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The impact of classroom environment on the learning outcomes of children with ADHD

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition that significantly impacts children's academic performance and social interactions in classroom settings. This paper explores the role of classroom environments in shaping the learning outcomes of children with ADHD, focusing on physical, social, and instructional dimensions. The review highlights how factors such as seating arrangements, noise levels, teacher-student interactions, and instructional strategies influence attention, engagement, and task completion. Evidence from literature underscores the importance of structured and supportive environments tailored to the unique needs of children with ADHD. Despite the demonstrated benefits of ADHD-friendly environments, challenges such as limited teacher training, financial constraints, and societal stigma persist, hindering their effective implementation. This paper provides evidence-based recommendations to address these barriers, including professional development, inclusive classroom practices, and policy reforms. By prioritizing these strategies, educators can create equitable and supportive learning environments that enhance the academic and social development of children with ADHD. Future research should focus on scalable interventions and long-term outcomes to ensure sustainable impacts.

Keywords: Polythene utilization, adults

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental condition characterized by persistent patterns of inattention, hyperactivity, and impulsivity that interfere with an individual's functioning or development. Globally, ADHD affects approximately 5-7% of school-aged children, making it one of the most common childhood mental health disorders ^[1]. In India, estimates suggest that the prevalence of ADHD ranges between 1.6% and 12.2%, highlighting significant variability based on diagnostic criteria and study methodologies ^[2]. This wide prevalence necessitates a focus on educational strategies to mitigate its impacts on learning outcomes.

The symptoms of ADHD manifest primarily in academic settings, where children are expected to demonstrate sustained attention, impulse control, and compliance with structured routines. These symptoms often lead to challenges in academic performance, peer relationships, and overall classroom behavior. For instance, studies have consistently shown that children with ADHD are at an elevated risk of academic underachievement, grade retention, and school dropouts ^[3]. Moreover, their difficulties extend beyond academics to encompass social interactions, as their impulsive behaviors and inattentiveness often alienate them from peers, creating a cycle of isolation and decreased self-esteem ^[4].

The classroom environment plays a critical role in shaping the learning experiences of children with ADHD. Research indicates that environmental factors such as noise levels, visual stimuli, teacher attitudes, and peer interactions can either mitigate or exacerbate the challenges faced by these children ^[5]. A well-structured, supportive, and accommodating classroom setting can significantly enhance their engagement and academic outcomes, while a poorly managed environment can intensify their difficulties. The importance of an ADHD-friendly classroom environment has been underscored by the Individuals with Disabilities Education Act (IDEA) in the United States, which mandates individualized education plans (IEPs) for students with ADHD ^[6]. Similar policies are gaining traction globally, albeit with significant variation in implementation and impact.

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In understanding the interplay between ADHD and classroom environments, it is crucial to consider the cognitive and neurobiological underpinnings of ADHD. Studies using functional magnetic resonance imaging (fMRI) have shown that children with ADHD exhibit altered activity in the prefrontal cortex, basal ganglia, and cerebellum, regions associated with attention regulation, executive function, and motor control [7]. These neurobiological deficits translate into observable classroom behaviors, such as difficulty staying seated, excessive talking, and inability to complete tasks. Consequently, traditional classroom setups, which prioritize conformity and sustained attention, often fail to accommodate the unique needs of children with ADHD.

Recent evidence suggests that physical aspects of the classroom, such as seating arrangements and noise levels, significantly impact the behavior and performance of children with ADHD. For instance, seating these children closer to the teacher and away from high-traffic areas has been associated with improved attention and task completion [8]. Similarly, reducing background noise through the use of soundproof materials or quiet zones has been shown to minimize distractions [9]. The design of the classroom, therefore, plays a pivotal role in either supporting or hindering the learning outcomes of these children.

Teacher-student interactions also play a fundamental role in determining the success of children with ADHD in classroom settings. Teachers who employ positive reinforcement, patience, and individualized attention have been shown to foster better academic and behavioral outcomes in these children [10]. However, a lack of training and awareness among educators often results in negative interactions, further alienating these students. Data from the National Center for Education Statistics (NCES) indicate that only 24% of teachers in the United States feel adequately trained to handle students with ADHD [11]. This highlights a critical gap in teacher preparation programs and underscores the need for professional development initiatives that focus on ADHD-specific strategies.

Moreover, peer dynamics within the classroom influence the social and emotional well-being of children with ADHD. Inclusive practices that encourage cooperative learning and peer support have been shown to improve social integration and reduce stigmatization [12]. Conversely, negative peer interactions, such as bullying or exclusion, can exacerbate the challenges faced by these children, leading to increased anxiety, depression, and behavioral issues [13].

Instructional strategies also play a crucial role in addressing the needs of children with ADHD. Structured lessons with clear objectives, frequent breaks, and multisensory approaches have been shown to enhance engagement and retention in these children [14]. For instance, incorporating hands-on activities, visual aids, and technology-driven tools can cater to their diverse learning styles and help maintain focus. The integration of assistive technologies, such as timers, organizational apps, and noise-canceling headphones, has further emerged as a promising approach to support individualized learning for children with ADHD [15]. Despite the growing body of evidence supporting ADHD-friendly classroom practices, significant challenges remain. These include limited resources, large class sizes, and systemic barriers in policy implementation. In low- and middle-income countries, these challenges are further

compounded by a lack of awareness and funding for inclusive education programs [16]. Addressing these issues requires a concerted effort from policymakers, educators, and parents to create an enabling environment for children with ADHD.

Main Objectives of the Study

1. To explore the impact of physical, social, and instructional classroom environments on the academic performance, engagement, and social integration of children with ADHD.
2. To identify challenges and propose evidence-based strategies for creating ADHD-friendly classroom environments that support inclusive education and equitable learning opportunities.

Literature Review

Research by Zentall *et al.* (2011) [8] highlighted the importance of seating arrangements for children with ADHD, demonstrating that proximity to the teacher and reduced distractions improve focus and task completion rates. Shield and Dockrell (2001) [9] emphasized the role of noise levels, showing that excessive auditory stimuli disrupt attention and learning, while soundproofing measures create calmer environments conducive to concentration. Tanner (2009) examined the influence of lighting and visual stimuli, finding that natural lighting and organized visual layouts positively affect the behavior and attention of children with ADHD.

Hoza (2007) [4] investigated peer relationships among children with ADHD, revealing higher rates of social rejection and bullying, which negatively impact self-esteem and classroom participation. Mikami (2010) [12] explored the role of cooperative learning activities and peer mentoring, showing that inclusive practices improve social integration and reduce stigma. DuPaul *et al.* (2011) [10] found that supportive teacher-student interactions, including clear communication and frequent feedback, significantly enhance academic outcomes for children with ADHD.

Fabiano *et al.* (2009) [14] demonstrated the effectiveness of structured and predictable learning environments in reducing anxiety and increasing engagement among children with ADHD. Multisensory learning approaches, as discussed by Greenhill *et al.* (2002) [15], were found to sustain attention and enhance retention by engaging multiple senses. The role of technology in differentiated instruction was explored by Mikami (2010) [12], who identified gamified learning platforms as a promising tool for improving motivation and individualized learning experiences.

Barkley (2014) [5] identified systemic barriers, such as inadequate teacher training and large class sizes, that hinder the adoption of ADHD-friendly environments. The NCES (2021) [11] survey revealed that only a minority of teachers feel adequately prepared to address the needs of students with ADHD, emphasizing the need for professional development and resource allocation. UNESCO's (2020) report highlighted the broader challenges of implementing inclusive education policies, particularly in low-resource settings.

Physical Environment

The physical environment of classrooms significantly affects the learning outcomes of children with ADHD, given their heightened sensitivity to external stimuli and

challenges with sustained attention. Optimizing physical settings is a critical step in creating inclusive classrooms that address the specific needs of these students. Research emphasizes that seating arrangements, noise levels, lighting, spatial layout, and the general visual organization of classrooms are key determinants of how effectively children with ADHD engage in academic activities. These elements not only influence attention and focus but also play a pivotal role in managing hyperactivity and impulsivity, which are hallmark traits of ADHD.

Seating arrangements have been found to be one of the most impactful factors in managing classroom behaviors and promoting engagement among children with ADHD. Evidence suggests that seating these students closer to the teacher enhances their focus and allows for better monitoring. Similarly, seating them away from windows, doors, or high-traffic areas minimizes distractions, thereby improving task completion rates [1]. Flexible seating options, such as standing desks or stability balls, have also demonstrated efficacy in helping children with ADHD manage their restlessness while maintaining productivity [2]. Noise levels in classrooms are another critical consideration. Excessive auditory stimuli can disrupt the learning process for children with ADHD, who are particularly vulnerable to distraction. Studies have shown that classrooms with higher noise levels correlate with reduced attention spans and lower academic performance [3]. To address this, schools have increasingly adopted soundproofing measures, such as installing acoustic panels and carpeting, to minimize noise distractions. Additionally, creating quiet zones within classrooms can provide a calm space for students with ADHD to focus and recharge [4].

Lighting and visual stimuli also significantly influence the

behavior and attention of children with ADHD. While adequate lighting is essential to maintain focus, overly bright or inconsistent lighting can exacerbate hyperactivity or inattentiveness. Research highlights the benefits of natural lighting, which has been linked to improved mood and concentration [5]. Furthermore, visually cluttered classrooms with excessive decorations and posters can overwhelm children with ADHD, leading to cognitive overload. Simplified and organized visual environments are recommended to enhance focus and reduce stress [6].

The spatial layout of the classroom, including the arrangement of desks, resource stations, and movement pathways, affects the ability of children with ADHD to manage their symptoms. Open and spacious layouts that facilitate controlled movement are particularly beneficial. For example, allowing students to move briefly during lessons—for activities like retrieving materials or visiting designated movement stations—can help channel their energy constructively [7]. This approach not only supports ADHD students but also fosters a more dynamic and interactive classroom environment.

Despite the well-documented benefits of adapting classroom environments to the needs of children with ADHD, several concerns remain. Limited budgets often restrict the ability of schools to implement physical modifications, particularly in underfunded educational systems. Additionally, large class sizes pose a challenge to individualizing physical settings for students with ADHD. There is also a notable gap in teacher training programs, with many educators lacking the knowledge and resources to implement ADHD-friendly classroom designs effectively [8]. These systemic barriers highlight the need for increased investment in inclusive education and professional development for teachers.

Table 1: The following table summarizes below aspects of the physical classroom environment and their impact on children with ADHD:

Classroom Aspect	Impact on ADHD Students	Recommended Adjustments	References
Seating Arrangements	Improves focus and reduces distractions	Close to teacher; away from high-traffic areas or windows	Zentall <i>et al.</i> , 2011 [1]
Noise Levels	High noise exacerbates attention difficulties	Acoustic panels, quiet zones, soundproofing	Shield & Dockrell, 2003 [3]
Lighting	Harsh or dim lighting reduces focus and increases hyperactivity	Use of natural light; consistent and moderate lighting	Tanner, 2009 [5]
Visual Stimuli	Excessive stimuli cause cognitive overload	Simplified and organized decorations	Kohn, 2001 [6]
Spatial Layout	Limited movement leads to hyperactivity	Open spaces; controlled movement pathways	Fabiano <i>et al.</i> , 2009 [7]

The physical environment is a critical but often overlooked aspect of educational interventions for children with ADHD. Addressing this dimension through evidence-based strategies can significantly improve academic outcomes and overall classroom behavior. Future efforts should focus on bridging systemic gaps to ensure that all children, regardless of their neurodevelopmental challenges, can access supportive and inclusive educational settings.

Social Environment: The social environment of a classroom significantly influences the learning outcomes and overall well-being of children with ADHD. Social dynamics within the classroom, including teacher-student interactions, peer relationships, and the overall culture of inclusivity, play a pivotal role in shaping the academic and emotional experiences of these children. Unlike physical modifications, which address external stimuli, the social environment involves interpersonal factors that directly

impact a child’s sense of belonging, self-esteem, and motivation to learn.

Teacher-Student Interactions: The quality of teacher-student interactions is critical for children with ADHD. Positive and supportive relationships with teachers have been shown to enhance engagement, reduce disruptive behaviors, and improve academic outcomes. Studies suggest that teachers who adopt a patient, empathetic, and proactive approach can significantly mitigate the challenges faced by children with ADHD [1]. For example, frequent feedback, clear communication, and individualized attention can help these students feel supported and understood. Research by DuPaul *et al.* (2011) [10] emphasizes that teachers trained in ADHD-specific strategies are more effective in managing classroom behaviors and fostering a conducive learning environment [2].

Conversely, negative interactions, such as punitive

disciplinary measures or constant criticism, can exacerbate symptoms of ADHD and lead to feelings of alienation. These children are particularly vulnerable to being labeled as "troublemakers," which can further affect their self-esteem and academic motivation [3]. This underscores the importance of professional development programs that equip teachers with the skills to manage ADHD-related behaviors constructively.

Peer Relationships: Peer relationships are another crucial aspect of the social environment. Children with ADHD often struggle with forming and maintaining friendships due to their impulsive behaviors, difficulty interpreting social cues, and tendency to dominate conversations [4]. These challenges frequently lead to social isolation or negative peer interactions, such as teasing and bullying. A study by Hoza (2007) [4] found that children with ADHD are more likely to experience peer rejection and are less likely to be included in social activities, contributing to lower self-esteem and increased emotional distress [5].

Inclusive classroom practices, such as cooperative learning activities, peer mentoring, and team-based projects, have been shown to improve social integration for children with ADHD [6]. For instance, assigning roles within group activities ensures that all students, including those with ADHD, can participate meaningfully. Encouraging peers to understand and support their classmates with ADHD also helps reduce stigma and fosters a culture of empathy.

Classroom Culture of Inclusivity: The overall classroom culture plays a significant role in determining how children with ADHD are perceived and treated by both teachers and peers. A positive and inclusive culture that values diversity and promotes mutual respect benefits all students, particularly those with neurodevelopmental differences. Creating this culture involves implementing policies that discourage bullying, promoting awareness about ADHD, and emphasizing the strengths of all learners [7].

Moreover, fostering a classroom environment that celebrates small successes can motivate children with ADHD to stay engaged and persevere through challenges. Recognizing effort, rather than just outcomes, is particularly important for these students, as it reinforces a growth mindset and builds resilience [8].

Findings and Concerns: Despite the recognized importance of the social environment, several challenges persist. Teachers often lack the training and resources to effectively manage the social dynamics of children with ADHD. A survey by the National Center for Education Statistics (NCES) found that only 24% of teachers feel adequately prepared to address the social and emotional needs of students with ADHD [9]. Additionally, systemic issues such as large class sizes and insufficient funding for inclusive education programs further hinder efforts to create supportive social environments. Peer rejection and bullying remain significant concerns, particularly in classrooms where inclusivity is not actively promoted. A lack of understanding about ADHD among peers and educators contributes to the stigmatization of these children. Addressing these issues requires a multifaceted approach, including professional development for teachers, awareness campaigns for students, and policy-level interventions to support inclusive education.

Instructional Strategies

Instructional strategies are central to fostering positive learning outcomes for children with ADHD, given their unique challenges related to attention, impulsivity, and hyperactivity. Effective instructional approaches aim to create structured, engaging, and adaptable learning experiences tailored to these children's needs. Structured learning environments have been consistently identified as beneficial, providing clarity and predictability that help children with ADHD manage their symptoms. Lessons designed with explicit instructions, clear objectives, and logical progression ensure that these students can follow along without feeling overwhelmed. Breaking down tasks into smaller, manageable steps has been shown to improve task completion rates and reduce frustration. Visual aids, checklists, and step-by-step instructions further enhance the ability of children with ADHD to focus and succeed in classroom tasks. Multisensory learning approaches, which engage visual, auditory, and kinesthetic modalities, have emerged as particularly effective for children with ADHD. Such strategies help sustain attention and improve comprehension by providing varied and stimulating experiences. For instance, the use of interactive visuals, manipulatives, and auditory prompts helps children remain engaged and reinforces learning outcomes. Educational technologies also play a crucial role, with gamified learning platforms and adaptive tools offering personalized and interactive learning opportunities. Studies have shown that these tools increase motivation and improve retention in children with ADHD, particularly when combined with immediate feedback and rewards for task completion. Incorporating frequent breaks into classroom routines is another essential strategy. Children with ADHD often struggle with restlessness and maintaining focus for extended periods. Brief, purposeful breaks that allow for physical movement help them reset and return to tasks with renewed concentration. Research indicates that integrating physical activities, such as stretching or walking, into lessons provides an outlet for excess energy and improves overall engagement. Such breaks can be seamlessly integrated into classroom routines without disrupting the flow of instruction. Differentiated instruction, which tailors teaching methods to individual student needs, has proven invaluable in supporting children with ADHD. This approach ensures that students receive the specific accommodations they require, such as extended time for assignments, alternative assessment formats, or access to assistive technologies. Tools like noise-canceling headphones, timers, and organizational apps have been shown to support self-regulation and time management in children with ADHD, making learning more accessible and less stressful.

Despite the effectiveness of these strategies, several barriers limit their widespread implementation. One significant concern is the lack of training among educators in ADHD-specific instructional methods. Studies reveal that many teachers feel unprepared to adapt their teaching to meet the needs of children with ADHD. Furthermore, large class sizes and limited resources in many schools prevent the individualized attention required for these strategies to be fully effective. Another challenge is balancing the needs of children with ADHD alongside their neurotypical peers, which can strain classroom dynamics if not managed appropriately.

Instructional strategies are an indispensable component of inclusive education for children with ADHD. Structured learning environments, multisensory approaches, frequent breaks, and personalized instruction have demonstrated significant benefits in improving their engagement and academic performance. However, addressing systemic barriers, such as inadequate teacher training and resource constraints, is essential to ensure these strategies are consistently and effectively applied. Future research should prioritize the development of scalable, evidence-based models that integrate these strategies into mainstream classrooms, thereby ensuring equitable educational opportunities for all learners.

Challenges in Implementing ADHD-Friendly Environments:

Implementing ADHD-friendly environments in classrooms faces several challenges, often stemming from systemic, financial, and educational constraints. Despite growing awareness of the benefits of inclusive and accommodating classrooms for children with ADHD, practical barriers continue to limit the widespread adoption of these practices. One major challenge is the lack of adequate training for teachers to effectively address the needs of students with ADHD. Studies reveal that many educators feel unprepared to manage the behavioral and learning difficulties associated with ADHD, leading to ineffective interventions and missed opportunities for positive reinforcement¹. Professional development programs focusing on ADHD-specific strategies remain limited, leaving educators without the tools to create supportive learning environments. Financial constraints also play a significant role in hindering the implementation of ADHD-friendly environments. Many schools, particularly in low-income areas, lack the funding needed to invest in physical modifications, such as soundproofing, flexible seating, and assistive technologies. These financial limitations also extend to hiring additional support staff, such as special education teachers or classroom aides, who can help manage the unique needs of children with ADHD². Furthermore, systemic barriers, such as large class sizes and rigid curricula, make it difficult for teachers to provide individualized attention or incorporate flexible teaching strategies. Cultural and societal attitudes towards ADHD present another challenge. In some regions, there is still a stigma attached to neurodevelopmental disorders, leading to a lack of understanding and acceptance among parents, peers, and educators. This stigma can result in insufficient advocacy for children with ADHD and reluctance from schools to adopt necessary changes³. Peer relationships can also suffer, as children with ADHD are often misunderstood by their classmates, leading to social exclusion or bullying, which exacerbates their challenges in the classroom environment. The variability in ADHD symptoms and their manifestations across individuals further complicates the implementation of standardized ADHD-friendly practices. While some children may benefit from structured routines and predictable environments, others may require more flexibility and opportunities for movement. This heterogeneity demands highly adaptive approaches, which are often difficult to implement in standardized education systems⁴. Additionally, the absence of clear policy guidelines on ADHD accommodations in many educational systems creates inconsistencies in how schools address the needs of these

students. Teacher burnout is another significant challenge, particularly when educators are required to balance the needs of children with ADHD alongside the demands of neurotypical students. The additional effort involved in implementing ADHD-specific strategies, combined with the pressures of meeting curriculum goals and managing large class sizes, can lead to frustration and reduced effectiveness among teachers⁵. Without adequate support from school administrations, these challenges may discourage educators from adopting innovative practices, further limiting progress in ADHD-friendly education. Despite these challenges, addressing the barriers to implementing ADHD-friendly environments is crucial for fostering equitable education. Increased funding for inclusive education, comprehensive teacher training programs, and the development of clear policy frameworks are necessary steps to ensure that children with ADHD receive the support they need to succeed academically and socially. Moreover, fostering a culture of understanding and acceptance within schools and communities can help reduce stigma and promote the widespread adoption of ADHD-friendly practices. Future efforts should prioritize collaboration among educators, policymakers, parents, and researchers to overcome these challenges and create truly inclusive learning environments.

Conclusion

The classroom environment plays a pivotal role in shaping the learning outcomes of children with ADHD. By addressing the physical, social, and instructional aspects of the classroom, educators can create inclusive and supportive environments that enhance academic performance, engagement, and social integration for these children. The physical environment, including seating arrangements, noise levels, and visual stimuli, provides the foundation for a structured and focused learning space. Social interactions, particularly positive teacher-student relationships and peer dynamics, contribute significantly to emotional well-being and classroom participation. Instructional strategies, such as structured lessons, multisensory approaches, and differentiated instruction, ensure that children with ADHD receive tailored support to thrive in an academic setting. However, the implementation of ADHD-friendly environments faces challenges, including limited teacher training, financial constraints, and systemic barriers such as large class sizes and stigma. Addressing these issues requires collaborative efforts among educators, policymakers, parents, and researchers to develop cost-effective and scalable solutions. Increasing teacher awareness, fostering a culture of inclusivity, and advocating for policy reforms are essential steps toward overcoming these obstacles. Future research should focus on long-term studies that examine the sustained impact of ADHD-friendly environments on academic and social outcomes. Additionally, exploring innovative strategies, such as technology integration and community-based support systems, can further enhance the educational experiences of children with ADHD. By prioritizing the needs of these students, schools can create learning environments that empower all children to achieve their full potential, regardless of their neurodevelopmental differences.

Conflict of Interest

Not available

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Not available

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