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FOSTERING INDEPENDENCE IN CHILDREN WITH AUTISM; DESIGNING SENSORY-INFORMED TRANSITION SPACE IN LEARNING ENVIRONMENTS: A LITERATURE REVIEW

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Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that creates social interaction, communication problems, and sensory processing difficulties, which create substantial learning challenges for children in standard educational settings. The combination of hypersensitivity and hyposensitivity in autistic students creates overwhelming anxiety when they experience transitions through hallways and corridors. Research shows that sensory-informed interior design promotes engagement, comfort, and self-regulation for learners with ASD. Grounded in Sensory Integration Theory, this paper reviews current research on how transition space design can be harnessed to foster greater independence for children with autism. The methodology involved a synthesis of interdisciplinary peer-reviewed articles covering sensory-friendly strategies, spatial zoning, adaptive technologies, and biophilic principles within learning environments. The research indicates that transition spaces with carefully planned acoustic control, calming lighting, and visual navigation tools, as well as designated spatial protection areas and self-regulation zones, can help reduce stress levels and behavioral problems. These design strategies enable autistic children to handle transitions more effectively while improving their ability to navigate spaces independently. The paper presents evidence-based design recommendations that unite theoretical knowledge with practical applications to establish sensory-sensitive transition areas that support the independence, active involvement, and emotional well-being of neurodiverse children.

Keywords

Autism Spectrum Disorder, Sensory-Informed Design, Transition Spaces, Independence, Learning Environments

Introduction

Autism Spectrum Disorder (ASD) is a complex neurodevelopmental condition that results in challenges in social communication and interaction, leading to restricted and repetitive behavioral patterns (American Psychiatric Association, 2013). There has been an increased global prevalence of ASD, with approximately 1 in 36 children receiving an autism diagnosis (CDC, 2023). Children with ASD frequently experience distinctive sensory processing differences that substantially impact their comfort and functional capacity in educational settings (Baranek et al., 2006). These sensory variations may exhibit as hypersensitivity or hyposensitivity to environmental stimuli, including light, sound, texture, and movement, potentially leading to discomfort, distraction, or distress in inadequately designed spaces (Ben-Sasson et al., 2009). Furthermore, individuals with ASD often encounter communication difficulties in both verbal and non-verbal domains, creating additional barriers to expressing needs and understanding environmental expectations (Tager-Flusberg & Kasari, 2013).

The physical learning environment serves as a crucial factor that either promotes or obstructs the educational growth of children with ASD (Humphrey & Symes, 2011). Traditional learning spaces often employ one-size-fits-all methods that rely on visual displays, strict seating plans, and intense lighting, creating overwhelming conditions for students with autism and thereby reducing their learning potential (Ashburner et al., 2008). The standard educational settings usually do not provide the required sensory accommodations and flexible design elements that help students with neurodiverse needs to manage their anxiety while staying focused (Scott, 2009).

Research shows that autism-friendly interior spaces lead to better educational outcomes, improved behavioral regulation, and overall well-being for students with ASD (Mostafa, 2014). The combination of sensory-responsive design features, including color schemes, acoustic control, and adjustable lighting systems, is effective in reducing anxiety levels while helping autistic students maintain self-regulation (Unwin et al., 2021). Additionally, well-designed spatial flow and adaptive technology systems create better accessibility and student engagement for children with ASD (Goodman & Williams, 2007).

The implementation of successful design strategies in educational settings becomes challenging because institutions often lack sufficient resources, professional development programs, and design support (Doveston & Keenaghan, 2010). This has resulted in learning spaces for autistic children failing to meet their educational and emotional requirements because they lack appropriate support systems (Benton & Johnson, 2015).

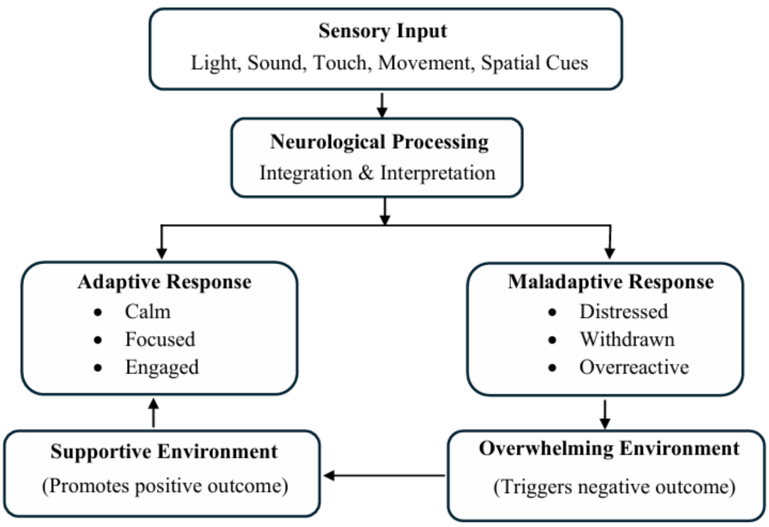
The review explores how transitions between learning environment spaces impact sensory regulation, behavioral responses, and independence development in children with autism spectrum disorder (ASD). It reviews design methods that address the sensitivities of autistic students and spatial arrangements that facilitate controlled transitions between learning areas. The review combines scientific studies with educational design best practices to establish evidence-based recommendations for building autism-friendly learning spaces. The research demonstrates that well-planned transition areas help students manage sensory overload and anxiety while developing self-regulation skills and confidence, which leads to better autonomy and active participation for neurodiverse students with ASD.

Theoretical Framework

Sensory Integration Theory

The study uses Ayres' Sensory Integration Theory (1972) as its theoretical basis to show how environmental design impacts sensory processing and behavioral control in people with ASD. The theory suggests that organized spaces facilitate the management of sensory inputs, enabling the production of appropriate reactions to environmental stimuli. According to Ayres (1972), Sensory Integration Theory, ASD individuals with ASD process sensory information differently than typical people do, which prevents them from managing environmental stimuli effectively. The distinct ways people process information require specific design solutions to create environments that cater to their individual needs. The theory enables researchers to create environments that deliver suitable sensory experiences while reducing excessive stimuli, helping people achieve better functional results and greater self-sufficiency. It serves as a foundation for discovering new ways in which environmental changes help autistic individuals control their senses and gain independence.

Figure 1: Simplified Sensory Integration Theory



Note. Figure 1 illustrates a simplified diagram based on Sensory Integration Theory, showing how sensory input is received and neurologically processed, resulting in either adaptive or maladaptive responses.

Table 1: *Definition of Terms*

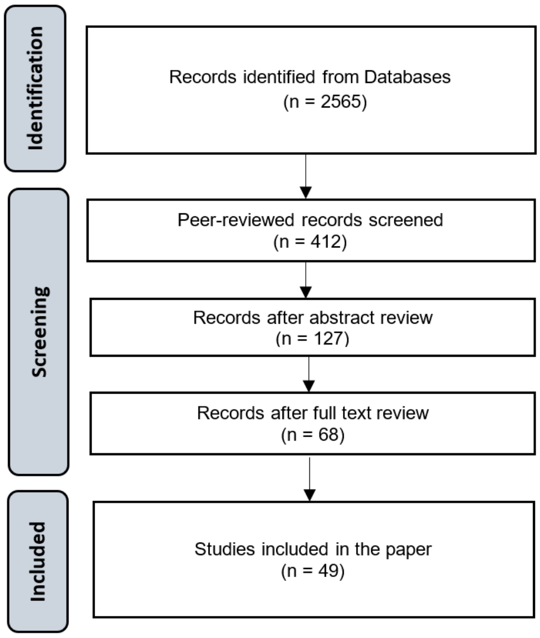
Term	Definition	Reference(s)
Autism Spectrum Disorder (ASD)	A neurodevelopmental disorder characterized by persistent deficits in social communication and interaction, and restricted, repetitive patterns of behaviors, interests, or activities.	(American Psychiatric Association, 2013)
Hyposensitivity	(Under-responsiveness) Atypical reduction in response to sensory input, resulting in diminished awareness of or reaction to stimuli (e.g., pain, sound, touch).	(Ben-Sasson et al., 2009)
Hypersensitivity	(Over-responsiveness) Heightened or aversive reaction to sensory input; everyday stimuli (like bright lights, loud sounds, certain textures) can be overwhelming or painful.	(Ben-Sasson et al., 2009; Marco et al., 2011)
Sensory Seeking	Frequent or intense craving for sensory experiences (e.g., spinning, jumping, hand-flapping, or touching objects) to achieve self-regulation.	(Baranek et al., 2006; Schaaf & Lane, 2015)
Sensory Avoidance	Active effort to withdraw from or block specific sensory input that is perceived as overwhelming or aversive, such as loud noises or fluorescent lighting.	(Baranek et al., 2006; Schaaf & Lane, 2015)
Sensory Regulation	The ability to manage, adjust, or adapt behavioral responses to sensory input to participate successfully in different activities and environments.	(Ayres, 1972; Schaaf & Lane, 2015)
Sensory-Informed Design	The intentional arrangement and modification of environmental stimuli (e.g., lighting, acoustics, materials) to optimize sensory experiences and support regulation for occupants.	(Dargue et al., 2021)
Learning Environment	The physical and social spaces in which learning occurs, including schools, classrooms, shared areas, transition zones, and outdoor areas, are designed to support both educational and sensory needs.	(Humphrey & Symes, 2011; Noiprawat & Sahachaisaeree, 2012)
Transition Space	Designated area connecting different functional zones (e.g., hallways, vestibules, buffer zones) that allows adjustment, physical or sensory, between activities/environments.	(Gaines et al., 2016; Mostafa, 2014)
Wayfinding	Environmental supports or cues (e.g., signage, color-coding, maps) that help individuals navigate a space independently and with confidence.	(Dargue et al., 2021; Kinnaer et al., 2016)
Spatial Zoning	The organization of space into distinct areas based on activity, stimulation level, or function, often using visual, auditory, or tactile boundaries.	(Gaines et al., 2016; Lowe et al., 2014)
Acoustic Control	The use of sound-absorbing materials and design solutions (carpets, ceiling tiles, soft furniture) to manage noise levels and improve comfort for people with sound sensitivities.	(Mostafa, 2018)
Biophilic Design	Integrating natural elements (light, plants, views of nature, textures) within built environments to promote stress reduction and well-being.	(Love, 2018; Dianat et al., 2025a)
Adaptive Technologies	Tools/devices incorporated into spaces (e.g., noise-canceling headphones, visual schedules, adjustable lighting) to enable users to access and participate in activities more fully.	(Goodman & Williams, 2007)

Methodology

This literature review investigates the role of transition space design in fostering independence among children with ASD within educational environments.

The research employed a five-stage methodology to identify peer-reviewed articles published between 2000 and 2025. An extensive database search of PubMed, ScienceDirect, and Google Scholar with the following Boolean operators to search for articles that included these specific following: ("Autism Spectrum Disorder" OR "ASD") AND ("Transition Spaces" OR "Hallways" OR "Corridors") AND ("Independence") AND ("Sensory Design" OR "Environmental Modifications") AND ("Learning Environment" OR "School Design"). The search produced 2,565 results in the first stage.

Figure 2: Flow Chart illustrating key steps in the literature review and analysis



After removal of non-peer-reviewed materials, duplicates, and grey literature, 412 peer-reviewed studies remained. Abstracts were screened based on inclusion criteria: (1) empirical focus on environmental design for individuals with ASD, (2) studies addressing sensory features of transition spaces, and (3) relevance to educational or learning environments. This process resulted in 127 studies for full-text review.

From these, 68 studies were identified as highly relevant and methodologically sound. The final inclusion of 49 articles was included.

Note. This PRISMA-style diagram has been provided to enhance the clarity and transparency of the study analysis. The current study did not involve a systematic literature review.

Literature Review

Characteristics and Environmental Implications of ASD

ASD is a neurodevelopmental condition characterized by challenges in social communication, sensory processing differences, and repetitive behavioral patterns (Baron-Cohen et al., 2009; American Psychiatric Association, 2013). Sensory processing differences play a significant role in shaping individual experiences and environmental needs (Baranek et al., 2006). It affects individuals across a broad spectrum. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) uses three severity levels to categorize autism based on support requirements for daily living skills (American Psychiatric Association, 2013). Research shows that sensory sensitivities affect more than 96% of children with ASD who experience them at different levels from mild preferences to severe disruptions that interfere with their daily activities and must be addressed through thoughtful design strategies (Marco et al., 2011; Gaines et al., 2016; Mostafa, 2014).

People with autism exhibit distinct communication traits, including social referencing problems, irregular joint attention, and conventional gestures (Chawarska & Volkmar, 2005). Young autistic children exhibit specific communication patterns, characterized by abnormal eye contact and social interaction, as well as inconsistent responses to name calls and delayed language skills (Paul et al., 2008; Wetherby et al., 2007). According to Paul et al. (2008) and Wetherby et al. (2007), these communication differences have significant implications for environmental design, particularly in terms of visual support and spatial organization. The combination of sensory processing issues with communication problems generates complex environmental requirements for individuals with autism spectrum disorder (Baranek et al., 2006; Tager-Flusberg & Kasari, 2013; Koenig & Williams, 2017). Research indicates that learning environments should integrate sensory regulation support with communication assistance through design methods that facilitate the development of self-advocacy skills (Mostafa, 2014; Gaines et al., 2016).

Learning Environment Design: Foundations for Autism-Responsive Spaces

The Department for Education and Skills (2006) reports that 60% of autistic children learn in mainstream educational settings, which demonstrates the need for inclusive classroom design. Autistic students face social misunderstandings and environmental stressors in their learning environment, which can be mitigated through effective design solutions (Gaines et al., 2016; Zainal & Magiati, 2016).

The design of learning spaces for autistic children needs to focus on both spatial layout and sensory considerations (Gaines et al., 2016; Scott, 2009). For example, it should be a clean, well-ventilated space with adequate room for diverse activities (Noiprawat & Sahachaisaeree, 2012). These environments need to have separate zones for individual and group work, which should be supported by visual systems that help students understand and work independently (Noiprawat & Sahachaisaeree, 2012; Lowe et al., 2014).

Acoustic management is a vital element in autism-responsive design, as individuals with autism tend to be more sensitive to sound (Ben-Sasson et al., 2009; Kinnealey et al., 2012). Learning spaces need controlled background noise, echo, and reverberation to prevent sensory overload and enable students to focus (Mostafa, 2018). The auditory environment for autistic students improves substantially when educational spaces are designed to incorporate carpet installation, acoustic panel placement, and strategic furniture arrangement (Mostafa, 2018).

The Kingwood Trust research shows that properly designed environments enable multiple developmental targets, including independence, social interaction, accessibility, and adaptive growth (Lowe et al., 2014). Well-designed spaces empower individuals to make choices while offering adjustable support systems that adapt to personal requirements and preferences (Bassaw et al., 2025a; Lowe et al., 2014). According to Nagib & Williams (2016), these five key areas must be addressed through effective environmental design interventions: social and communication support, sensory regulation, safety considerations, behavioral support, and flexibility for individual differences.

Sensory-Informed Design Principles: Evidence-Based Environmental Strategies

The design elements that respond to sensory inputs create substantial effects on ASD children with ASD who participate in educational activities (Dargue et al., 2021). By enabling co-presence, Physical design influences all types of nonverbal communication in the visual, tactile, and olfactory domains. (Pati et al., 2025) Students with autism achieve better behavioral control and academic success when their learning environment includes structured spaces with suitable sensory elements (Mostafa, 2014). Sensory design research identifies multiple essential environmental elements that determine how autistic people experience comfort and achieve functionality (Mostafa, 2014). The combination of natural and adjustable lighting systems provides health benefits, emotional comfort, and physical comfort (Edwards & Torcellini, 2002; Dianat et al., 2025a; Gago et al., 2015). The use of fluorescent lighting fixtures should be avoided because their flickering and humming sounds create visual and auditory disturbances (Khare & Mullick, 2013). The management of color and visual elements in spaces is a fundamental aspect of creating autism-friendly environments (Mostafa, 2014). For example, combining neutral color schemes with simple visual arrangements helps students focus better while reducing their emotional responses to environmental stimuli (Khare & Mullick, 2013). The preferences for colors differ among people, so designers need to create adaptable systems that support different sensory characteristics and operational requirements (Mostafa, 2014).

Acoustic design represents another fundamental component of sensory-responsive environments (Shield & Greenland, 2010). According to Kinnaer et al. (2016), sound-dampening materials and designated quiet zones enhance the environmental comfort of autistic individuals. Soft materials combined with furniture placement and architectural elements help decrease overwhelming sound levels while preserving practical communication functions (Mostafa, 2014). Natural materials with soft finishes deliver suitable sensory experiences that do not lead to distress or distraction (Ayres, 1972; Fan et al., 2023). Educational facilities require materials that combine sensory benefits with durability and simplicity in maintenance (Du Preez & Combrinck, 2022; Mostafa, 2014). Additionally, the implementation of spatial zoning principles demands the creation of separate areas that combine distinct sensory elements with specific functional uses (Gaines et al., 2016). For example, defined zones for active versus calm activities, individual versus group learning, and high versus low stimulation support autistic individuals' understanding of environmental expectations while providing appropriate sensory regulation opportunities (Nolan et al., 2023).

Transition Space Design Strategies for Supporting Navigation and Independence

Learning environment design is critical in shaping student health outcomes by influencing daily routines, accessibility, and engagement with supportive environments (Dianat et al., 2025b). Especially, Transition spaces play a crucial role in helping individuals with autism navigate between various activities and environments (Gaines et al., 2016). An adequately designed transition area helps autistic people manage their anxiety while improving self-regulation and independence through its ability to offer suitable preparation and sensory adjustment support (Gaines et al., 2016; Mostafa, 2014). These spaces serve as vital protective zones, enabling autistic individuals to navigate shifting environmental requirements and social expectations (Scott, 2009; Khare & Mullick, 2013; Ashburner et al., 2008). The use of sensory buffering zones between high- and low-stimulation areas creates a connection between these spaces (Mostafa, 2014; Humphrey & Symes, 2011).

The transition areas between indoors and outdoors, which include verandah spaces and covered pathways, offer advantages for facilitating movement between these environments (Humphrey & Symes, 2011; Scott, 2009). Additionally, a combination of sloped ceilings with gradual lighting changes and textural transitions in physical design elements creates gentle sensory adaptation zones, which minimize stress while enabling better environmental movement (Scott, 2009; Kinnealey et al., 2012).

These semi-protected environments provide sensory adjustment opportunities while maintaining a connection to natural elements, thereby reducing stress and regulating emotions in individuals with autism (Hebron & Humphrey, 2012).

Wayfinding and predictability elements within transition spaces significantly impact the independence and confidence of individuals with autism (Irish, 2022; Gaines et al., 2016). Visual schedules, combined with clear signage and consistent landmarks, help individuals with autism navigate independently (Dargue et al., 2021). These environmental supports should follow the sequence of normal daily activities, creating predictable patterns to help autistic people develop independence while reducing their anxiety levels (Scott, 2009).

Visual communication supports, including floor patterns, color coding, and directional indicators, can significantly enhance autistic individuals' ability to navigate independently while reducing reliance on adult assistance (Irish, 2022). These environmental modifications support the development of self-advocacy skills and confidence in unfamiliar settings (Ashburner et al., 2008).

Multi-sensory environment integration within transition spaces provides opportunities for sensory regulation and preparation for upcoming activities (Gaines et al., 2016; Mostafa, 2014; Kinnealey et al., 2012). There should be an inclusion of controlled sensory experiences, such as tactile elements, visual focal points, and auditory management tools that individuals can access based on their current needs and preferences (Hebron & Humphrey, 2012). These elements should be designed to accommodate diverse sensory profiles while maintaining safety and accessibility standards (Kinnealey et al., 2012).

Table 2: *Key Interior Design Elements for ASD-Friendly Transition Spaces*

Design Element	Description & Application	Evidence/Best Practice Source
Acoustic Control	Use of sound-absorbing materials (carpets, panels, soft furnishings) and minimizing echo/reverberation to reduce auditory overload.	Mostafa, 2018; Gaines et al., 2016
Lighting Quality	Use indirect, natural, or dimmable lighting to avoid glare and flicker, and reduce the use of harsh fluorescent lights.	Khare & Mullick, 2013
Spatial Zoning	Clear spatial cues and separation between zones for different activities; visually defined pathways.	Gaines et al., 2016; Kinnaer et al., 2016; Bassaw et al, 2025b
Wayfinding and Signage	Predictable visual cues (floor markings, color coding, icons) to support independent orientation and reduce anxiety.	Dargue et al., 2021; Kinnaer et al., 2016
Tactile Elements	Sensory-friendly materials with a variety of textures (but avoid overwhelming or aversive textures).	Kinnaer et al., 2016
Sensory Buffer Zones	Intermediate spaces between high- and low-stimulation areas (e.g., vestibules, alcoves, quiet corners).	Gaines et al., 2016; Mostafa, 2014
Flexible Furniture	Moveable, modular furnishings allowing personal space customization during transition.	Lowe et al., 2014; Nagib & Williams, 2016
Natural Elements	Inclusion of natural light, plants, and views of the outside; biophilic elements to reduce stress.	Mostafa, 2014; Love, 2018; Dianat et at., 2025a
Predictability	Consistent layout, clear boundaries, and routine environmental cues to support emotional safety.	Humphrey & Symes, 2011; Dargue et al., 2021
Multi-sensory Tools	Access to regulating items (weighted blanket, soft bean bags, fidget objects) within transition zones to support calming or alerting as needed.	Love, 2018

Independence Skill Development Through Design: Environmental Foundations for Autonomy

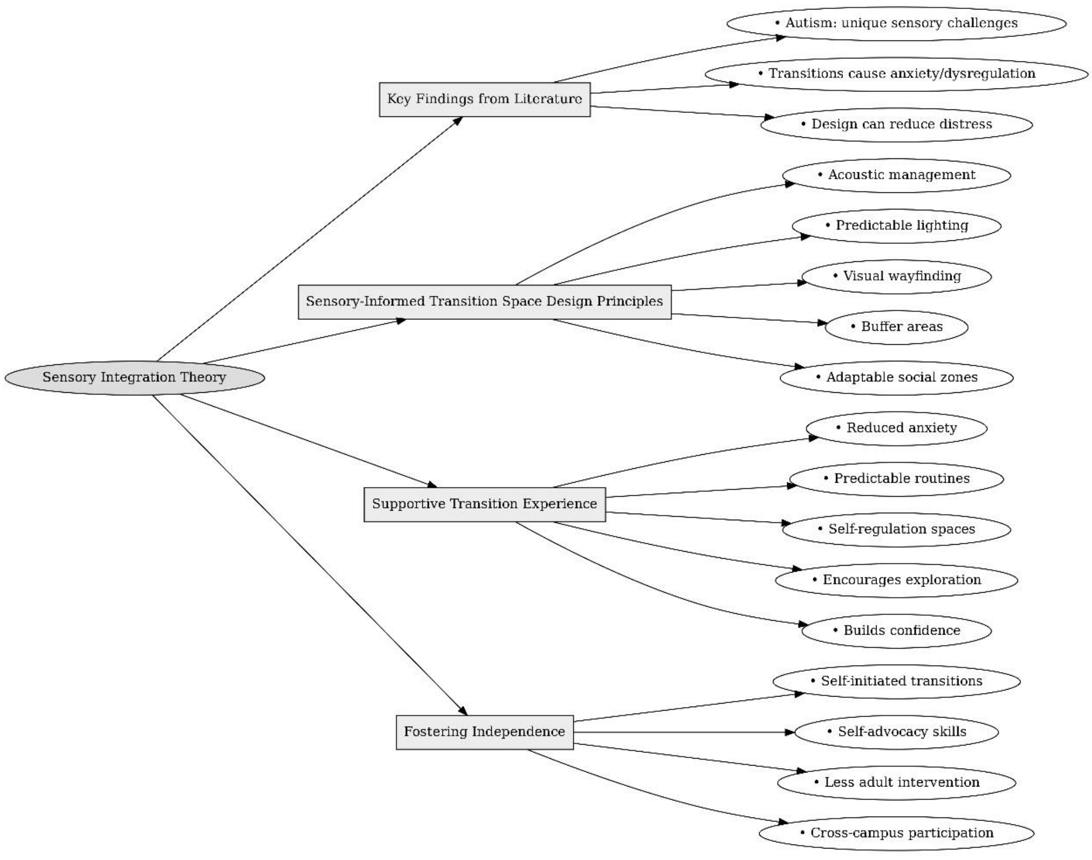
The development of learning environments with proper design strategies enables autistic children to become independent through multiple interrelated systems (Gaines et al., 2016; Khare & Mullick, 2013). Promoting self-advocacy skills and independent functioning in different spaces depends on environmental changes that enhance self-regulation abilities, social competencies, and executive function development (Ashburner et al., 2008; Mostafa, 2014). The ability to self-regulate is a fundamental requirement for achieving independence (Ashburner et al., 2008). Research indicates that individuals with autism require independent access to quiet zones and retreat spaces equipped with sensory tools and calming resources tailored to their individual needs (Nagib & Williams, 2016; Scott, 2009). The implementation of design choices that enable control helps autistic people build their self-advocacy abilities and decision-making competencies (Lowe et al., 2014; Khare & Mullick, 2013). Additionally, combining seating choices, adjustable lighting, and sensory input options within spaces enables individuals to develop self-awareness and environmental adjustment skills (Gaines et al., 2016; Mostafa, 2014). The Autism Intervention Modules for School Organization (AIMS-O) program demonstrates through research that environmental modifications, which support task initiation, organization, planning, and working memory skills, lead to increased independence in academic and daily activities (Kenworthy et al., 2014).

The design of physical areas with varying stimulation levels, ranging from solitary to collaborative spaces, enables autistic individuals and others to exercise their autonomy through choice selection (Mohamed & Almaz, 2024; Bassaw et al., 2025b). Observational learning frameworks demonstrate that clear sightlines and peer modeling in naturalistic settings facilitate skill acquisition without direct instruction, with documented improvements resulting from structured observational training and peer modeling (Plavnick & Hume, 2014). According to Liang et al. (2024), visual schedules can provide organizational structure that supports planning, task initiation, and independent task completion for individuals with autism.

Discussion

The research indicates that purposeful sensory-based design of transition areas creates spaces that enable autistic children in educational environments to become more independent while remaining engaged. The transition moments between classrooms and activities and environmental shifts create high stress for autistic students because they face unpredictable sensory stimuli, social requirements, and disrupted daily routines. The implementation of adjustable lighting systems, acoustic control features, and tactile comfort elements in design creates spaces that help users regulate their senses while providing them with tools for self-regulation. The research demonstrates that

Figure 3 Sensory Integration Mind Map



Note. The Sensory Integration Mind Map illustrates how supportive sensory-informed environments, such as acoustic management, predictable lighting, visual wayfinding, and adaptable zones, can help reduce anxiety, foster independence, and encourage self-regulation during transitions.

social participation benefits from offering people choices and flexible participation options. The design of different interaction areas, including quiet, solitary spaces and collaborative, open spaces, allows children to choose their level of participation based on their comfort and readiness, thereby supporting their independence and social development. This underscores the role of environmental affordances in enabling observational learning through clear sight lines and peer modeling, without requiring direct social demands.

The integration of executive function supports, such as organizational storage, visual schedules, and environmental cues within transition spaces, also holds significant potential. These tools enable students to start and complete their work independently, as they minimize the need for adult guidance. The dual capability of these tools helps students regulate their senses and develop executive functions, enabling them to gain more independence. The implementation of sensory-informed transition space design strategies must be tailored to specific contexts, considering both available space and budget limitations, as well as the diverse sensory needs of students. The development of practical designs for autism-friendly spaces requires sustained teamwork between designers, educators, occupational therapists, and people with autism to validate their practical applications.

Future research needs to evaluate transition space interventions through empirical studies that measure their effects on three specific outcomes: transition time efficiency, behavioral incident frequency, and student comfort levels. Research studies with extended timeframes should investigate how children with ASD develop independence, academic engagement, and life satisfaction through continuous exposure to well-designed transition environments.

Conclusion

The research demonstrates how sensory-informed transition space design functions as an important yet underappreciated factor for developing learning environments that effectively support children with ASD. The design of these spaces as functional pathways between classrooms enables educators and designers to meet the sensory, social, and organizational needs of students with autism. The value of these areas lies in their ability to unite comfort elements with operational functionality, enabling students to manage their senses while learning new skills. The combination of structured design elements with visual direction and adaptable social areas in transition spaces creates environments that promote student independence, emotional stability, and environmental mastery. The research offers adaptable design principles that are effective across various educational environments and funding levels, supporting both new building projects and school renovations. The research lays a foundation for understanding how transitional periods can become drivers of independence and inclusion, although further studies are needed to determine their lasting effects. The intentional design of all school environments throughout the school experience, including transitional areas, enables the creation of spaces that support the accommodation and empowerment of autistic students for success. The design of spaces for ASD individuals with ASD creates opportunities to enhance their quality of life and self-sufficiency.

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