more customization and control. Light distribution in single spaces should be consistent to avoid dramatic shifts in intensity. [43, 44]

The use of "autism-friendly lighting" and soothing music in a decompression space helps children reorganize thoughts and improve focus, using deep pressure input from weighted products. Autism-friendly color choices should start with a neutral palette, with natural materials like wood, stone, and cotton-based fabric preferred for best friendliness[45]

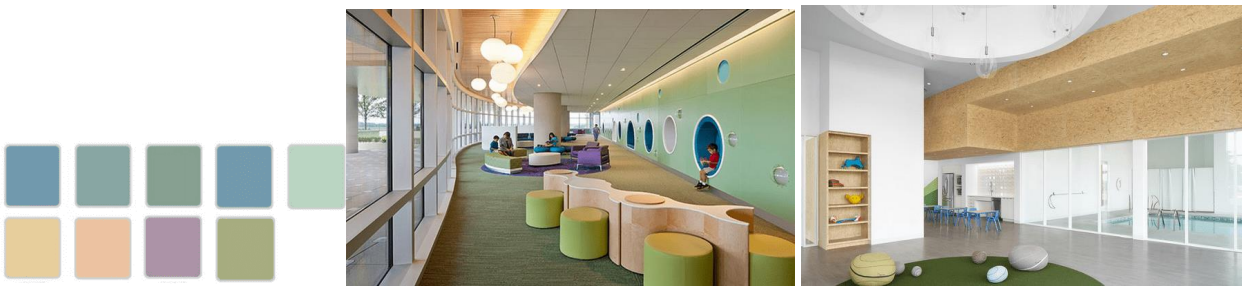

Fig (10) Use color to define spatial boundaries and relationships, providing sensory avoidance for sensory avoiders with soothing music and autistic-friendly lighting for decompression.

12. Furniture:

Furniture types create a micro-climate of acoustical control for individual or small-group users, supplying an escape from sensory overload in large open-plan spaces and single activity spaces. Examples include cocoon chairs, seating pods, egg-shaped chairs, hammocks, free-standing acoustical couches, alcove seating, and high-back booth seating. The acoustical performance of existing furniture can be improved with sound-absorbent padding or quiet casters.

The Faison School for Autism in the US demonstrated the benefits of spatial elements in designing accessible, inviting, and comfortable spaces for autistic users, highlighting the importance of clear corridor strips and color in spatial sequence aids. [2]

Furniture, such as linear seating and partitioning systems, can effectively compartmentalize spaces, supplying flexibility and adaptability without permanent delineation. These systems create acoustical microclimates and supply easy access to sensory support materials, ensuring a comfortable and accessible environment for all users. Built-in alcove seating is an example. Doors, when used with compartmentalization, can connect and separate spaces, but revolving doors are not recommended due to potential stress on autistic users. Doors should supply acoustical separation and be lightweight for easy access. [46]

Natural materials and neutral textures are recommended for furniture, while sensory kits and loose soft furnishings like swatches, cushions, and area rugs can provide tactile stimulation. Contour chairs and couches offer full-body tactile stimulation, supporting sensory overload and escaping in escape and transition spaces, making them suitable for social and study spaces. [36]Fig (11)

Fig (11) The furniture industry can explore the development of stress-reducing chairs specifically designed for individuals with disabilities like autism

During the COVID-19 pandemic, autistic places implemented one-way circulation strategies to reduce face-to-face interaction and crowding. Design thinking workshops supported these strategies, requesting their extension beyond the pandemic, especially at major congestion nodes. Dedicated furniture, such as fidget, bounce, or spin furniture, can supply short breaks, proprioceptive stimulation, and vestibular readjustment, improving focus. Balance chairs, like therapy balls or stools, can help focus attention, promoting proprioceptive engagement and effective learning.

Clear signage should be used in autistic places to name major buildings, entrances, and spaces, using text and icons to show their name and function. Large, visible signage should be used from the farthest points to support orientation and destination planning, ensuring autistic users can predict their surroundings. [3][47]Fig (12)

13. Technology:

Digital virtual environments can help autistic users transition to new spaces, providing seamless setups and real-time audio video. Sensory flagging alerts the autism community and facilities to maintenance and safety issues. A sensory spaces infrastructure network provides escape spaces at various scales and locations, with smart systems supporting effective use and post-occupancy data refining future builds. Smart sensors gather use patterns and user surveys, while post-occupancy research studies examine the physiological impacts of autism-friendly design changes. Technology can also

support smart scheduling and allocation of spaces based on student autism-friendly spaces and staff needs. [48][49]

14. Case Study:

The case study aims to promote the integration of students with autism into society by studying interior design proposals for educational, therapeutic, and sleeping spaces. The study will analyze various design concepts that cater to the specific needs and preferences of students on the autism spectrum, ensuring a comfortable and inclusive environment for their education, therapy, and rest. The study looks to provide practical solutions that foster a sense of belonging and ease the integration of students with autism into mainstream society. The project trains students to handle autism as a case with multiple design requirements, such as sensory-friendly environments, visual supports, and flexible layouts. By immersing students in designing spaces tailored to meet the needs of individuals with autism, they gain a deeper understanding of the challenges faced by this community and develop innovative solutions. The case study not only fosters empathy and inclusivity among students but also equips them with valuable skills to create inclusive environments that positively affect the lives of individuals on the autism spectrum. By focusing on both the physical and emotional aspects of design, students will be equipped with the knowledge and skills necessary to make a meaningful impact in the lives of those with autism. In conclusion, the case study aims to spread the culture of integrating students with autism into society by studying interior design proposals for educational, therapeutic, and sleeping spaces. Fig (13)

Fig (12) Clear signage in autistic areas should find major buildings, entrances, and spaces, using text and icons for function and orientation, ensuring autistic users can predict their surroundings

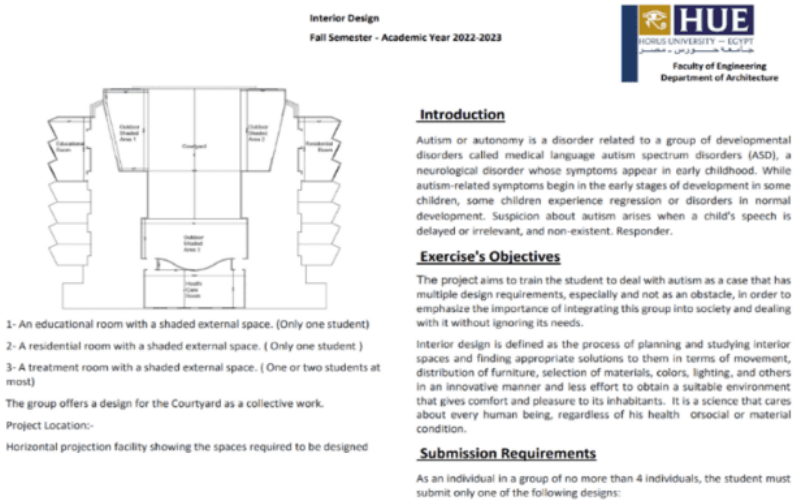

Fig (13) The project aims to promote sensory-reduced design and the autistic perspective in building environments, benefiting students with autism and reducing prejudice, promoting pleasant environments for everyone

14.1. Design strategies:

Autistic places are designed to follow Universal Design Research lines, ensuring inclusivity, and preventing barriers for all groups. However, these research lines have not been fully tested against autistic use needs to be an opportunity for testing design interventions, ensuring solutions do not impede the access and usability of other groups in autistic places, and supplying a comprehensive approach to autistic places. Table (2)

Flexible and adaptable:	**Focusing on furnishings, spatial arrangements, and lighting solutions to accommodate children's needs, allows for efficient learning and physical growth through various activities that enhance their development, learning, physical abilities, self-confidence, and independence.**
Non-threatening things:	The space should be welcoming, promote meetings, and have high seating areas, low areas, and closed caves. It should be shallow enough for teacher monitoring and have soft sensory input items like beanbag chairs, stuffed sofas, carpets, and water.
Not distracting:	To create a clutter-free classroom, eliminate unnecessary visual materials, disorganized signage, and insufficient storage space. Avoid flashing lamps, reduce fluorescent light intensity, and use natural lighting and household lamps for task lighting. Block out mechanical noise from heaters and fans.
predictable:	Autistic children require consistency and visual guidance, which can be achieved through bright tables, boards, pictures, posters, clear paths, pockets, neighborhoods, landmarks, murals, indoor gardens, punctuation, and viewpoints, while environmental information is received through smell, sight, sound, and touch.
Can be controlled:	Autism-related children require more personal space than typical children, which can be controlled through transitional areas between private and public spaces. These areas provide environmental information and comfort, and two vertical mattresses can provide a sense of control, and support diverse social interactions, and decision-making opportunities.
Sensorimotor coordination:	Sensorimotor coordination is crucial for children with confusing sensory integration needs, who often ignore their visual environment. Schools should offer sensory opportunities, including sensory gyms, for exploration.
Security:	Designing a safe environment for children with autism is challenging due to physical hazards like wires, broken windows, and toxic paints, as well as emotional security concerns, as they are more susceptible to seizures and self-harm.

Universal Design and Universal Delight principles emphasize agility, flexibility, and adaptability in designing for autistic users. They suggest using tactile surfaces, adjustable lighting, and flexible furniture layouts. These principles create sensory pathways parallel to pedestrian traffic, ensuring a comfortable, accessible environment.

The project team is instructed to start analytical studies by creating a mind map to visualize space requirements and conducting a SWOT analysis. This will help organize and visualize the project's strengths, weaknesses, opportunities, and threats, supplying a more comprehensive understanding of the analytical studies. Fig (14-15)

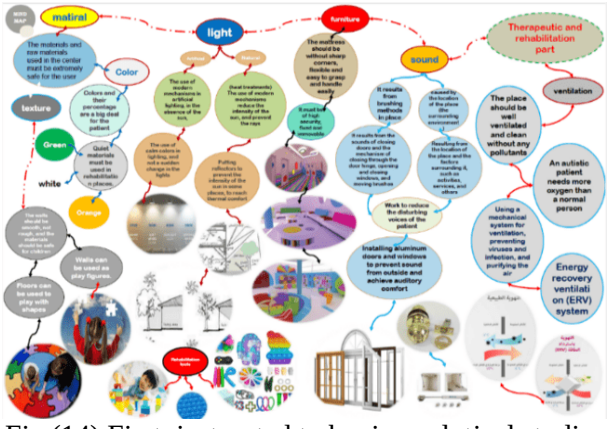

Fig (14) First, instructed to begin analytical studies by creating a Mind-Map to transmit all the space requirements and conduct a SWOT analysis

Fig (15) First, instructed to begin analytical studies by creating a Mood board.

The space is designed with a one-way circulation path, starting with a sensory movement playground in the classes and added social pods in the outdoor space. Users can access main amenities or adjust to sensory/social/visual adjustments in a transition space with ambient white noise. The circulation then flows through three sensory zones, gradually increasing stimulation levels from high to low, in a logical sequence that mimics the proposed use patterns.

Curvilinear circulation layout supplies a soft, gradual flow but lacks orientation like orthogonal systems. They support an internal image of location within the larger space and cardinal directions, especially in internal spaces without external visual anchoring. Organic curvilinear geometries can be

used in outdoor spaces, where visual connection to anchoring context elements like identifiable landmarks compensates for the lack of geometric orientation. Orthogonal systems are more effective internally for a sense of location and orientation, with continuous linear and orthogonal datum aiding visual tracking and reducing vestibular issues. Access to external views, particularly identifiable landmarks, may also support this sense of orientation. Fig (16).

Shared spaces can be stressful, making it difficult for users to escape sensory overload. To make social spaces more inviting, it is essential to have a clear safe corner, three original entry points, and a transition space from high to low stimulation areas. This will help users experience the space in different arrangements and avoid other spaces if they wish. In addition, having a clear path leading to different areas can help users easily reach the desired area. Overall, creating a welcoming and engaging social space is crucial to user satisfaction and satisfaction.

The space is designed with a one-way circulation path, starting with a sensory movement playground in the classes and added social pods in the outdoor space. Users can access main amenities or adjust to sensory/social/visual adjustments in a transition space with ambient white noise. The circulation then flows through three sensory zones, gradually increasing stimulation levels from high to low, in a logical sequence that mimics the proposed use patterns. The student residence has a one-way circulation system with secondary entrances and exits, managing acoustics using carpet tiling and ceiling baffling. Sensory zones include an outdoor interface space, playground, pods, and social alcoves. These spaces are part of a larger network of sensory escape and transition spaces, supplying a safe and inclusive environment for individuals or classes. Fig (16)

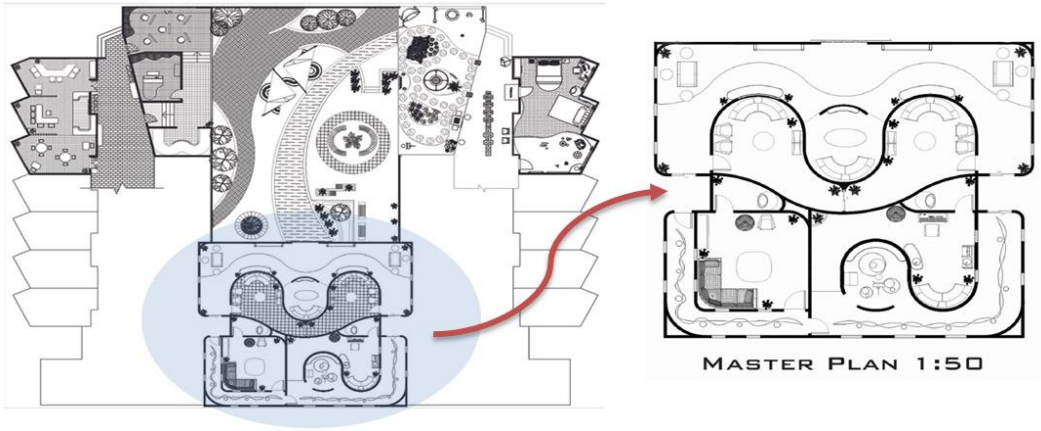

Fig (16) The curvilinear circulation floorplan offers a soft, gradual flow but lacks orientation, supporting an internal image of the location. Organic curvilinear geometries can be used in outdoor spaces, while orthogonal systems provide a sense of location and orientation, with visual anchoring

Shared spaces can be stressful, making it difficult for users to escape sensory overload. To make social spaces more inviting, it is essential to have a clear safe corner, three original entry points, and a transition space from high to low stimulation areas. This will help users experience the space in different arrangements and avoid other spaces if they wish. In addition, having a clear path leading to different areas can help users easily reach the desired area. Overall, creating a welcoming and engaging social space is crucial to user satisfaction and satisfaction.

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The educational aspect of the autism spectrum focuses on developing skills and promoting natural dealing without fear. The focus is on natural lighting and lavender plants to calm the atmosphere, using calm colors like light green, vanilla, and lavender. Group tables, individual chairs, a blackboard, and small libraries are available for de-elopement and communication.

The Sensory Spatial Sequence Zone A is a tiered seating configuration designed for large group discussions, individual and classroom group configurable seating, and awareness building within the autistic student community. Fig (17) It features customizable tires with memory foam or soft loose cushions, accessible seating for wheelchair users, and a lightweight movable LCD screen for partitioning and sound absorption. Acoustical baffling and soft furnishings also help absorb localized noise. The configuration is free-standing, parallel to the external façade, allowing free circulation from all sides. Built-in storage space is available behind the main façade for sensory kits and assistive technology. Low, wheelchair-accessible sensory escape alcoves flank the main.

Fig (17) Zone A Sensory Spatial Sequence is a tiered seating setup for autistic students, featuring customizable tires, wheelchair accessibility, and a lightweight LCD screen, promoting natural dealing without fear

Entrance point.

The Sensory Spatial Sequence Zone B is a classroom designed for group and individual work, study, and socializing. It features free-standing cells, workstations, comfortable seating, and individual pod seating. The partitioning is acoustically flexible, with ceiling baffling, carpet tiles, and a lightweight LCD screen for sound absorption. The autism spectrum education program uses natural lighting and lavender plants to calm the atmosphere. Facilities include group tables, individual chairs, a blackboard, and small libraries for communication. Fig (18)

The therapeutic part Zone C The therapeutic part is used to treat patients of autism spectrum and attached to it is a patient examination room, a blood analysis room, a therapeutic room, a bathroom, a service room, and a rest room—the calm colors such as light blue vanilla and light Gray. The use of lavender, used to calm nerves, was considered. Fig (19)

The Sensory Spatial Sequence is an autism-friendly space accessible through a retractable soft curtain. It offers a quiet, isolated, and rechargeable environment for individuals with autism. The space features ergonomic seating, soft upholstered sides, and ceiling-mounted hammock swing seats. Sensory kits are available in concealed storage spaces, and an assisted technology point allows students to use noise-canceling headphones and tablets. The space is equipped with high-performance acoustical baffling, carpet tiles, and sound-absorbent window treatments.

Zone D A sensory garden is a safe and stimulating environment that stimulates all senses, including sight, touch, taste, and sound, using plants and materials. It is particularly beneficial for autistic patients, as early intervention is crucial. When designing a sensory garden, it is important to incorporate colors for visual stimulation, such as plants, stones, pebbles, and bricks. The balance of colors is crucial, and it is important to avoid overwhelming the child. The size of the garden may also be considered, as half of those with autism are non-verbal. Communicating the intention of specific areas of the garden can be helpful.

Research indicates that natural exposure can alleviate symptoms of autism spectrum disorder (SID), a sensory integration disorder. Children with SID often experience hypersensitivity to their surroundings, which can be alleviated by creating a sensory garden. Distracting activities like games or gardening tasks can help overcome this hypersensitivity. A sensory garden designed specifically for autism can supply a sense of control, purpose, and self-confidence for individuals. Fig (20)

Fig (18) Sensory Spatial Sequence Zone B is a flexible classroom for autism spectrum education, featuring natural lighting and lavender plants for promoting calmness and group work

Fig (19) Zone C's therapeutic area, including a patient examination room, blood analysis room, therapeutic room, bathroom, service room, and rest room, uses calm colors and lavender for nerve-calming

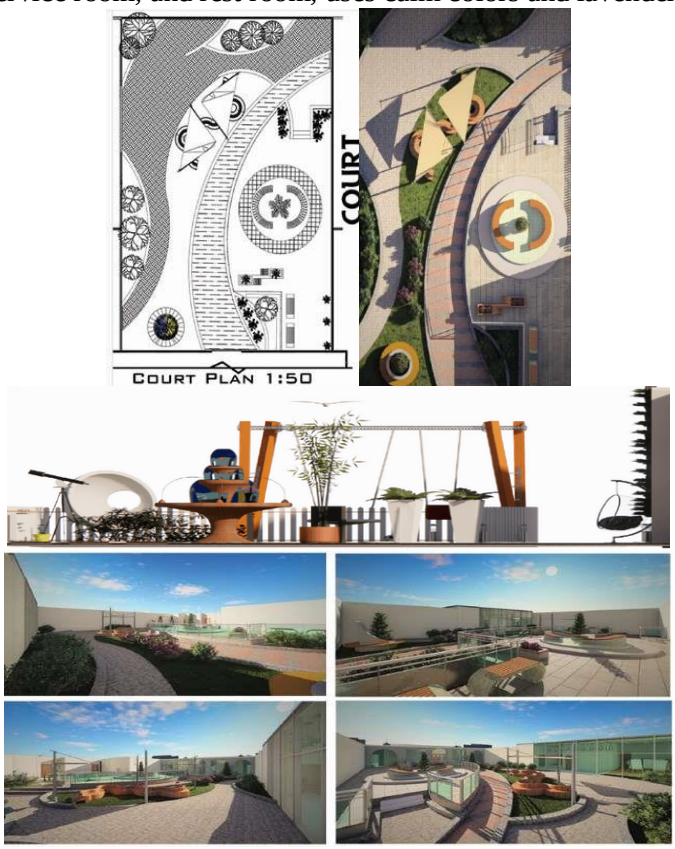

Fig (20) Zone D A sensory garden is a safe, stimulating environment for autistic patients, incorporating plants, materials, and colors for visual stimulation, while communicating its intention

15. Conclusion:

Architecture is the refuge and fortress that protects us all from all external circumstances to give us safety and housing. This claimed to meet our needs, especially for those with exceptional cases.

Autism is a disease of unknown origin and there is no cure yet, and all we can do for those with this disease is to provide them with an environment that supports them and is proper for their needs.

Understanding the diverse nature of autism is crucial for supplying effective support and accommodations. Tailoring interventions to meet individual strengths, challenges, and preferences is possible. Adopting a spatial support approach can foster inclusivity and improve the overall well-being of the autistic community by creating comfortable, accessible, and autonomous environments.

The spectrum approach to spatial support aims to help the community without harm, challenging traditional standards based on spectrum autism and perceiving forms, and promoting inclusive and accessible design.

There is a positive correlation between noise levels and repetitive behaviors, suggesting that noise levels may contribute to their frequency. This hypothesis requires empirical testing in a controlled setting, but the data trends suggest better user-friendly built environments.

It is necessary to spread awareness of groups with special needs among architects and designers to know the nature of these needs and meet them in their work. Our civilization is the best witness to our humane treatment of humanitarian cases, and this drives us to meet the humanitarian needs of our children with special needs, including those with autism.

Exposure to natural environments improves well-being, productivity, stress reduction, and cognitive function for autistic and non-autistic users. Therefore, architects should prioritize incorporating natural environments in design for healthier, more sustainable spaces.

16. References:

1- Burgstahler, S.E. and R.C. Cory, Universal design in higher education: From principles to practice. 2010: Harvard Education Press.
2- Mostafa, M., The autism-friendly university design guide. Dublin City University, Dublin. 2021.
3- Love, J.S., Sensory spaces: sensory living–studio teaching the design of autism-friendly adult accommodation. Archnet-IJAR: International Journal of Architectural Research, 2022. 16(3): p. 595-619.
4- Ostroff, E., Universal design: an evolving paradigm. Universal Design Handbook, 2011.
5- Null, R., Universal Design: Principles and models. 2013: CRC Press.
6- Rose, D.H., et al., Universal design for learning in postsecondary education: Reflections on principles and their application. Journal of postsecondary education and disability, 2006. 19(2): p. 135-151.
7- Edwards, C. and G. Harold, DeafSpace and the principles of universal design. Disability and Rehabilitation, 2014. 36(16): p. 1350-1359.
8- Bigelow, K.E., Designing for Success: Developing Engineers Who Consider Universal Design Principles. Journal of Postsecondary Education and Disability, 2012. 25(3): p. 211-225.
9- Roos, B.A., M. Mobach, and A. Heylighen, How does architecture contribute to reducing behaviors that challenge? A scoping review. Research in Developmental Disabilities, 2022. 127: p. 104229.
10- Mostafa, M., Architecture for autism: Autism ASPECTSS™ in school design. International Journal of Architectural Research: ArchNet-IJAR, 2014. 8(1): p. 143-158.
11- Vincent, L.B., et al., Evaluating the effectiveness of a reverse inclusion Social Skills intervention for children on the Autism Spectrum. Journal of Autism and Developmental Disorders, 2023. 53(7): p. 2647-2662.
12- Mostafa, M., The autism-friendly university design guide. Dublin City University. https://issuu. com/magdamostafa/docs/the_autism_friendly_ design_guide, 2021.
13- Callahan, K., Valuing and supporting introverted students in the virtual design classroom. International Journal of Art & Design Education, 2021. 40(4): p. 714-722.
14- Botha, M., B. Dibb, and D.M. Frost, " Autism is me": an investigation of how autistic individuals make sense of autism and stigma. Disability & Society, 2022. 37(3): p. 427-453.
15- Mottron, L. and D. Bzdok, Autism spectrum heterogeneity: fact or artifact? Molecular psychiatry, 2020. 25(12): p. 3178-3185.
16- Zaniboni, L., et al. Comfortable and safe environments for people with autism: Preliminary analysis of risks and definition of priorities in the design phase. in Journal of Physics: Conference Series. 2021. IOP Publishing.
17- Saade, S., et al., Evaluation of autism training in a much-needed context: The case of France. Autism in Adulthood, 2023.
18- Yi, L.H., M. Isa, and H. Mohd, Architectural Design Strategies of Sensory Integration

through Spaces for Autistic Children. European Proceedings of Multidisciplinary Sciences, 2019.
19- Felix, S.B., Design elements for safe spaces in primary & secondary classrooms: creating calm for students with autism spectrum disorder. 2022.
20- Gibbs, J., et al., Barton Myers: Works of Urbanism and Architecture. 2019: punctum books.
21- Watchorn, V., et al., Promoting participation through the universal design of built environments: Making it happen. 2014.
22- Sheykhmaleki, P., et al., Prioritising public spaces architectural strategies for autistic users. Archnet-IJAR: International Journal of Architectural Research, 2021. 15(3): p. 555-570.
23- Black, M.H., et al., Considerations of the built environment for autistic individuals: A review of the literature. Autism, 2022. 26(8): p. 1904-1915.
24- Coronado, M.C., et al., The Impact of School Facilities on Student Learning and Engagement. 2021.
25- Almaz, A.F.H. and A.A.M.A. ZEINA, The Perceived Interaction of Sensory Processing in Internal Space, Architectural Surrounds, and Endless Space. International Design Journal, 2023. 13(4): p. 331-338.
26- 26.Sneddon, P.L., The effects of auditory stimulation on academic and behavioral performance in children with and without attention-deficit hyperactivity disorder. 2004: Utah State University.
27- Islam Rafaat Mohamed, A.F.H.A., Humanistic and Interactive Methodology in Architecture as a Design Indicator for Human Space. design engineering (toronto), 2021(9): p. 2398 - 2415.
28- Almaz, A.F.H.A., The role of the digital revolution in developing creativity in the interior architecture. International Design Journal, 2017. 7(3): p. 123-135.
29- Kinnaer, M., S. Baumers, and A. Heylighen, Autism-friendly architecture from the outside in and the inside out: An explorative study based on autobiographies of autistic people. Journal of Housing and the Built Environment, 2016. 31: p. 179-195.
30- Zeina, A.A.M.A., The impact of the development of modern technologies on the sustainable development of urban spaces. MEJ. Mansoura Engineering Journal, 2021. 46(1): p. 24-30.
31- Habbak, A.L.Z. and L. Khodeir, Multi-sensory interactive interior design for enhancing skills in children with autism. Ain Shams Engineering Journal, 2023. 14(8): p. 102039.
32- Hamilton, L. and D. McCabe, 'It's just a job': Understanding emotion work, de-animalization and the compartmentalization of organized animal slaughter. Organization, 2016. 23(3): p. 330-350.
33- Mostafa, M., Designing for autism: an ASPECTSS™ post-occupancy evaluation of learning environments. Archnet-IJAR: International Journal of Architectural Research, 2018. 12(3): p. 308.
34- Clément, M.-A., et al., The need for Sensory-Friendly "Zones": Learning from youth on the autism spectrum, their families, and autistic mentors using a participatory approach. Frontiers in Psychology, 2022. 13: p. 883331.
35- Ghazali, R., et al., Determinant Factors of Sensory in Creating Autism Learning Environment. Environment-Behaviour Proceedings Journal, 2021. 6(16): p. 113-118.
36- Gaines, K., et al., Designing for autism spectrum disorders. 2016: Routledge.
37- Almaz, A.F.H., The impact of sensory perception on interior architecture standards for visually impaired and blind students in educational facilities. International Design Journal, 2022. 12(3): p. 263-273.
38- Beaver, C., Designing environments for children and adults on the autism spectrum. Good Autism Practice (GAP), 2011. 12(1): p. 7-11.
39- Mostafa, M., Architecture for autism: Built environment performance in accordance to the autism ASPECTS design index, in Autism 360°. 2020, Elsevier. p. 479-500.
40- Al Maqbool, R.M.A., Impact of Color on Learning Environment of Autistic Children. 2020, Eastern Mediterranean University (EMU)-Doğu Akdeniz Üniversitesi (DAÜ).
41- Ludlow, A.K., E. Taylor-Whiffen, and A.J. Wilkins, Coloured filters enhance the visual perception of social cues in children with autism spectrum disorders. International Scholarly Research Notices, 2012. 2012.
42- Unwin, K.L., G. Powell, and C.R. Jones, The use of Multi-Sensory Environments with autistic children: Exploring the effect of having control of sensory changes. Autism, 2022. 26(6): p. 1379-1394.
43- Almaz, A.F.H., The Impact of Anthropometrics on the Functional Design of Office Furniture. International Design Journal, 2022. 12(5): p. 21-30.
44- Raafat Mohammed Awad, I., Factors affecting contemporary architectural design and its

relationship to the Pharaonic architectural heritage. 2021.
45- Van Reen, E., et al., Lighting system for circadian control and enhanced performance. 2020, Google Patents.
46- Zeina, A. and A. Almaz, The use of architectural treatments for optimal utilization of solar. 2023.
47- Michel, L., Light: The shape of space: Designing with space and light. 1995: John Wiley & Sons.
48- Rivera, K.E., Elementary Classrooms for Autism: Teacher Perceptions of Environment Influence, Adaptations, and COVID-19 Impacts. 2023, University of Missouri-Columbia.
49- Awad, I., and A. Omar, Noise reduction strategies for Heating, Ventilation and Air-Conditioning Systems (HVAC). Journal of Heritage and Design, 2022. 2(7): p. 303-314.