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THE OPTIMIZATION MODEL FOR THE LEARNING ENVIRONMENT OF CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD)

Irman Suherman^{1(*)}, Abdul Kholik²

Universitas Djuanda, Indonesia^{1,2}

Email: irman.suherman@unida.ac.id¹, abdul.kholik@unida.ac.id²

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Abstract

Autism Spectrum Disorder (ASD) exhibit developmental characteristics that affect their communication skills, social interaction, emotional regulation, attention, and responses to sensory stimuli. Environments that are excessively noisy, poorly lit, unstructured, or visually cluttered combined with inflexible teaching strategies can increase sensory load and hinder a child's engagement in the learning process. This study aims to analyze a learning environment optimization model for children with ASD to support a safe, structured, adaptive, and inclusive learning process. A qualitative approach utilizing a case study method was employed. The case was examined in depth through observations of the learning environment and activities, interviews, and an analysis of documentation regarding environmental management and the learning process. Data were analyzed thematically through stages of data reduction, categorization, pattern identification, interpretation, and conclusion drawing. The results indicate that the effectiveness of the learning environment for children with ASD depends on the integration of sensory stimulus management, spatial structure and predictability, visual supports, lighting and acoustic adjustments, the availability of "calm areas," flexible learning arrangements, and consistent teaching strategies. Case study findings also demonstrate that environmental adjustments tailored to a child's individual characteristics and needs can enhance comfort, attention, self-regulation, participation, and engagement in learning. The study implies that optimizing learning environments for ASD requires a contextual, child-centered approach that integrates physical, sensory, pedagogical, psychological, and social aspects. This approach can serve as a foundation for schools and educators to develop learning environments that are more inclusive and responsive, thereby supporting the optimal development of children with ASD.

Keywords: ASD, case study, inclusive learning, learning environment, sensory regulation.

(*) Corresponding Author:

Irma Suherman, irman.suherman@unida.ac.id, 081285354312



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INTRODUCTION

The learning environment is a crucial component determining the quality of the educational experience for children with Autism Spectrum Disorder (ASD), as the characteristics of ASD involve not only communication and social interaction but also behavioral patterns, a need for order, and distinct responses to sensory stimuli. Classrooms are generally multisensory spaces presenting various stimuli simultaneously—such as conversational speech, equipment noise, lighting, colors, visual displays, movement, tactile

sensations, and activity transitions. For some children with ASD, these stimuli may be perceived as overwhelming or difficult to filter, leading to distraction, anxiety, discomfort, repetitive behaviors, meltdowns, or withdrawal from learning activities. Jones et al. (2020), for instance, demonstrated that negative sensory experiences at school can hinder learning through distraction, anxiety, distress, and limited participation; factors such as stimulus predictability, school resources, staff knowledge, and classroom design can help mitigate these impacts. These conditions indicate that the learning environment for children with ASD cannot be viewed merely as a matter of available space and facilities, but rather as an environmental system capable of simultaneously accommodating the child's sensory, emotional, cognitive, social, and pedagogical needs. Environmental issues may also manifest as uncontrolled noise, unsuitable lighting, unstructured layouts, cluttered decor, unpredictable spatial changes, a lack of space for calming down, and a mismatch between environmental characteristics and the child's individual sensory profile.

Many research has been conducted on learning environments for ASD. In a review of classroom design, Martin (2016) found that empirical evidence regarding classroom design criteria that support children with ASD remains limited and many design recommendations have not been adequately tested; thus, more robust research is needed to develop evidence-based designs. Menzinger (2009) found that light and sound intensity are linked to the behavioral responses of students with Asperger syndrome and recommended the provision of safe spaces, clear schedules, visual communication, and consistent, predictable approaches. Ashburner et al. (2008) demonstrated a relationship between sensory processing and the emotional, behavioral, and educational outcomes of children with ASD, indicating that sensory needs must be considered to support their classroom participation. It is important to adopt approaches beyond just the sensory aspect, as children with ASD exhibit varied responses (Ashburner et al. 2014; Fernández-Andrés et al. 2015). Another study by Jones et al. (2020), drawing on the perspectives of 57 parents and 70 teachers, showed that negative sensory experiences at school contribute to distraction, anxiety, distress, and limited participation among children with ASD. Similarly, a field study of special education classrooms by Ueno et al. (2019) highlighted the importance of classroom acoustic quality, noting that children with ASD may struggle to understand teacher instructions in noisy conditions and can be sensitive to specific sounds. Consequently, the use of visual schedules and work systems in regular classrooms can enhance on-task behavior and work independence among students with ASD (MacDonald et al. 2018).

The learning environment for children with ASD should provide a sense of safety, predictability, control over stimuli, flexibility, visual support, and space for self-regulation, as well as opportunities to participate in learning activities tailored to the child's individual characteristics. However, research indicates that interventions specifically modifying the physical school environment remain relatively limited compared to interventions focusing on the child, peers, or educators. The research issue is not merely whether the learning environment needs to be optimized, but rather how that environment is analyzed contextually and optimized based on the children's actual needs, spatial characteristics, teaching practices, and the learning dynamics unfolding within it.

This study aims to develop an optimization model for the learning environments of children with ASD, designed to foster a learning process that is safe, structured, adaptive, and inclusive. Employing a qualitative approach with a case study method, the research examines the learning environment not merely through its physical characteristics but also through children's experiences, teaching practices, interaction patterns, responses to stimuli, and strategies used to manage the learning setting. The study's novelty lies in its integration of a multidimensional analysis—encompassing physical, sensory, pedagogical,

psychological, and social aspects—into a unified optimization model framework grounded in the real-world learning contexts of children with ASD.

RESEARCH METHOD

Research Design

This study used a qualitative approach with a case study design to gain an in-depth understanding of the learning environment conditions and their optimization for children with Autism Spectrum Disorder (ASD). The case study method was selected because the research aims not only to identify the physical conditions of the classroom but also to understand how the sensory, pedagogical, social, and psychological aspects of the environment interact with the characteristics and learning needs of children with ASD (Crowe et al. 2011; Harrison et al. 2017). In this study, the scope is limited to the learning environments of children with ASD within educational institutions that provide services for this population, thereby enabling an in-depth analysis of the relationships among child characteristics, environmental conditions, instructional practices, and the adjustments that have been implemented.

Respondent

Research respondents were selected using purposive sampling, based on their direct involvement in and knowledge of the learning process and the learning environment of children with ASD. Informant selection was not based on a large sample size, but rather on the informants' ability to provide relevant and in-depth information regarding the research focus. The profiles of the research respondents are presented in Table 1 below:

Table 1. Profile of Respondent

Code	Profile	Qty	Criteria
R1	School Principal	1	Understanding policies and service management for children with ASD
R2–R5	Class Teacher	4	Having at least one year of direct experience teaching children with ASD
R6–R7	Special Support Teacher	2	Providing intensive support to children with ASD
R8–R11	Parents	4	

Data Collection

Data collection was conducted through direct observation, semi-structured interviews, and documentation at an inclusive school in Bogor, namely Sekolah Kreativa. Observations focused on classroom learning activities and the school environment. Semi-structured interviews were conducted with the principal, teachers, special support teachers, and parents to explore their experiences regarding the learning environment, challenges encountered, adjustments made, and observable changes in the children's attention, emotional regulation, behavior, participation, and independence. Some of the interview questions addressed to the teachers were as follows:

- (1) What are the characteristics of the learning needs of the ASD child you teach?
- (2) What environmental conditions best help the child concentrate and engage in learning?
- (3) What environmental conditions typically cause the child to become distracted, uncomfortable, or experience difficulties with self-regulation?
- (4) What adjustments have been made so far to support the ASD child?
- (5) In your opinion, what changes are most needed to optimize the learning environment?

Data Analysis

Data analysis was conducted using a step-by-step thematic approach, ranging from transcribing interview results, organizing observation notes and documentation, and repeatedly reading the entire dataset, to initial coding, grouping codes with similar meanings, forming categories, identifying key themes, and interpreting the relationships between themes. The thematic analysis followed the stages developed by Braun and Clarke (2006): familiarization with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and compiling the analysis report (Wong, 2008; Dalkin et al., 2021; Paulus et al., 2022).

RESEARCH RESULTS AND DISCUSSION

Research Results

1. Conditions of Learning Environment for ASD

Research findings identified six children with ASD who exhibited diverse needs regarding communication, attention, sensory responses, social interaction, and independence. Observations revealed that this diversity in characteristics directly influences how the learning environment should be arranged. Children sensitive to sound tend to require a study position further away from noise sources, whereas those easily distracted by visual stimuli need a space with a simpler, more organized layout. These differences demonstrate that the learning environment cannot be separated from the children's individual characteristics.

The class teacher explained that environmental adjustments have been made based on each child's response to the learning situation.

“We strive to tailor instruction to each child's needs. For instance, for children who are sensitive to sound, we offer seating options further away from sources of noise” (R4, interview).

The findings indicate that the teacher has practically implemented forms of environmental accommodation, although most adjustments remain reactive to situations arising during the learning process. Generally, the learning space features a clear functional division between areas for instruction, group activities, resource storage, and individual tasks. The arrangement of tables and chairs allows for relatively adequate movement, enabling children to transition easily between activities. In addition to the main learning area, there is a space available for children to use when they need time to calm down.

The assistant teacher explained that this quiet area is utilized not only when a child exhibits difficult-to-manage behavior but also as part of a self-regulation strategy. According to the assistant teacher:

“Children tend to be more focused when visual schedules and concrete materials are used. However, sudden changes can cause anxiety and make it difficult for them to adapt” (R6, interview).

This statement illustrates the link between the physical environment and the structure of learning; the available space becomes more meaningful when its use is supported by routines, visual cues, and predictable activity arrangements.

Observations indicate that the learning environment is relatively conducive, yet there remain certain stimuli that could potentially distract the children. Noise levels tend to rise during group activities or due to sounds from outside the classroom. Some children show a shift in attention when noise intensity increases, while others show no significant response, highlighting differences in sensory sensitivity among the children. Regarding lighting, the classroom receives ample natural light through the windows; however, at certain times, direct sunlight creates glare in specific areas. Additionally, various educational materials and decorations are displayed on the classroom walls. While these materials serve a pedagogical purpose, for some children, they can also act as visual stimuli

that divert attention. These findings demonstrate that an environment designed to enrich the learning experience does not necessarily affect every child in the same way. Therefore, the effectiveness of an environmental element should be evaluated based on the child's individual response, rather than solely on the function intended by the teacher.

Other research findings indicate that teachers and assistants provide support when children encounter difficulties, yet in certain situations, they also allow children the opportunity to complete activities independently. Interactions among the children remain limited and generally require teacher facilitation. Parents also provided information reinforcing the observational findings regarding the importance of a calm and structured environment. One parent remarked,

“At home, my child is also sensitive to crowds. At school, I notice he is calmer because there is a dedicated area he can use when he feels tired or overstimulated” (R8, interview).

Another parent emphasized the importance of consistency between the school environment and the child's needs at home:

“What we hope for most is that the school can maintain consistent routines and provide space for the child to learn according to their abilities and needs” (R10, interview).

These statements indicate that parental perceptions of environmental quality are not based solely on the physical condition of the space, but also on the school's ability to foster a sense of safety, order, and support tailored to the child's individual needs.

The research findings indicate that the learning environment already incorporates several elements that support learning for children with ASD—specifically, a relatively organized spatial structure, the use of visual supports, the availability of quiet areas, and the active involvement of teachers and support staff. However, there are still areas requiring optimization, particularly regarding noise control, the reduction of visual distractions, the management of transitions, and consistency in adjusting the environment to suit each child's sensory profile.

2. Experiences of ASD Regarding the Learning Environment

Observations indicate that children with ASD respond in diverse ways to the learning environment—whether regarding sensory stimuli, activity structures, social interactions, or situational changes during instruction. These varying responses are evident even when children are in the same room and participating in essentially the same learning activities. Some children are able to engage effectively when the environment is calm and activities follow a routine, whereas others show shifts in attention in response to increased noise, transitions between activities, or the emergence of attention-grabbing visual stimuli.

These findings demonstrate that the responses of children with ASD to the environment are individual in nature and heavily influenced by each child's sensory characteristics and self-regulation abilities. The classroom teacher noted:

“The children do not all respond in the same way. Some can continue learning even when the class is somewhat noisy, while others immediately lose focus or choose to withdraw when there is too much noise” (R5, interview).

This variation represents a significant research finding, as it demonstrates that a learning environment generally considered conducive does not necessarily provide the same experience for all children with ASD.

Support teachers also explained that the responses of children with ASD do not always signify a refusal to engage in learning activities; rather, such responses can serve as a way for the child to alleviate the sensory load they are experiencing.

“If the noise level becomes too high, the child will usually stop working on the task. Sometimes they cover their ears or move to a quieter spot. Only after the

environment becomes calm are they typically able to resume learning” (R7, interview).

Observations also revealed that responses to sound do not always manifest as overt behaviors. In some children, the changes are more apparent through reduced eye contact with the teacher, decreased engagement with the task, or increased body movement. Consequently, observing sensory responses requires a comprehensive approach rather than focusing solely on behaviors that appear disruptive.

Furthermore, the way children with ASD experience their environment is evident in their self-regulation processes. When a child shows signs of fatigue, anxiety, or overstimulation, the availability of a quieter area offers an opportunity to reduce sensory input before rejoining the activity. During observations, some children spontaneously moved to this area after completing specific tasks or when the classroom became noisier. In other instances, teachers directed children to the area as a strategy to aid self-regulation. Interestingly, utilizing the quiet area did not always result in a complete cessation of activity; once they reached a more stable state, the children were able to return to their learning tasks. Parents also observed similar patterns between their children's experiences at home and at school. One parent noted,

“At home, if it gets too noisy, the child usually seeks out a quieter spot. That is why I see it as quite helpful that there is a place at school where they can go to calm down” (R11, interview).

These findings indicate that the need for a space for self-regulation is part of the child's learning experience, rather than merely an additional facility. Such an area provides the child with an opportunity to manage their state before returning to participate in activities.

3. Environmental Impact on ASD Learning

Research findings indicate a strong link between the learning environment and the quality of engagement shown by children with ASD during the learning process. This impact is particularly evident in their ability to sustain attention, follow instructions, complete tasks, regulate emotional and sensory responses, and participate in both individual and group activities. When the environment is relatively calm, activity structures are clear, and children receive information about the sequence of activities through visual supports, they tend to demonstrate more stable engagement. Conversely, when the environment becomes overly noisy or activities change without preparation, some children experience a drop-in attention and require more time to re-engage with the activity. The classroom teacher noted:

“When the classroom is calm and the children know the sequence of activities, they are easier to guide. However, when the atmosphere is noisy or activities change suddenly, some children immediately lose focus” (R2, interview).

Observations indicate that these changes do not always manifest as extreme behaviors; instead, they may be signaled by a cessation of activity, a shift in gaze away from the task, increased physical movement, or a need for more intensive teacher assistance. These findings suggest that the quality of the environment can influence the level of support a child requires to remain engaged in learning.

The most noticeable impact is on attention and concentration. During individual learning activities, children tend to sustain their attention longer when their desks contain only the necessary materials and their seating position is relatively far from sources of distraction. Conversely, when there are noises from outside the classroom, conversations between students, or interesting objects within their line of sight, some children are more prone to distraction. In such situations, teachers must repeatedly provide reminders to bring the child back to the task. An assisting teacher noted:

“If the seat is near the door or in a high-traffic area, the child looks outside more often, and it takes longer to complete the task. Once moved to a quieter spot, they are usually able to refocus” (R5, interview).

Environmental influence is also evident in the child's learning engagement. Children tend to be more active when activities are presented with a clear structure, utilize concrete materials, and have a comprehensible beginning and end. Visual schedules provide information on the sequence of activities, allowing children to anticipate what comes next once the current activity concludes. On several occasions, children even took the initiative to check the schedule before transitioning to the next activity. A teacher noted:

“After using visual schedules, children less frequently ask repeatedly about the next activity. They can see for themselves what is coming up next” (R3, interview).

This demonstrates that visual supports serve not only as communication tools but also help children understand the environmental structure and reduce uncertainty. Children who previously required repeated verbal instructions are able to follow multi-step activities with less assistance. Thus, environmental structure has the potential to enhance engagement while simultaneously reducing the child's reliance on direct teacher assistance.

A further impact is observed in self-regulation and the management of emotional responses. When children encounter stimuli perceived as overwhelming—such as loud noises or heightened classroom activity—access to a quieter area allows them to reduce exposure to the stimulus and regain composure before resuming learning. In observed situations, children showing signs of discomfort were not immediately forced to continue their tasks but were given time to calm down. Once their state stabilized, the teacher guided them back to the unfinished activity. An assistant teacher explained:

“We don't always ask the child to return to the task immediately if they appear overly tired or agitated. Usually, we allow a brief period in the quiet area, and then invite them back once they are ready” (R7, interview).

This approach illustrates that the environment can function as part of a self-regulation strategy. Children are not merely required to adapt to the environment; rather, the environment provides the space and time necessary for them to manage their responses. For children with ASD, opportunities of this kind are important because improved regulation is a prerequisite for re-engaging in the learning process.

4. Optimization Model for the Learning Environment of Children with ASD

The model for optimizing the learning environment for children with Autism Spectrum Disorder (ASD) employs an approach that is individualized, adaptive, and continuous. Research findings indicate that a child's characteristics, environmental conditions, and responses to learning are closely interrelated and mutually influential. The same environment can yield different experiences for each child, as levels of sensory sensitivity, communication skills, attention, self-regulation, and independence vary from child to child. Consequently, the optimization model developed in this study does not view physical spatial changes as the sole solution; instead, it integrates four environmental components: physical, sensory, pedagogical, and socio-psychological. A classroom teacher explained:

“We cannot use the same approach for every child. Some children simply need their seating moved, while others require a visual schedule or a quieter space to regain their focus on learning” (R4, interview).

The resulting model begins by identifying the child's individual characteristics to serve as a basis for decision-making. This identification process covers communication skills, attention patterns, sensory sensitivity, emotional regulation abilities, flexibility regarding change, interaction skills, and levels of independence. This stage is crucial because an environment that is effective for one child may not necessarily be effective for another. Based on these characteristics, the next stage involves mapping the learning

environment conditions across physical, sensory, pedagogical, and socio-psychological aspects. This mapping process goes beyond merely assessing the availability of facilities; it also involves observing how those facilities and conditions are utilized and how the child responds to them. A support teacher emphasized that:

“We usually first look at the reasons why a child struggles to participate in activities. Sometimes, it is not because the child refuses to learn, but rather because factors such as noise, seating arrangements, or changes in activities cause them discomfort” (R6, interview).

The next stage involves identifying both hindering and supporting factors. Research findings indicate that hindering conditions include uncontrolled noise, excessive visual stimuli, sudden changes in activities, inflexible spatial layouts, and overly high social demands. Conversely, supporting factors include organized spaces, comfortable lighting, quiet areas, visual schedules, consistent instructions, the use of concrete learning aids, appropriately sized study groups, and teachers who are responsive to individual children's needs. At this stage, observation and interview data are compared to determine whether a specific environmental element truly influences the child's experience. This process is crucial because the mere presence of a facility does not automatically guarantee its effectiveness. A quiet area, for instance, can only be considered a supporting factor if its use actually helps the child self-regulate and re-engage with learning.

Regarding the physical dimension, adjustments may involve seating arrangements, zoning spaces by function, providing areas for individual and small-group work, reducing spatial crowding, and creating quiet areas. In the sensory dimension, optimization is achieved by managing noise, lighting, visual stimuli, and other sources of stimulation known to compromise the child's comfort. Pedagogical optimization involves the use of visual schedules, consistent instructions, breaking tasks down into simpler steps, allowing time for transitions, and utilizing concrete learning aids. Finally, the socio-psychological dimension is optimized through responsive teacher-child relationships, opportunities for gradual social interaction, peer support, and the creation of a sense of security during learning activities. Parents emphasized the importance of continuity in this approach, stating:

“What we hope for is not just a nice space, but a school that understands the child's needs and consistently implements routines that make the child feel safe” (R11, interview).

The subsequent stage in the learning environment optimization model involves monitoring the child's responses and conducting continuous evaluation. Any adjustments made must be re-examined to determine whether they truly yield the expected changes. Indicators that can be used include increased attention span, task engagement, the ability to navigate transitions, reduced distress responses, improved self-regulation skills, decreased reliance on teacher assistance, and increased social participation.

Teachers do not simply implement changes and consider the matter resolved; rather, they engage in a process of identification, adjustment, observation, evaluation, and further adjustment. The model for optimizing learning environments for children with ASD is depicted as an adaptive, individual-needs-based cycle, as shown in Figure 1 below:

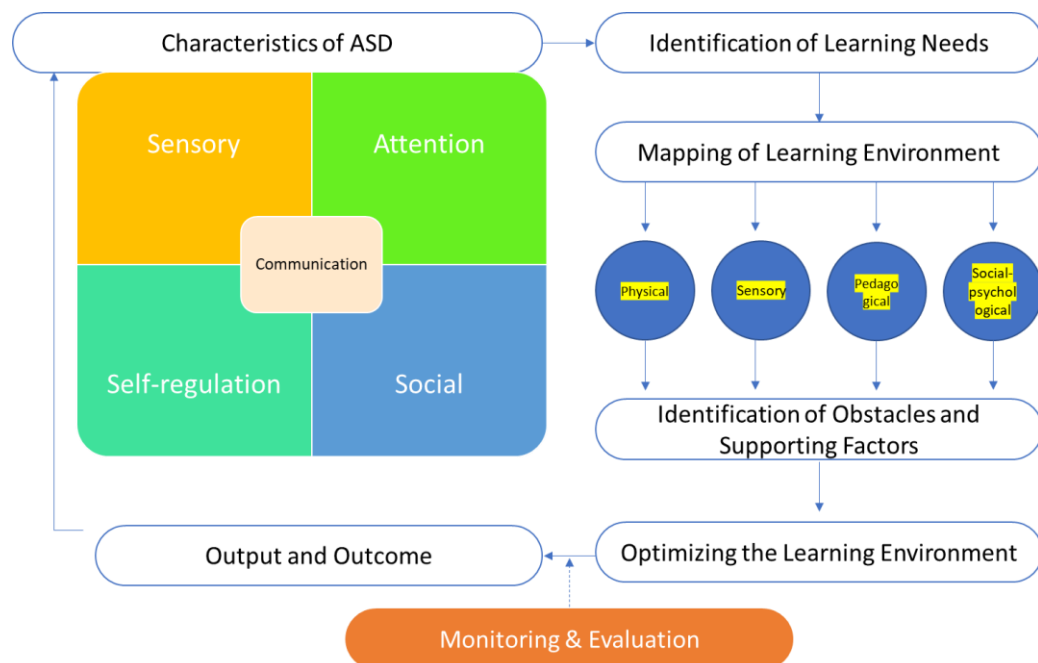


Figure 1. The Optimization Model for the Learning Environment of Children with ASD

Figure 1 above illustrates that child outcomes serve as the basis for determining whether an environmental adjustment should be maintained, developed, or modified. Success in optimization is not measured by the completeness of a school's facilities, but rather by the extent to which the environment helps the child achieve a learning state characterized by greater comfort, predictability, engagement, and independence. This model also positions the teacher as a key actor in the optimization process, as they are the ones who most frequently observe changes in the child's responses and can make direct adjustments during instruction.

The model establishes individualization as the core principle for optimizing learning environments for children with ASD. Environments are not designed solely based on spatial standards or facility amenities; instead, they are shaped through a process of interpreting the child's responses and adjusting the setting to meet their actual needs. Furthermore, this model broadens the understanding of ASD learning environments by integrating physical, sensory, pedagogical, social, and psychological dimensions into a unified development cycle.

Discussion

The learning environment for children with Autism Spectrum Disorder (ASD) cannot be understood merely as the physical space where learning activities take place. Rather, the learning environment is a system that brings together a child's individual characteristics with physical and sensory stimuli, pedagogical demands, and the social interactions that occur during the learning process. Variations in how children respond to space, sound, visual stimuli, changes in activity, and social interaction demonstrate that learning success is heavily influenced by the degree of alignment between environmental demands and the child's capacity to process and respond to them. This perspective is crucial because discussions regarding optimizing environments for ASD have often focused primarily on spatial design, overlooking the fact that a child's learning experience is also shaped by how the space is utilized, how activities are organized, and how teachers respond to changes in the child's state. Al Qutub et al. (2024) note a link between school

environment quality and the behavior of autistic students, yet evidence regarding classroom environments specifically tailored to ASD needs remains relatively limited.

Differences in children's environmental responses reveal that some can maintain attention even in relatively noisy classrooms, whereas others quickly lose focus as sound intensity rises. Similar patterns are observed regarding visual stimuli and changes in activity. The term "ASD-friendly environment" should not be interpreted as a one-size-fits-all condition for every autistic child. An environment that is overly simplified might help some children minimize distractions but fail to provide sufficient support for those who require specific stimuli to remain engaged. Conversely, an environment rich in learning aids might facilitate learning for one child while acting as a source of distraction for another (Jones et al., 2025). Experimental studies comparing autistic and non-autistic children have shown that classroom displays increase off-task behavior—with a more pronounced effect among the autistic group—whereas noise levels did not produce a significant effect under the experimental conditions tested.

Noise, the density of visual stimuli, and lighting conditions can affect a child's ability to sustain attention and regulate their behavior. Difficulties with auditory filtering, sensory under-responsiveness, and sensory-seeking behaviors are linked to lower academic achievement in children with ASD; furthermore, difficulty processing verbal instructions in noisy environments is associated with attention issues (Ashburner et al. 2008). Adams et al. (2025) identified potential links between specific sounds and reduced learning outcomes or well-being, as well as connections between certain visual elements—including lighting and distractions—and diminished learning outcomes for autistic students. Sensory optimization should not aim to eliminate all stimuli, but rather to manage stimuli that are irrelevant to the task at hand.

Children with ASD find it easier to engage in activities when they understand what is currently happening and what will follow. Sudden changes increase the child's need for teacher assistance, highlighting the importance of predictability and external support in organizing activities. Macdonald et al. (2018) found that the use of visual schedules and work systems can improve on-task behavior among autistic students in inclusive classrooms, while also fostering greater independence in their work; consequently, visual supports should not be viewed merely as supplementary aids.

Pedagogical and relational environments are just as important as the physical environment. The teacher-child relationship serves as a mechanism that enables responsive environmental adjustments. Teachers who recognize signs of sensory fatigue, understand triggers for discomfort, and are able to modify activity demands can prevent environmental conditions from becoming barriers to learning. The quality of the teacher-student relationship is linked to behavioral engagement in the classroom for autistic children, and a high-quality relationship can act as a protective factor against low engagement (Losh et al. 2022). Optimizing the environment requires more than just interventions regarding the building or furniture; a teacher's competence in interpreting a child's responses is itself an integral part of an adaptive environment.

Success in a social environment should not be measured solely by a child's participation in group activities; it must also encompass the quality of engagement, opportunities for communication, a sense of security, turn-taking skills, and the development of peer relationships. Environmental impacts on learning unfold through a chain of mechanisms. Environmental stimuli first influence a child's comfort level and processing load; these conditions subsequently affect attention and emotional regulation. Regulation, in turn, determines the child's ability to sustain task engagement, and engagement ultimately influences participation and opportunities for developing independence. This pattern explains why minor environmental changes—such as altering seating arrangements or reducing visual stimuli—can lead to significant behavioral

changes in specific children. Ashburner et al. (2008) support this mechanism by demonstrating that sensory processing characteristics are linked to attention and academic achievement in children with ASD.

This optimization model is significant because it shifts the focus of intervention from "fixing" the child to adjusting the relationship between the child and the environment. Children are not simply expected to adapt to the existing school environment; instead, schools need to identify environmental barriers and make adjustments based on the child's needs. As noted by Leifler et al. (2021), accommodations within the pedagogical and psychosocial environment have the potential to enhance the functioning and performance of children with ASD at school, although the available evidence remains heterogeneous and insufficient to establish a single universal approach.

The most critical aspect of the model for effectively supporting ASD learning is monitoring the child's response as an evaluation mechanism. Historically, school environment evaluations have often stopped at questions regarding the availability of facilities or whether spaces meet specific standards. A quiet room is not automatically effective; a visual schedule does not necessarily help every child; and reducing decorations does not automatically improve attention. Effectiveness must be determined through observable changes in attention, self-regulation, engagement, participation, and independence. Al Qutub et al. (2024) highlight the limited quantitative evidence regarding the impact of indoor environmental quality on the behavior of autistic children, while Adams et al. (2025) note that several aspects of the school environment remain under-researched.

Furthermore, environmental optimization should be viewed as an ongoing process rather than a one-time renovation project. A child's needs may evolve with age, communication abilities, learning experiences, and increasing academic or social demands; an environment suitable for one developmental stage may not be optimal for the next. Schools need to establish periodic evaluation mechanisms that allow teachers, support staff, parents, and—where possible—the children themselves to provide feedback on the effectiveness of implemented adjustments. This approach also reinforces the principle of "person–environment fit," which posits that environmental quality is determined by the alignment between individual characteristics and environmental demands.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the learning environment plays a crucial role in supporting the learning process, self-regulation, and participation of children with Autism Spectrum Disorder (ASD). An effective learning environment is not defined solely by the physical conditions of the classroom but is an integration of physical, sensory, pedagogical, and socio-psychological dimensions that must be tailored to each child's individual characteristics and needs. The research indicates that uncontrolled sensory stimuli, unstructured spatial layouts, unpredictable activity changes, and inflexible teaching strategies can hinder a child's attention, comfort, emotional regulation, engagement, and independence. Conversely, structured yet flexible spatial arrangements, the control of auditory and visual stimuli, the provision of quiet areas, the use of schedules and visual cues, step-by-step instruction, and responsive teacher-child relationships can create an environment that is safer, more predictable, and supportive of the child's engagement in learning. Therefore, optimizing the learning environment for children with ASD should be understood as an individualized, adaptive, and continuous process—beginning with mapping the child's characteristics and responses, identifying environmental barriers and supports, and adjusting the environment and teaching strategies, followed by ongoing monitoring of responses and periodic evaluation. This approach underscores that optimizing learning for children with ASD is not directed solely at the

child adapting to the environment, but also at the environment's ability to adapt to the child's needs, thereby creating a "child-environment fit" that enables the child to learn in a manner that is more comfortable, active, independent, and meaningful.

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