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Designing Autism-Friendly Learning Space through Integrating Autistic Behavior and Motion Space Mapping

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ABSTRACT
The increasing number of students with autism in Indonesia has encouraged the development of therapy and educational service centers, including in Malang. At PKBM Ki Hadjar Dewantara, a non-formal educational institution, a notable rise in students diagnosed with autism spectrum disorder (ASD) has been recorded. This study focuses on understanding the behavioral characteristics of autistic students within classroom settings. Autism, as a developmental condition, affects social interaction, communication, emotional regulation, sensory processing, play, and repetitive behavior. Using a qualitative approach, the research employed empirical observation, interviews with educators and therapists, and behavior setting techniques through motion space mapping. The findings highlight the importance of autism-friendly learning spaces, organized into four adaptive zones: the play zone (high stimulation), the learning and creativity zone (transitional), the escape or safe zone (low stimulation), and the multisensory zone (Snoezelen). This zoning strategy reflects an inclusive and adaptive design that accommodates diverse sensory and behavioral needs. The study demonstrates how flexible spatial design in non-formal education can foster engagement, comfort, and development for autistic students while supporting sustainable and inclusive learning practices.
Keywords: autism behavior; mapping the motion; learning space; and autism-friendly

INTRODUCTION
Autism is a developmental syndrome that affects children from birth, with symptoms typically emerging between 0–6 months, and is characterized by difficulties in social interaction, communication, emotional regulation, repetitive behavior, and perceptual processing (Mulyadi, 2011). In Indonesia, autism cases have risen significantly, reaching approximately 112,000 children aged 5–19 as of 2010, with a prevalence rate of 1.68 per 1,000 children under 15. Given Indonesia's child population of 66 million, every child, including those with autism, is entitled to education, prompting the government and various foundations to establish Autism Treatment Centers across cities, including Malang (Handajani et al., 2020). The growing prevalence of autism has also increased the demand for therapy services and autism centers, one of which is PKBM Ki Hadjar Dewantara, a non-formal educational institution in Malang that caters to children with autism spectrum disorder (ASD) as well as ADHD, Down syndrome, slow learners, dyslexia, speech delay, and gifted children. The school provides diverse therapies such as hypnosis, hypno-parenting, tapping, and totok, tailored to students' individual needs, yet its facilities remain limited in addressing the complex developmental and therapeutic requirements of its students. This study introduces novelty through its focus on motion space and behavior mapping, adaptive zoning strategies, and inclusive design principles specifically within non-formal educational contexts. Unlike most research in Indonesia, which focuses on therapy or curriculum adaptation, this study explores how spatial design can directly influence learning, emotional regulation, and sensory comfort. Through empirical observation and motion mapping, it offers a new interdisciplinary approach linking behavioral science and interior design, providing practical guidance for creating

sustainable, flexible, and autism-friendly classrooms that enhance comfort, safety, and participation in meaningful learning activities.

The case of PKBM Ki Hadjar Dewantara was selected purposively because it represents one of the few inclusive non-formal education centers in Malang that integrates therapy and education for children with autism alongside other special needs. This institution provides a relevant empirical setting to explore how autistic behavior interacts with spatial conditions in everyday learning contexts. Insights from this case are not limited to a single location; rather, they provide transferable principles for other PKBMs and inclusive schools aiming to design adaptive, autism-friendly environments.

RELATED STUDY

The literature review synthesizes theories and research on autism spectrum disorder (ASD), highlighting children's cognitive, communicative, social, sensory, and emotional challenges, their unique spatial preferences, and autism-friendly design criteria, while linking behavioral architecture and motion space mapping to propose an integrated, sustainable approach for designing inclusive educational environments.

A. Characteristics and Behaviors of Children with Autism Spectrum Disorder

Autism is a long-term neurodevelopmental condition distinguished by differences in social interaction and communication, as well as repetitive and restrictive behaviors (World Health Organisation, 2022). Autism prevalence is increasing due to increased public awareness, improved evaluation procedures, and earlier discovery (Fombonne, E., 2005; Zeidan, et.al., 2022). At present, it is estimated that approximately 1 in 100 children and young individuals are diagnosed with autism (Zeidan et.al., 2022). Although research has shown gender based differences in autistic traits (Ratto et.al., 2018), males are still three times more likely to receive an autism diagnosis than females (Loomes, 2017). Research shows that the environment significantly impacts the behavior of autistic children, particularly in terms of how stimuli are regulated. One key issue associated with inadequate stimulus control is insufficient generalization, which occurs when behaviors learned in specific settings, such as clinics or classrooms, do not transfer to other environments (Charlop et al., 1983). Characteristics of ASD Children with a combination of impairments consist of 5 aspects, namely: Cognitive Disorders, Social Skills Disorders, Communication Disorders, Sensory Perception Disorders, and Behavioral and Emotional Disorders (Pradita, 2021). This suggests that certain stimuli influencing behavior may be present in one context, like a therapy setting, but absent in everyday situations. Consequently, behaviors often fail to generalize across different environments, highlighting the role that environmental factors play in shaping the behavior of autistic children.

B. Personal Space of Autistic Children

Autistic children show weaker social relations and different personal space preferences than neurotypical children. They frequently struggle with establishing spatial arrangements during social interactions, especially with strangers, resulting in a bigger personal space. According to Naumi (2016), autistic boys often have 45 to 90 cm of personal space with both male and female peers, but autistic girls have 90 cm to 2 m with men and 90 to 120 cm with females. Coloring activities may reduce personal space and improve communication skills. According to Hall (1966), personal space, also known as proxemic distance, is the study of bodily placement and distance, with four types: intimate space (0 to 45 cm), personal space (45 to 120 cm), social space (120 to 360 cm), and public space (360 to more than 760 cm).

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C. Autism-Friendly Learning Space

Designing spaces for children on the autism spectrum requires an understanding of how they perceive their environment, including the people and objects around them, as highlighted by Bogdashina (2003). Design criteria consist of: ensure an organized and understandable spatial layout; variety of large and small spaces; allow users control over environmental conditions; accommodate diverse teaching methods for individuals with autism; security aspect with opportunities for independence; use simple and minimal detailing; engage end users in the brief and design process; utilize technology to enhance the learning experience; and apply suitable technical specifications (Scott, I., 2009P). According to Vogel (2008), architects should create environments with 'high stimulus' and 'low stimulus' areas, including transition zones and escape areas to manage sensory input and provide relief from overstimulation (Ghazali, 2018). Eight specific design criteria must be considered when creating environments for individuals with autism, including: flexible and adaptable design; non-distracting space; a controllable environment; predictability; a non-threatening atmosphere; sensory motor attunement; a non-institutional feel; and safety.

D. Behavioral Architecture

A behavior setting involves a group of people engaged in activities in a specific location and time. Research in this area focuses on identifying and measuring behaviors that occur consistently or occasionally in these contexts. Different organizations or communities can create unique behavior settings influenced by their shared beliefs, agreements, and decisions (Haryadi, 2014). By considering user behavior, architects can modify designs to enhance comfort for those using the space. Architecture is a discipline that focuses on creating physical environments that accommodate human needs and activities while also allowing for movement across different spaces/areas.

E. Motion Space and Behavior Mapping

The physical structure of a learning environment is crucial for engaging autistic children and can help reduce tantrums. An effective spatial arrangement considers the motion space, which is influenced by the anthropometry of autistic children, their activities, and the number of users (Handajani et al., 2020). The required classroom layout should have clear partitions that avoid confusion for autistic children. Classrooms should also meet specific width requirements that align with the motion space and the physical dimensions of autistic children. Human dimensions can be measured in two ways: static dimensions, which assess the subject in a stable position (standing or sitting), and dynamic dimensions, which consider the subject in motion (Panero and Zelnik, 1979). The significance of motion space—how individuals move and interact within their environments—adds complexity to designing autism-friendly learning spaces. Gaining insights into the movement patterns and preferences of autistic learners can help organize educational settings more effectively (Dewey et al., 2021). Furthermore, by combining movement sensor monitoring technology and environment sensors, it is possible to present crucial information about the behavioral patterns of people with ASD when navigating locations. It can be used as a guide for designing layouts that allow for easy movement and accessibility for ASD students.

F. Research GAP and Novelty

Most autism studies emphasize clinical interventions, therapy, or general classroom adaptations, with little focus on spatial and architectural dimensions. While research highlights the importance of sensory regulation, personal space, and behavioral architecture, few

frameworks integrate these into practical design for diverse autistic learners. Non-formal institutions, such as community learning centers (PKBM), which play a growing role in Indonesia, also remain underexplored. This research introduces a novel adaptive zoning strategy, dividing autism-friendly learning spaces into four areas: a play zone (high stimulation), a learning and creativity zone (transitional), an escape/safe zone (low stimulation), and a multisensory zone (Snoezelen). Using behavioral observation, interviews, and motion space mapping, the study provides both theoretical insights and practical guidance, advancing inclusive and flexible classroom design tailored to autistic children.

METHODS

This qualitative study combines behavioral observation with motion space mapping to explore how autistic students interact with classroom environments. The research was conducted at PKBM Ki Hadjar Dewantara, a non-formal community-based learning center located in the suburban area of Malang, Indonesia. The site was selected purposively because of its inclusive educational model, which integrates learning activities with therapeutic interventions for children with autism spectrum disorder (ASD), ADHD, Down syndrome, speech delay, and other developmental conditions. Unlike therapy-focused autism centers, PKBM Ki Hadjar Dewantara emphasizes everyday classroom participation, multisensory activities, and emotional regulation through play and learning routines. Therefore, it provides an ideal context for observing the behavioral and spatial dynamics that emerge in inclusive non-formal education. Although only one institution was selected, the research aims to provide transferable insights rather than generalizations. The combination of autistic behavior analysis and motion space mapping offers a replicable framework that can be applied to other PKBMs or inclusive learning environments seeking to improve their classroom layouts, sensory zoning, and adaptive design. Thus, the case study serves as a methodological and practical reference for the development of autism-friendly learning spaces in Indonesia and beyond.

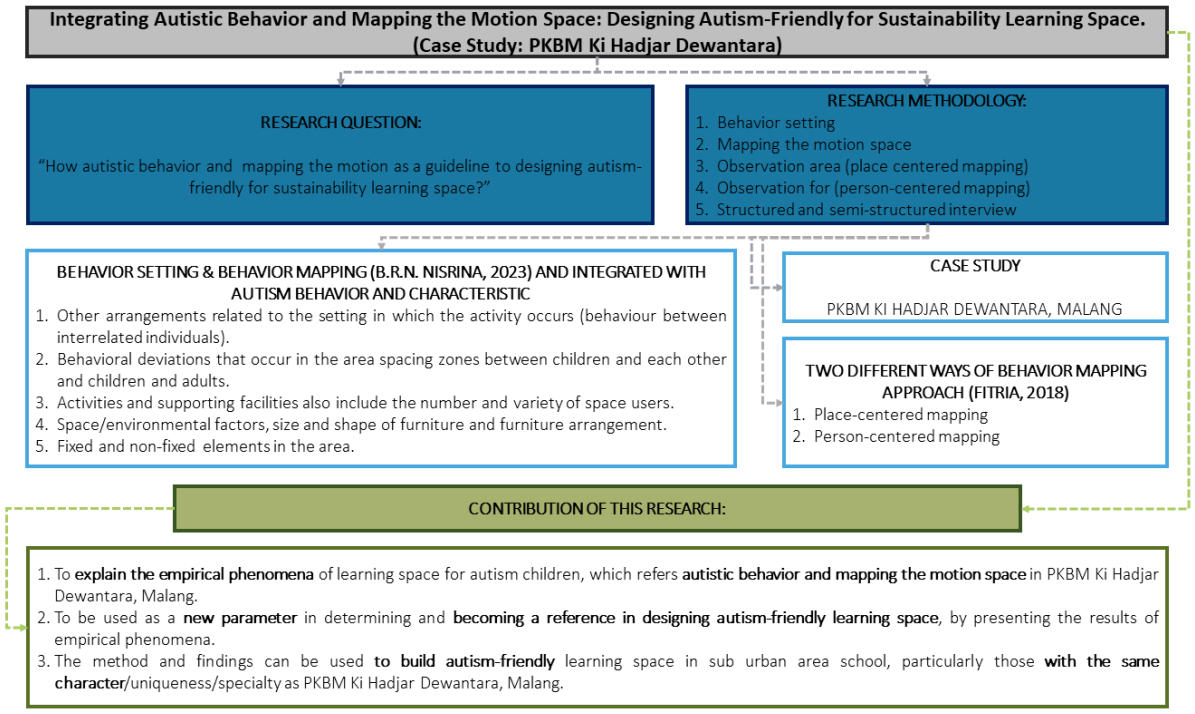

Figure 1. Outline of the methodology
Source: personal data, 2025

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A. Participants

The study focused on individuals diagnosed with autism spectrum disorder (ASD). The selection was male students aged 7–9 years based on three main considerations:

1. This age range represents a critical period for the development of motor coordination, social skills, and adaptive behaviors that can be directly observed within classroom settings.
2. Within the PKBM, most autistic students enrolled in this category were male, consistent with the global ratio showing that boys are diagnosed more frequently than girls (Loomes et al., 2017).
3. Focusing on one gender group minimized behavioral variability related to sex-based differences in sensory and emotional responses, enabling a clearer analysis of motion and interaction patterns.

Future research may include female participants or broader age ranges for comparative purposes.

B. Autism Level and Diagnostic Consideration

The study observed children with mild to moderate autism spectrum disorder, as identified by PKBM teachers and therapists. These levels were selected because children with mild to moderate ASD can participate in classroom routines and structured group learning, allowing meaningful observation of behavior and motion in shared spaces. Students with severe autism were excluded from this phase because their learning processes typically occur through individualized therapy sessions. Concentrating on mild to moderate levels allowed the research to capture a balance between observable independence and behavioral challenges relevant to classroom-based design analysis.

C. Behavior Setting and Mapping the Motion Space of ASD

A behavior-environment study involves four key dimensions: actors, activities, location, and time. A systematic observation method that tracks the activities of individuals or groups in specific spaces over a defined time. Two approaches were used in this study (Fitria, 2018):

1. Place-Centered Mapping: This technique focuses on how individuals or groups occupy and adapt their behavior in a specific location, regardless of its size.
2. Person-Centered Mapping: This method examines human movement over time across multiple locations.

Additionally, five parameters for behavior settings were established to guide the mapping and data collection process (Nisrina, 2023) and integrated with autism characteristics and behavior:

1. Exploring autism children's activity in the classroom.
2. Other setting includes the location of activities and the distance between other pupils and teachers.
3. Providing activities and facilities to support autism children with autism.
4. Analyzed the spatial distribution, rhythm, timing, and duration of activities of children with ASD based on hours/moments with mapping the motion mapping method.
5. Mobility and circulation of autism children with autism.

D. Two Different Ways of Mapping the Motion Space Approach

The observation location is in the suburban area of Malang, PKBM Ki Hadjar Dewantara. The observation and documentation were conducted in April 2024 and August 2024. The phenomena observed include the learning activities of autistic children from the time they

attend the classroom till time off, beginning about 08.00 am to 11.00 am. Observations were conducted in the classroom (place-centered mapping). This study focuses on students with Autism and others (person-centered mapping):

1. **Light blue** indicates an autistic boy between the ages of 7 to 9 years old.
2. **Light orange and dark orange** indicate other boys with special needs between the ages of 8 to 11 years old (light orange) and other girls with special needs between the ages of 11 years old (dark orange).
3. **Dark red** indicates a teacher over the age limit set by the researcher.

Although this study focuses on one site, its methodological design—integrating autistic behavior observation with motion space mapping—is adaptable to other inclusive learning contexts. The findings contribute to the development of autism-friendly classroom prototypes that balance high- and low-stimulation zones, promote emotional regulation, and support active participation. These insights can guide educators, designers, and policymakers in improving spatial comfort and inclusion across various PKBMs or similar non-formal education settings.

RESULTS AND DISCUSSION

The researcher analyzed observations of children with autism, other special needs, and teachers across five parameters—activities, spatial distances, facility adequacy, spatial-temporal rhythms, and mobility patterns—revealing that classroom design and facilities strongly influence autistic children's engagement and participation, thereby informing inclusive educational strategies.

A. Exploring Autism Children's Activity in the Classroom

Table 1 outlines the observed characteristics and activity patterns of children with Autism Spectrum Disorder (ASD) in the Ki Hadjar Dewantara classroom, categorized into five key dimensions: cognitive, social, communication, sensory perception, and behavioral-emotional. Findings reveal that many students struggle with abstract thinking, imagination, and problem-solving, emphasizing the need for structured learning using visual aids and concrete materials. Socially, children often avoided peer interaction, preferring isolation or withdrawal from group tasks, and showed difficulties with eye contact, space sharing, and turn-taking. Emotional responses were frequently unstable, with sudden outbursts such as shouting or crying, indicating sensitivity to overstimulation and frustration. These observations highlight the diverse and complex needs of autistic learners and underscore the importance of tailored classroom design and teaching strategies that provide predictable routines, clear visual guidance, and supportive sensory environments to enhance their engagement, emotional regulation, and participation in learning activities.

Communication difficulties shaped classroom participation, with some children showing delayed speech, limited vocabulary, or relying on echolalia, mumbling, and singing as alternative expressions. These variations highlight the need for multimodal teaching that integrates verbal, visual, and symbolic interaction. Sensory challenges affected gross and fine motor skills, such as walking, balancing, and handling objects, underscoring the importance of sensory-friendly materials and equipment. Behavioral and emotional difficulties were marked by hypersensitivity and poor self-regulation, leading to episodes of laughter, crying, or tantrums. Overall, the findings emphasize the need for autism-friendly classrooms that integrate cognitive, social, communication, sensory, and emotional support within structured yet flexible learning spaces.

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Table 1. Characteristics of ASD Children with a Combination of Disorders

Disorder	Autism Children's Activity in PKBM Ki Hadjar Dewantara Classroom
Cognitive Disorders	ASD student with cognitive disorders has less capacity to fantasize or imagine things, thus they grow indifferent to other people or the environment, imaginative animal characters, and so on.
Social Skills Disorders	Almost every child in the class diagnosed with ASD exhibited poor social skills. Children with ASD who have the condition are uninterested in social engagement (not responding to the external environment, satisfied to be alone, comfortable with their own world), as seen by the lack of changes in facial expressions and eye contact. Uncontrollable and unstable feelings (anger, shouting, and throwing objects) make it difficult for them to interact.
Communication Disorders	Have difficulties communicating, are ambiguous, or are unable to communicate at all. Language skills are limited, as confirmed by delayed speech proficiency, a small vocabulary, difficulties repeating what others say (echolalia), hearing impairments, and a unique way of communicating. In addition, some children have communication difficulties, such as frequent mumbling and singing to themselves.
Sensory Perception Disorders	ASD sensory perception abnormalities have been proven to prevent children's large and fine motor development. Large motor development involves walking, running, jumping, throwing, and catching, whereas fine motor development includes eye, hand, and foot coordination, as well as the capacity to write, grasp, clamp, and watch.
Behavioral & Emotional Disorders	Have excessive or extremely terrible behavior. In terms of emotions, they also have restricted tolerance, which causes them to become angry, laugh, cry, or throw tantrums without reason, and it is difficult to regulate.

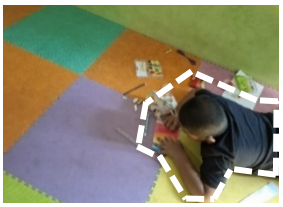
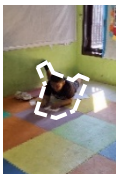
Source: Personal data about characteristics of ASD Children (2025)

B. Other Settings, including the Location of Activities and the Distance Between

Table 2 highlights the varied interactions and movement patterns of autistic students within the classroom, categorized by activity, location, and proximity. The observations show that autistic students frequently move between seating areas, toy shelves, and play rugs, seeking sensory comfort and adapting to environmental stimuli. However, social challenges often lead them to prefer solitude or interact only with similarly passive peers, avoiding those with disruptive behaviors such as ADHD. This tendency is sometimes reinforced by prior negative experiences, underscoring their vulnerability in shared environments and the need for protective, inclusive spatial design. The study also notes that hyporesponsive autistic students tend to engage in repetitive, solitary tasks—such as coloring—while ignoring teacher instructions and environmental cues. These behaviors serve as coping mechanisms but limit participation, requiring continuous teacher guidance to sustain engagement. The research further identifies a critical issue in classroom management: an imbalanced teacher-student ratio in inclusive settings. This disproportionate ratio restricts teachers' ability to provide individualized attention, thereby reducing the overall effectiveness of learning and behavioral support. Consequently, the findings emphasize the necessity of structured classroom zoning, adequate supervision, and tailored pedagogical approaches to better accommodate autistic learners' diverse needs.Spatial dimensions also play a significant role in shaping autistic students' interactions. The study notes that autistic boys generally maintain two distinct

distance zones: personal space (45–120 cm) and social space (120–360 cm). These boundaries reflect their sensitivity to proximity and the need for predictable, structured spatial arrangements to minimize stress. Understanding such spatial preferences is critical in designing autism-friendly learning environments that account not only for activity-based needs but also for spatial regulation. By aligning classroom layouts with these behavioral insights, educators and designers can develop supportive, inclusive learning spaces that reduce conflict, foster comfort, and promote meaningful participation among autistic students. Building on these findings, the study provides evidence for the necessity of adaptive learning zones tailored to autistic students' needs. Classrooms should incorporate spaces for high-stimulation activities, transitional learning and creativity, low-stimulation safe zones, and multisensory environments. Such zoning strategies can accommodate the diversity of behaviors observed, from the need for solitude to the desire for guided engagement. Ultimately, this approach offers a framework for inclusive classroom design that bridges behavioral research with practical architectural solutions.

Table 2. Other Settings (Location of Activities and Distance) in PKBM Ki Hadjar Dewantara

Documentation Results	Other Setting (Location of Activities And Distance) In Ki Hadjar Dewantara
 	The behavior of autistic students discovered during our research was quite diverse and moved frequently, for example, from the seating area for study, moving to the toys shelf area (even though it wasn't time to play/a break), sitting on the surrounding rugs area, and sometimes being accompanied by one teacher while learning or playing.
 	Because they have difficulties adapting and associating with children with other needs, it is quite common for them to receive physical abuse from ADHD or other students with special needs; therefore, autistic students are more likely to play alone or with other students who are also passive.
 	Researchers found that hypo-sensitive students with autism prefer solitude and engaging in repetitive activities, like coloring. They may ignore the environment, including teacher instructions, and focus solely on their task. Teachers must encourage and repeatedly suggest learning activities to engage the child effectively.
 	Two teachers manage classroom conditions, but the teacher-student ratio is disproportionate for children with special needs. This imbalance makes the teacher's role less effective, leading to a less conducive learning environment and inadequate control over the classroom dynamics.
  	Male autistic students' distance zones from other people are roughly divided into two zones: personal space (45-120cm) and social space (120-360cm).

Source: Personal data about other settings (2025)

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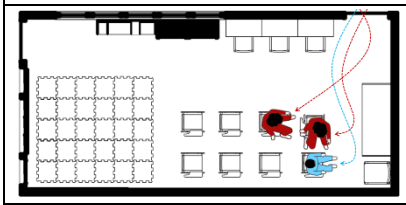
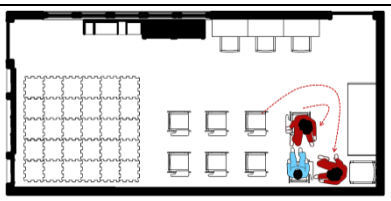
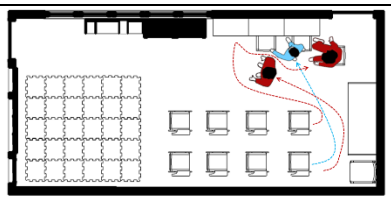
C. Providing Activities and Facilities to Support Autism Children Activity

According to the observation data, the teaching and learning activities lasted for 180 minutes and were divided into two phases. During this period, a considerable proportion of autistic children and students with other special needs engaged in academic tasks such as writing, reading, and simple counting, as well as creative activities such as making crafts, which accounted for 41.66% of their overall activity. The second most frequent activity observed was break time and play, in which students interacted with peers or engaged in solitary play, representing 20.83% of their activities. These findings suggest that while academic engagement remains a significant focus, opportunities for relaxation and play constitute an essential component of their classroom routines. In addition, students with autism and other special needs were observed utilizing nearly all available classroom facilities throughout the learning process. Commonly used facilities included tables, chairs, carpets, pediatric therapy chairs designed for autistic children, sensory tables, bag racks, and toy shelves. Some autistic children used bag racks not only for storage but also as spaces to hide, rest, or escape from overwhelming stimuli in their environment. Furthermore, several students chose to complete their tasks on the floor rather than at desks, reflecting diverse preferences in learning styles and comfort levels.

D. Analyzed the Spatial Distribution, Rhythm, Timing, and Duration of Activities of Children with ASD Based on Hours/Moments with Mapping the Motion Space Method

This behavior–environment study identifies five key elements—participants, actions, location, time, and supporting resources—and uses motion space mapping to document individual and group activities within specific classroom zones. The method effectively captured the behaviors of autistic and other special needs students, along with their interactions with teachers. Motion space mapping emphasized mobility, circulation, and engagement with learning facilities through three techniques: person-centered mapping, place-centered mapping, and physical traces. To enhance clarity and replicability, visual coding used color distinctions: light blue for autistic boys aged 7–9, light orange for boys with other special needs aged 8–11, dark orange for a girl with other special needs aged 11, and dark red for the teacher.

Table 3. Mapping the Motion Space for Individual Observation Class

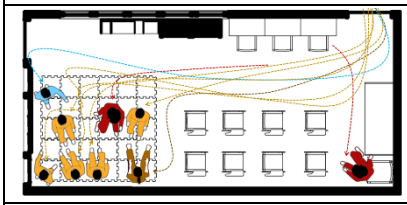
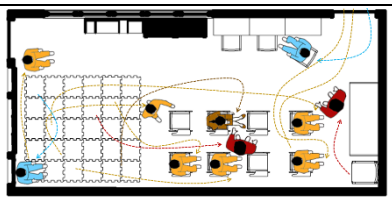
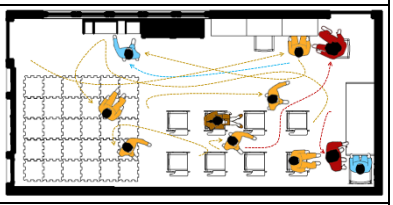
Memorization of Short Surahs	Reading & Counting Lesson	Craft
(08.00 – 08.10 AM)	(08.11 – 08.35 AM)	(08.36 – 09.00 AM)
		
Facilities that support student activities	Facilities that support student activities	Facilities that support student activities
- Table - Chair	- Table - Chair	- Pediatric table

Source: Personal data about mapping the motion (2025)

Table 3 presents the results of an observed class at Ki Hadjar Dewantara, which included surah memorization, reading and counting, and craft work, each supported by specific furniture such as tables, chairs, and pediatric tables. The visual maps revealed circulation patterns, focal points of interaction, and the influence of spatial layout, showing how furniture selection and zoning directly shape learning behavior, emotional regulation, and social participation. These

findings provide an evidence-based foundation for designing autism-friendly, flexible, and supportive learning spaces. This analysis further indicates that consistent spatial organization and appropriate furniture arrangement can significantly enhance autistic students' focus, reduce anxiety, and promote smoother transitions between learning activities. The mapping documents three phases of learning—memorization of short surahs, reading and counting lessons, and craft activities—while identifying supporting facilities such as tables, chairs, and pediatric tables that facilitate student engagement. This detailed motion mapping provides insight into how autistic students interact with their environment in small, structured learning contexts. The findings reveal that the observed autistic student had difficulty sustaining focus but was still able to follow instructions and complete tasks when guided by the teacher.

Table 4. Mapping the Motion Space for Observation Class

Ice Breaking (Preparation)	**Reading & Counting Lesson**	**Craft**
(09.01 – 09.10 AM)	(09.11 – 09.35 AM)	(09.36 – 10.00 AM)
		
Facilities that support student activities	Facilities that support student activities	Facilities that support student activities
- Carpet	- Table - Chair - Pediatric table	- Table & chair - Pediatric table - Carpet - Toys storage

Source: Personal data about mapping the motion (2025)

Table 4 presents the mapping of motion space in an observation class consisting of 10–11 students with diverse special needs, including autism, ADHD, emotional disorders, hyperactivity, slow learning, Down syndrome, visual impairment, intellectual disabilities, and dyslexia. The spatial distribution during these activities demonstrates a largely unrestricted use of classroom space, reflecting the challenges of managing heterogeneous groups of students. Facilities supporting the sessions included carpets, tables, chairs, pediatric tables, and toy storage, which were utilized differently depending on the activity type—such as ice-breaking, reading and counting lessons, or craft-making. However, the findings indicate that classroom conditions were often uncontrolled and less conducive to structured learning, largely due to high student mobility and the absence of effective environmental regulation.The motion space patterns further reveal distinct behavioral differences between autistic students and their peers with other special needs. While students with ADHD, hyperactivity, or emotional disorders tended to move frequently around the room during learning tasks, autistic students were observed to withdraw from social interactions and avoid group engagement. One autistic student even showed tendencies of self-isolation, restricting movement, and limiting interaction with the surrounding environment. These contrasting patterns highlight the complexity of accommodating multiple special needs within the same classroom, emphasizing the importance of designing learning environments that balance structured spatial arrangements with flexible areas for mobility. Such insights underscore the necessity of adaptive zoning strategies that address both the need for movement among some students and the need for stability and low-stimulation spaces for autistic learners.

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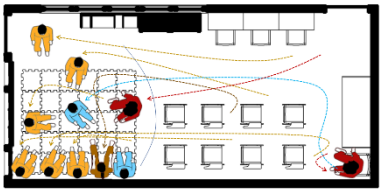
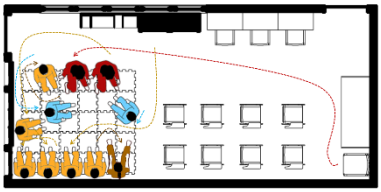
Table 5. Mapping the Motion Space for Observation Class

Break time & Eating Snack	Playing with Others	Pray and Go Home
(10.01 – 10.10 AM)	(10.11 – 10.35 AM)	(10.36 – 10.40 AM)
		
Facilities that support student activities	Facilities that support student activities	Facilities that support student activities
- Carpet	- Carpet - Toys storage	- Carpet

Source: Personal data about mapping the motion (2025)

Table 5 presents the motion space mapping of the observation classroom during the final sequence of daily activities, which included break time, playtime, and prayer before dismissal. During break time, most students, including those with autism, gathered on the playground carpet, the main shared area for resting, eating, and interacting. Autistic students tended to remain within a limited zone, engaging selectively with peers or teachers and showing minimal movement around the classroom. This behavior reflects their preference for spatial stability and predictable interaction patterns, in contrast to other students who exhibited higher levels of mobility. The mapping further revealed that while autistic students maintained consistent positions, other special needs students moved freely across the classroom. Since leaving the room during break was not allowed, their increased mobility sometimes led to disruptions, such as interrupting peers' activities or disturbing autistic students. These dynamics often created challenges in maintaining an organized and inclusive classroom atmosphere. The findings highlight the importance of designing spatial zoning strategies that balance both stability and movement—providing low-stimulation, structured areas for autistic students while allowing flexible, activity-friendly zones for other special needs learners.

E. Mobility and Circulation of Autism Children Movement

According to empirical phenomena in the existing classroom (Figure 2), the physical setting at the PKBM Ki Hadjar Dewantara observation class is less capable of accommodating the activities of students with special needs, particularly children with autism. Furthermore, circulation and mobility were evenly spread across the room. Unlike students with autism, they tend to stay in one area, rarely move, and are frequently bothered by their peers. As a result, autistic students require an isolated area to escape from their overstimulating surroundings, which might cause autistic students feel exhausted or overwhelmed.

Based on empirical findings from the PKBM Ki Hadjar Dewantara classroom, this study recommends designing a sustainable, autism-friendly learning environment tailored to autistic students' characteristics using the motion space mapping approach. Although primarily designed for autistic learners, the classroom should also accommodate other special needs students. The proposed design divides the classroom into three zones: a play zone (high stimulation), a learning and crafting zone (transition zone), and an escape or safe zone (low stimulation) to support regulation and engagement. Due to limited classroom space, a separate multisensory or Snoezelen room is recommended for therapy sessions, allowing more focused interventions and increasing the likelihood of positive outcomes for students' emotional regulation, sensory integration, and overall developmental progress.

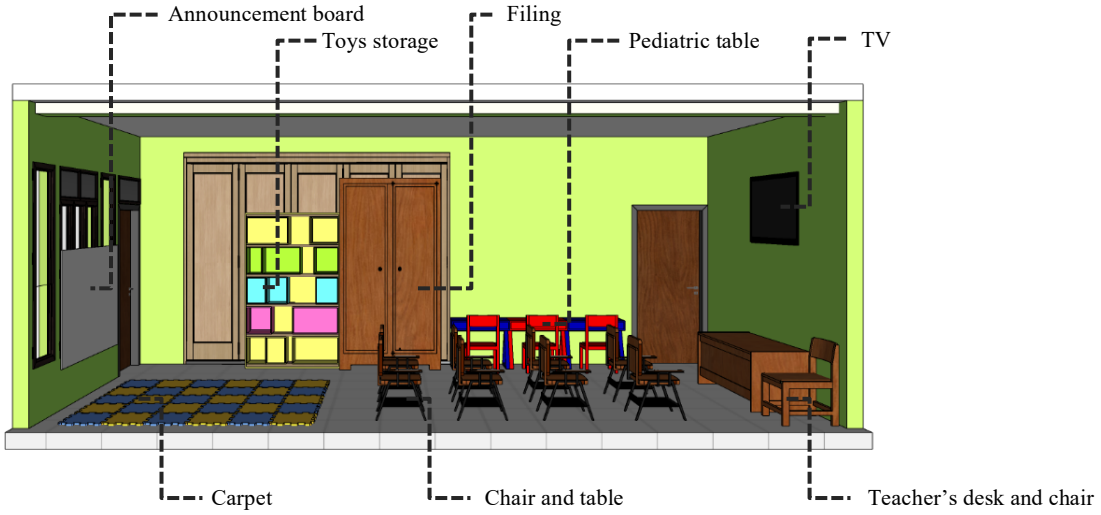


Figure 2. Existing classroom in PKBM Ki Hadjar Dewantara.
Source: personal data, 2024

F. Design Needs for Autism-Friendly Sustainability Learning Space

The findings in **Table 6** stress the need to align classroom design with the behavioral and cognitive traits of children with autism spectrum disorder (ASD). Observations revealed challenges in imagination, social interaction, communication, and sensory regulation, affecting learning engagement. To address this, classrooms should include interactive technology to enhance imagination, safe zones to prevent overstimulation, and predictable layouts to reduce anxiety and improve focus. Literature also highlights the importance of multisensory rooms, clear zoning between high- and low-stimulus areas, and adaptable, safe furniture to support sensory regulation and diverse teaching methods. Integrating these strategies fosters inclusivity, supports emotional and social development, and creates flexible, sustainable learning environments that enable autistic students to participate meaningfully.

Table 6. Design Needs for Autism-Friendly Sustainability Learning Space

Autism Children's Activity in PKBM Ki Hadjar Dewantara Classroom	Design Needs for an Autism-friendly Sustainability Learning Space based on literature review
An ASD student with cognitive disorders has less capacity to fantasize or imagine things.	- Integrating interactive technology to enhance the learning experience, to develop imagination skills. - Engage end users (students and teachers) for the design process (example: by spatial thinking).
- Children with ASD frequently prefer to isolate and show no engagement in social relationships. - Lack of facial expressions and limited eye contact. - Unstable emotional (anger and violent conduct such as shouting or throwing objects).	- Providing the escape or save zone to manage sensory input and provide relief from overstimulation. - Divided zone into play zone 'high stimulus' and escape zone/safe zone 'low stimulus' areas - Including learning and crafting zone 'transition zones'. - Variety of large and small spaces
- Autistic students with communication disorders may struggle to express themselves, with limited language skills, delayed speech development, and a limited vocabulary. - Have echolalia, hearing problems. Some may frequently mumble or sing to	- Facilities must be accommodating diverse teaching methods, so the autistic students can understand the learning. - Organized and understandable spatial layout design.

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themselves.	
ASD sensory perception abnormalities have been proven to prevent children's large and fine motor development.	A multisensory room, or Snoezelen, should be designed in a separate room. So that students' therapy sessions can be more focused, and the possibility that students will have a positive effect after having therapy can be increased.
Have restricted tolerance, which causes them to become angry, laugh, cry, or throw tantrums without reason, and it is difficult to regulate.	- Allows the teacher to have greater control over classroom conditions. - Simple and minimal detailing design. - Applying the furniture design with a curved angle. - Concern about the security and safety aspect.

Source: Personal data about design needs for autism-friendly (2025)

G. Design Recommendation: Autism-Friendly Sustainability Learning Space

The design recommendations in **Table 7** highlight the importance of dividing learning spaces into distinct zones to accommodate the diverse needs of students with autism and other special needs. Each zone is intentionally designed to support learning, emotional regulation, and social interaction. The Play Zone provides a sensory-rich environment that encourages creativity, exploration, and skill development through interactive technologies. The Learning and Crafting Zone serves as a structured area where routines and visual aids help students process information and build independence. Low-stimulation areas, including the Escape Zone and Multisensory Room, offer balance between active engagement and moments of calm. The Escape Zone includes soothing visuals and sensory tools to reduce stress and restore focus, while the Multisensory Room—with touch-responsive technologies, sound, and lighting—enhances emotional stability and sensory integration. Collectively, these zones demonstrate how thoughtful spatial organization can influence cognitive, behavioral, and emotional outcomes. This holistic and evidence-based design approach promotes adaptable, supportive, and inclusive learning environments, ensuring that all students can participate meaningfully and thrive in spaces that nurture both educational and emotional well-being.

Table 7. Design Recommendation regarding dividing zones

Autism-Friendly for Sustainability Learning Space Based on Zone	Design Recommendation regarding dividing zones
Play Zone (High stimulation)	The Play Zone is designed to support students with autism and special needs by offering an engaging, sensory-rich environment that fosters creativity and exploration. Through interactive technologies like motion sensors and touch-based tools, students develop key imaginative, problem-solving, and social skills, while gaining independence and emotional regulation in a safe, supportive space.
Learning and Crafting Zone (Transition zone)	The Learning and Craft Zone serves as a transitional space designed to provide an adaptable and flexible environment for students with autism and other special needs, allowing them to engage in a variety of teaching methods that suit their individual learning styles. By incorporating visual aids, structured routines, and craft activities, this space helps students process information more effectively, building their understanding and confidence while promoting skill development in a supportive and inclusive environment.
Escape Zone or Safe Zone (Low stimulation)	The Calm Zone, also known as the Escape or Safe Zone, is a dedicated area within the classroom designed to reduce stress and anxiety for students with autism and other special needs by offering a peaceful, low-stimulation environment. This quiet retreat, equipped with sensory tools, soft lighting, and calming visuals, allows students to self-regulate,

	preventing disruptive behaviors and tantrums while providing them with a safe space to regain focus and emotional balance.
Multisensory Room (Snoezelen)	The Multisensory Room (Snoezelen) should be set up as a distinct, soothing area within the classroom where students with autism and other special needs can participate in therapy sessions aimed at enhancing their sensory skills. Featuring interactive technologies like touch-sensitive surfaces, motion sensors, and immersive sound and visual effects, the room offers an engaging environment that fosters exploration and supports emotional regulation. This specialized space not only aids in cognitive and emotional growth but also has a lasting, positive influence on the students' overall well-being.

Source: Personal data about design recommendation (2025)

Additionally, this discussion has been strengthened by integrating comparisons with previous relevant studies. The current findings align with Charlop et al. (1983), who demonstrated that classroom environmental structure directly influences behavioral regulation and engagement among autistic children. Similarly, Ghazali et al. (2018) emphasized that sensory-based zoning reduces overstimulation and fosters focus, which corresponds with this study's zoning recommendation involving high- and low-stimulation areas. Moreover, Dewey et al. (2021) highlighted how spatial mobility patterns can inform adaptive teaching and behavioral intervention strategies, further supporting the motion space mapping method used in this research. These comparisons confirm that the proposed adaptive zoning—comprising play, learning, escape, and multisensory zones—can be an effective spatial strategy for balancing sensory input, social engagement, and emotional regulation. Therefore, this study not only supports prior findings but also contributes additional evidence from non-formal educational settings, an area that remains underexplored in existing literature. Furthermore, the findings demonstrate that spatial design can act as an active pedagogical tool, shaping behavioral outcomes and emotional well-being. This reinforces the critical role of interdisciplinary collaboration between educators, therapists, and designers in developing inclusive learning environments.

CONCLUSION

The findings of this study reveal that autistic students at PKBM Ki Hadjar Dewantara experience interconnected cognitive, social, communication, sensory, and emotional-behavioral challenges that significantly influence classroom participation. Observations identified limited imagination, delayed speech, echolalia, motor difficulties, emotional instability, and repetitive behaviors. Motion space mapping showed that autistic students preferred minimal mobility and stable positions, contrasting with peers with ADHD who exhibited higher activity levels that sometimes led to overstimulation or social conflict. These patterns underscore the importance of predictable, structured, and clearly defined spatial layouts to foster focus, reduce anxiety, and encourage meaningful engagement among autistic learners.

By integrating behavioral analysis with motion space mapping, this study offers valuable insights into designing autism-friendly classrooms, especially within non-formal educational contexts. It introduces four adaptive zones: the Play Zone, Learning and Creativity Zone, Escape or Safe Zone, and Multisensory Zone. These zones balance active and calming spaces, providing structured opportunities for interaction, sensory regulation, and emotional recovery. The spatial arrangement demonstrates how adaptive design can translate behavioral understanding into supportive learning environments that enhance attention, communication, and emotional well-being.

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Beyond classroom design, the implications contribute to advancing inclusive education and promoting equity for learners with special needs. Autism-friendly environments not only reduce behavioral conflicts and overstimulation but also cultivate a sense of safety, belonging, and self-regulation. Future research should expand this approach across broader contexts by incorporating advanced sensory monitoring technologies, assessing long-term behavioral and academic impacts, and fostering interdisciplinary collaboration among educators, therapists, designers, and policymakers to refine adaptive spatial frameworks and strengthen inclusive educational infrastructure.

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AUTHOR CONTRIBUTHORSHIP

Brainnisa Ramadhani Nur Nisrina: Conceptualization, Data Curation, Analysis, Funding Acquisition, Related Study, Methodology, Observation, Interview, Documentation, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing –Review and Editing; Tiara Ika Widia Primadani: Observation, Related Study, Interview; Michelle Nadine Santoso: Observation, Visualization, Design 3D Modelling; Yuvita Wulan Tanemaru: Observation, Visualization, Design 3D Modelling.

DATA AVAILABILITY

This project contains the following underlying data: Data Availability_JDI 2025_Brainnisa Ramadhani_Integrating Autistic Behavior and Mapping the Motion Space.pdf.

REFERENCES

Bogdashina, O. (2003). Sensory perceptual issues in autism and asperger syndrome: Different sensory experiences-different perceptual worlds. *Jessica Kingsley Publishers*.

Charlop, M.H., et al. (1983). Behavior-setting interactions of autistic children: behavioral mapping approach assessing classroom behaviors. *Analysis and Intervention in Developmental Disabilities*, 3, 359-373. https://doi.org/10.1016/0270-4684(83)90006-X.

Dewey, D., et al. (2021). The Effect of physical activity and exergaming on motor skills and executive functions in children with autism spectrum disorder. *Game of Health Journal, 10(1).* https://www.liebertpub.com/doi/10.1089/g4h.2019.0180.

Fitria, T.A. (2018). Pengaruh seting ruang terhadap perilaku pengguna dengan pendekatan behavioral mapping. *Yogyakarta: Jurnal Perancangan UNISA*, 1(2), 183-206.

Fombonne, E. (2005). The changing epidemiology of autism. *Journal of Applied Research in Intellectual Disabilities*, 18(4), 281–294. https:// doi.org/10.1111/j.1468-3148.2005.00266.x.

Ghazali, Roslinda, et al. (2018). The Effects of Sensory Design on Autistic Children. *Asian Journal of Behavioural Studies (AjBeS),* 3(14), 68-83. https://doi.org/10.21834/ajbes.v3i14.165.

Hall, Edward T. (1966). *The hidden dimension*. Anchor Books.

Handajani, R. P. and Pramesti, R. N. H. (2020). Mapping the motion space of children in the autism treatment center of Malang City with the teach approach (Treatment and

education of autistic and related communication handicapped children). *Jurnal RUAS,* 18, 2477-6033. DOI:10.21776/ub.ruas.2020.018.01.6

Haryadi. (2014). Arsitektur dan perilaku, pengantar ke teori, metodologi dan aplikasi. *Yogyakarta: Proyek Pengembangan Pusat studi Dirjen Dekbud.*

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry*, 56(6), 466–474. https://doi.org/10.1016/j.jaac.2017.03.013.

Mulyadi K. (2011). Autism is treatable. (*Jakarta: PT Elex Media Komputindo*).

Naumi, F. I. (2016). Personal space in children (Review of the autistic children and normal children). Bachelor's thesis, *State University of Semarang*.

Panero J., M. Zelnik. (1979). Human dimension. *Jakarta: Erlangga*.

Pradita, V. G. (2021). Identifikasi ragam terapi bermain pada anak autisme: studi literatur. *Malang: Malang Muhammadiyah University*.

Ratto, A. B., et al. (2018). What about the girls? Sex- based differences in autistic traits and adaptive skills. *Journal of Autism and Developmental Disorders*, 48(5), 1698–1711. https://doi. org/10.1007/s10803-017-3413-9.

Scott, I. (2009). Designing learning spaces for children on the autistic spectrum. *GAP Journal*, 10(1), 36–51.

Vogel, C. L. (2008). Classroom design for living and learning with autism. *Autism Asperger's Digest*, 7, 30-39.

World Health Organization. (2022, November 1). I*nternational statistical classification of diseases and related health problems*. Retrieved from https://icd.who.int/en.

Zeidan, J. et al. (2022). Global prevalence of autism: A systematic review update. *Autism Research*, 15(5), 778–790. https://doi.org/10.1002/aur.2696.