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Structured Environment to Enhance Gross Motor Skill in Young Children with Physical Motor Disabilities: A Case Study in an Inclusive Kindergarten

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Abstrak

Penelitian ini bertujuan untuk mengkaji peran *Structured environment* dalam meningkatkan kemampuan motorik kasar anak usia dini dengan hambatan fisik motorik di taman kanak-kanak inklusif. Penelitian menggunakan pendekatan kualitatif dengan desain studi kasus. Pengumpulan data dilakukan melalui observasi, wawancara dengan guru, dan studi dokumentasi untuk menggambarkan kondisi lingkungan pembelajaran serta perkembangan kemampuan motorik anak sebelum dan sesudah penerapan *structured environment*. Hasil penelitian menunjukkan bahwa sebelum intervensi, lingkungan kelas belum memiliki zonasi aktivitas yang jelas, rutinitas yang konsisten, serta penataan alat motorik yang terorganisasi. Setelah penerapan *structured environment*, zona aktivitas motorik tersusun secara jelas, jadwal visual diterapkan secara konsisten, dan rutinitas kegiatan menjadi lebih terprediksi. Perubahan tersebut berdampak positif terhadap peningkatan kemampuan motorik kasar anak, khususnya pada keseimbangan statis, kemampuan berjalan terarah dengan bantuan minimal, serta koordinasi gerak pada aktivitas melompat dan berguling. Selain itu, keterlibatan anak dalam aktivitas pembelajaran meningkat disertai respons emosional yang lebih positif. Faktor pendukung meliputi komitmen guru, ketersediaan sarana motorik, dan keterlibatan orang tua, sedangkan keterbatasan ruang dan waktu menjadi hambatan dalam implementasi. Penelitian ini menegaskan pentingnya *structured environment* sebagai strategi pendukung pembelajaran inklusif bagi anak dengan hambatan fisik motorik.

Kata Kunci: *structured environment*, motorik kasar, anak usia dini, hambatan fisik motorik, pendidikan inklusif.

Abstract

This study aimed to examine the role of a structured environment in enhancing the gross motor skills of young children with physical motor disabilities in an inclusive kindergarten setting. A qualitative approach with a case study design was employed. Data were collected through classroom observations, teacher interviews, and document analysis to describe the learning environment and the children's gross motor development before and after the implementation of a structured environment. The findings revealed that prior to the intervention, the classroom environment lacked clear activity zoning, consistent routines, and an organized arrangement of motor skill equipment. Following the implementation of the structured environment, motor activity zones were clearly defined, visual schedules were consistently applied, and daily routines became more predictable. These changes had a positive impact on children's gross motor performance, particularly in static balance, purposeful walking with minimal assistance, and movement coordination during jumping and rolling activities. In addition, children's engagement in learning activities increased and was accompanied by more positive emotional responses. Supporting factors included teachers' commitment, the availability of motor-related learning facilities, and parental involvement, while limited space and time were identified as barriers to implementation. This study highlights the importance of structured environments as an effective strategy to support inclusive learning for young children with physical motor disabilities.

Keywords: *structured environment*, gross motor skills, young children, physical motor disabilities, inclusive education.

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INTRODUCTION

Gross motor development is a key foundation in early childhood education because it supports children's mobility, balance, independence, and participation in everyday learning activities (Candra et al., 2023). Gross motor competence also contributes to broader developmental domains, including cognition and socio-emotional development, as many motor tasks require coordination, problem-solving, and social interaction (Saripidin, 2019). Therefore, early stimulation of gross motor skills is essential, particularly in inclusive classroom contexts where children's developmental needs vary widely. For young children with physical-motor disabilities, gross motor development often progresses more slowly due to factors such as muscle weakness, limited postural control, restricted range of motion, or neuromuscular conditions (Sefriyanti et al., 2022). These limitations not only reduce motor performance but also affect children's participation in classroom routines, peer interaction, and emotional regulation. Early intervention in kindergarten is therefore urgent, as the early years represent a sensitive period in which systematic stimulation can support long-term functional outcomes (Uce, 2025). However, many inclusive settings still provide limited motor stimulation opportunities due to environmental barriers, inconsistent classroom routines, and insufficient adaptive learning resources.

One strategy increasingly highlighted in inclusive education is the implementation of a structured environment. A structured environment refers to the intentional organization of classroom space, learning materials, routines, and visual cues to increase predictability and enhance children's participation (Ningsih et al., 2025). Previous studies have consistently reported the benefits of environmental structuring in improving children's readiness and engagement. For example, Brazendale et al. (2017) found that structured classroom settings improve children's attention and reduce disruptive behavior, which enables more sustained participation in physical and learning activities. Similarly, Hume et al. (2021) reported that environmental structuring through visual schedules, clear routines, and organized learning zones supports engagement and independence among children with special needs in inclusive classrooms. Evidence from Odom et al. (2011) also emphasizes that inclusive early childhood interventions are more effective when the physical and instructional environment is systematically designed to ensure accessibility and meaningful participation.

In addition, research on environment-based interventions indicates that structured motor spaces can increase opportunities for repeated and goal-directed motor practice. Rachmadina et al. (2024) demonstrated that structured arrangements of learning activities and materials help children with special needs follow step-by-step motor tasks and improve functional participation. Supporting this, Ningsih (2025) reported that structured environments facilitate consistent motor routines and strengthen teacher guidance during motor stimulation for children with physical motor limitations. From a theoretical perspective, these findings align with neuroplasticity principles which suggest that repeated, purposeful, and meaningful motor practice can strengthen neural connections and improve motor function (Ningsih et al., 2025). Despite growing evidence, implementing structured environments in inclusive kindergartens remains challenging. Teachers often have limited guidance on designing motor-oriented activity zoning; visual schedules are not consistently maintained; and motor stimulation resources are frequently inadequate. In Indonesia, inclusive early childhood education settings often face space constraints, time limitations, and heterogeneous student needs, which may hinder systematic motor stimulation. This situation creates a persistent gap between theoretical recommendations and practical classroom implementation, highlighting the need for in-depth research documenting how structured environments are applied and how they influence children's motor outcomes in authentic inclusive settings.

Accordingly, this study investigates how a structured environment supports the enhancement of gross motor skills among young children with physical motor disabilities in an inclusive kindergarten case study.

The novelty of this research lies in its focus on the process and mechanisms of environmental structuring specifically activity zoning, visual scheduling, and routine consistency as a practical intervention strategy within Indonesian inclusive early childhood classrooms, an area that remains underrepresented in prior studies. Unlike previous research that primarily reports general inclusive practices or motor intervention outcomes, this study provides detailed evidence on pre- and post-implementation classroom conditions and links environmental changes with specific gross motor improvements (e.g., static balance, purposeful walking with minimal assistance, and coordination in jumping and rolling activities). The findings are expected to strengthen evidence on environment-based intervention in inclusive early childhood education and offer practical recommendations for teachers and schools in designing adaptive and sustainable structured environments to support children with physical–motor disabilities.

METHOD

This study used a qualitative approach with an intrinsic case study design to explore the implementation of a structured environment and its influence on gross motor learning in an inclusive kindergarten setting.

Setting and Duration

The study was conducted at TK BPI Bandung, an inclusive kindergarten applying a center-based learning model. Data collection was carried out over eight weeks, covering baseline assessment, intervention planning, implementation, and evaluation.

Participants and Selection Criteria

The main participant was one child (aged 5–6 years) with physical motor impairments enrolled in the inclusive program. The participant was selected using purposive sampling based on the following inclusion criteria: (1) formally registered in the inclusive classroom, (2) identified by teachers as having significant physical motor limitations affecting gross motor participation, (3) able to attend school routines consistently during the study period, and (4) parental consent provided. Exclusion criteria included unstable medical conditions or absence during the intervention phase. Supporting informants consisted of the classroom teacher, a special education teacher (GPK), the child's parents, and the school principal, selected due to their direct involvement in planning and implementing the structured environment.

Research Procedure

The research process consisted of four stages:

1. Baseline observation
mapping classroom layout, routine structure, learning transitions, availability of motor equipment, and the child's initial gross motor performance.
2. Intervention planning: designing classroom zoning, organizing motor materials, developing visual schedules, and setting consistent daily routines aligned with the child's needs.
3. Implementation: applying structured environment components during daily learning activities, including motor activity zoning, routine consistency, activity sequencing, and visual support use.
4. Evaluation: documenting environmental changes and monitoring improvements in the child's gross motor performance and participation during motor-related activities.

Data Collection Techniques

Data were collected using 1) Observation conducted throughout baseline and implementation phases to record changes in structured environment components and the child's motor responses. 2) Interviews: semi-

structured interviews with teachers and parents to capture implementation strategies, challenges, and perceived changes in the child's development and engagement. 3) Documentation: photographs, videos, lesson plans, student developmental notes, and visual supports used in the classroom.

Instruments

Observation instruments included:

1. Structured Environment Checklist assessing: (a) activity zoning, (b) organization of motor materials, (c) routine consistency, (d) use of visual schedules/visual cues, and (e) transition management.
2. Gross Motor Observation Sheet focusing on functional gross motor indicators relevant to early childhood motor skills: static balance, purposeful walking, jumping, rolling, and movement coordination.

Data Analysis

Data analysis was conducted concurrently with data collection through three steps:

1. organizing and reducing data from field notes, interview transcripts, and documents;
2. displaying data in matrices and chronological intervention records (baseline vs. post-implementation conditions); and
3. drawing conclusions by identifying patterns linking environmental changes with motor skill improvements and classroom participation.

Trustworthiness

Credibility and trustworthiness were ensured through:

1. Triangulation across data sources (teachers, parents, principal) and methods (observation, interview, documentation),
2. Member checking to confirm key findings with informants,
3. Peer debriefing with early childhood and special education colleagues, and
4. Audit trail, including systematic storage of observation records, interview summaries, and intervention documentation.

Ethical Considerations

Permission to conduct the study was obtained from the school principal. Written informed consent was secured from the child's parents. Participant confidentiality was maintained by using pseudonyms and restricting access to recordings and documentation to the research team.

RESULT AND DISCUSSION

RESULT

Following eight weeks of implementing a structured environment in an inclusive kindergarten classroom at TK BPI Bandung, the findings indicate improvements in (1) classroom environmental organization, (2) the child's gross motor performance, and (3) participation in motor activities.

Tabel 1. Changes in Classroom Structured Environment

Structured Environment Component	Baseline Condition (Before Implementation)	Post-Implementation Condition (After Structured Environment)	Data Evidence
Activity zoning (motor learning areas)	Activity zones were not clearly defined; motor learning activities overlapped with other classroom functions.	Motor activity zones were clearly delineated (balance area, jumping/rolling zone, and walking pathway).	Observation notes; classroom photos
Motor equipment organization	Motor equipment was scattered and not consistently placed; materials were difficult to access and required time to prepare.	Motor equipment was grouped and systematically arranged; materials became easier to access and use during sessions.	Observation; documentation
Walking pathway visual guidance	No structured pathway; child walked without consistent visual direction and frequently lost balance.	A cone-marked pathway was introduced as a visual guide to support purposeful walking and directional control.	Observation notes; video
Visual schedule and activity sequence	Visual schedule was absent/inconsistently applied; the child showed uncertainty during transitions.	Visual schedules and motor task sequences were consistently displayed, helping the child anticipate transitions and task order.	Observation; photos; interview (teacher)
Routine consistency	Daily routines were irregular; motor activities were unpredictable in time and structure.	Daily routines became more consistent and predictable; motor tasks followed a structured sequence.	Observation; interview (teacher/GPK)
Transition management	Transitions were unclear and time-consuming; child required repeated verbal prompting and showed occasional resistance.	Transitions became smoother through visual cues and consistent routines; child followed instructions more efficiently.	Observation; interview
Teacher prompting/scaffolding	Teacher support was reactive; limited structured cues; frequent repetition needed.	Teacher scaffolding became more systematic (step-by-step guidance, consistent cues) aligned with structured routines.	Interview (teacher/GPK); observation

Baseline observations indicated scattered motor equipment, inconsistent routines, and the absence of a consistently applied visual schedule. After implementation, the classroom environment became more structured through systematic motor equipment organization, the introduction of a cone-marked walking pathway as visual guidance, and consistent use of visual schedules and activity sequencing (**Table 1**). Teachers reported smoother transitions and improved child participation during gross motor activities.

Tabel 2. Teacher and GPK reports

Gross Motor Domain	Baseline Performance	Post-Implementation Performance	Evidence Source	Interpretation
Static balance	Unstable standing; easily lost balance when maintaining posture.	Improved stability; able to stand on one foot for 3 seconds.	Observation notes; video	Enhanced postural control and balance maintenance.

Dynamic balance (walking)	Frequent loss of balance during walking; required close assistance.	Able to walk along cone-marked pathway with minimal assistance.	Observation; teacher report	Improved gait control, directional walking, and dynamic balance.
Movement coordination	Poor coordination during gross motor tasks; needed frequent physical support.	Improved coordination in motor sequences with reduced physical support.	Observation; interview	Better motor planning and bilateral coordination.
Jumping (two-foot jump)	Difficulty performing two-foot jump; inconsistent landing; required support.	Performed two-foot jumping with better control and less teacher support.	Observation; video	Increased lower-limb coordination and motor confidence.
Rolling activity	Rolling required assistance; weak trunk coordination; limited smoothness.	Rolling performed with improved coordination and reduced support.	Observation; teacher/GPK report	Improved trunk control and movement sequencing.
Engagement in motor sessions	Participation inconsistent; off-task behavior occurred during motor tasks.	Engagement increased; reduced off-task behavior; sustained attention longer.	Interview; observation	Improved motivation and attention through predictable routines.
Emotional response	Hesitant and uncertain during activities; occasional resistance.	More positive emotions (enthusiasm/enjoyment) during motor sessions.	Interview; observation	Structured routines supported emotional security and readiness.

At baseline, the child showed limited stability during standing, frequent loss of balance during walking, and low coordination during jumping and rolling tasks. After implementation, the child was able to walk along a cone-marked pathway with minimal assistance, demonstrate improved static balance (standing on one foot for approximately three seconds), and perform jumping and rolling activities with reduced physical support.

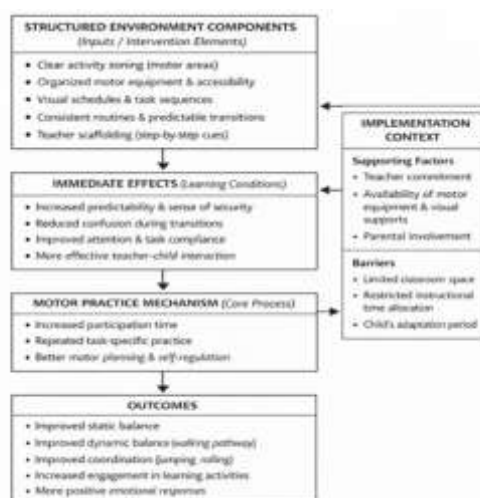


Figure 1. Conceptual Modeling Illustrating how structured environment components

Supporting factors included teacher commitment, availability of motor equipment and visual supports, and parental involvement in reinforcing routines. Barriers included limited classroom space, restricted instructional time allocation, and the child's adaptation period during early implementation.

DISCUSSION

Structured Environment as a Motor-Learning Intervention in Inclusive Kindergarten

This study demonstrates that a structured environment can function not only as a classroom management strategy but also as an environmental intervention that supports gross motor learning for children with physical-motor disabilities in inclusive kindergarten settings. In this case, the classroom changes such as clear activity zoning, systematic organization of motor equipment, consistent routines, and visual schedules created a predictable learning ecology that reduced uncertainty and increased accessibility for motor engagement. From an ecological perspective, children's motor development is shaped by the interaction between individual capacity and environmental opportunities; thus, classroom layout and material organization act as either facilitators or barriers to movement participation (Gibson, 1979; Bronfenbrenner, 1979). For children with physical motor limitations, predictable spatial cues and structured transitions are particularly important to support movement planning and reduce cognitive load during task switching (Shumway-Cook & Woollacott, 2017; Valentini, 2023).

The current findings align with evidence that environmental structuring and visual supports improve children's participation in inclusive settings by strengthening routines and increasing clarity of expectations. Visual schedules have been widely reported to enhance transition success and reduce confusion, thereby increasing time on task and functional participation among children with special needs (Knight et al., 2015; Hume et al., 2021; Liang, 2024). Similarly, classroom routines that are consistent and predictable contribute to children's behavioral regulation and readiness to participate in learning activities (Selman et al., 2024; UNESCO, 2020). In the present case study, the combination of visual schedules and clear motor zoning enabled the child to anticipate motor tasks and transitions, which likely contributed to improved focus and instructional responsiveness.

Mechanisms Explaining Gross Motor Improvements: Task-Specific Practice, Dosage, and Constraints

Observable improvements in static balance, dynamic walking performance, and coordination (jumping and rolling) suggest that structured environments promote motor development by increasing opportunities for repeated, task-specific practice in a safe and consistent context. Motor learning literature emphasizes that functional improvement occurs when practice is repetitive, goal directed, and embedded in meaningful activity sequences (Schmidt & Lee, 2019; Gentile, 2000). In early childhood contexts, structured motor intervention programs have been shown to significantly improve gross motor competence when they provide consistent practice dosage and progressive task demands (Wang et al., 2024; Hao, 2025). This aligns with the present finding that the structured environment reduced downtime and ambiguity, making motor sessions more orderly and efficient, thereby increasing the child's effective practice time.

The improvement in balance and walking control also reflects how environmental constraints can guide motor behavior. According to the constraints-led approach, movement emerges through the interaction of task constraints, environmental constraints, and the learner's characteristics (Newell, 1986). In this study, the cone marked pathway served as an external cue that improved directional walking control and reduced spatial ambiguity. Such external structuring has been associated with improved gait stability and movement calibration in children with motor difficulties, particularly when environmental cues are clear and consistent (Valentini, 2023; Shumway-Cook & Woollacott, 2017). In addition, structured zoning for balance and

coordination tasks likely increased opportunities for repetition with reduced variability, supporting gradual motor refinement.

From a neurodevelopmental perspective, consistent motor routines provide repeated sensorimotor input, which supports adaptation and skill acquisition. Neuroplasticity principles suggest that repetition, salience, and intensity of practice facilitate neural reorganization and functional motor gains (Kleim & Jones, 2008; Dayan & Cohen, 2011). Recent pediatric rehabilitation literature reinforces that intensive, structured, and meaningful motor experiences contribute to functional improvement and motor learning in children with neuromotor limitations (Meyling et al., 2025; Vacchini et al., 2025). Thus, the motor gains in this study are theoretically consistent with the idea that structured environmental cues can facilitate repeated motor practice, supporting motor adaptation over time.

Structured Environment and Emotional Engagement: Participation as a Mediator

Beyond motor skill improvement, this study found increased engagement and more positive emotional responses during motor activities. This finding is critical because participation is often a key mediator linking environmental supports to developmental outcomes in inclusive education. When learning environments are predictable, children experience greater emotional security, which supports sustained attention and willingness to participate in challenging tasks (Sameroff, 2010; UNESCO, 2020). Consistent with self-determination perspectives, structured environments can promote feelings of competence by enabling children to experience incremental success in manageable steps (Deci & Ryan, 2000). In inclusive kindergarten contexts, motivation is particularly important because children with motor difficulties may exhibit avoidance behaviors due to anxiety or fear of failure in physical tasks (Skinner & Piek, 2001; Valentini, 2023).

Current evidence also supports the role of structured inclusive environments in strengthening executive and adaptive functioning, which indirectly improves children's learning engagement. For example, studies on inclusive classroom environments indicate that supportive and well organized settings contribute to improved self-regulation and task persistence (Arzaqi et al., 2024; Hume et al., 2021). Therefore, the increased enthusiasm and reduced off-task behavior observed in this study can be interpreted as outcomes of improved predictability, reduced uncertainty, and better alignment between task demands and the child's capability.

Comparison With Previous Studies: Convergence and Contextual Differences

The present findings converge with previous research reporting that structured physical activity environments enhance early childhood motor development. Meta-analytic evidence indicates that structured exercise and motor training programs produce positive effects on preschool children's gross motor skills (Wang et al., 2024). Similarly, studies show that structured motor learning interventions facilitate improvements in balance, coordination, and movement control, particularly when practice is repeated and guided systematically (Hao, 2025; Nel, 2025). These prior findings support the results of this study that motor improvements occurred after the structured environment intervention.

In inclusive education literature, environmental adaptation is emphasized as a prerequisite for meaningful participation of children with disabilities. Evidence suggests that inclusive outcomes improve when environments provide consistent routines, clear expectations, and accessible learning tools (Odom et al., 2019; UNESCO, 2020; inclusive ECE teacher challenges study, 2024). Compared with prior studies that often focus on program-based intervention outcomes, this case study offers additional nuance by documenting micro level mechanisms in a real classroom context: activity zoning, visual sequencing, and transition support influenced attention, compliance, and motor engagement. This is consistent with studies emphasizing that structured classroom environments support behavioral regulation and increase learning opportunities (Brazendale et al., 2017; Hume et al., 2021).

However, the present findings also highlight contextual differences. Resource constraints such as limited space and restricted time remain significant barriers in inclusive kindergarten settings, especially in low-resource contexts (UNESCO, 2020; Valentini, 2023). While structured environments are effective, sustainability depends on practical feasibility and institutional support. Therefore, implementation strategies should prioritize low-cost, high impact structuring tools such as floor markers, portable stations, visual schedules, and brief but frequent motor routines.

Supporting and Inhibiting Factors Through an Implementation Lens

Teacher commitment emerged as the most influential facilitator of successful implementation. Implementation research consistently shows that intervention fidelity is shaped by practitioner readiness, consistency, and perceived feasibility (Fixsen et al., 2005; Bulotsky-Shearer et al., 2025). In this study, the teacher's consistency in maintaining routines and visual sequencing created stable practice conditions that supported the child's gradual adaptation. Similarly, the availability of motor equipment and visual supports enhanced feasibility by enabling daily repetition of structured motor tasks (Neshteruk et al., 2025; Zulauf-McCurdy et al., 2024). The role of parental involvement also strengthened generalization: consistent routines reinforced at home reduce novelty barriers and accelerate behavioral adaptation, supporting continuity between school and home environments (Epstein, 2018; Selman et al., 2024).

Conversely, barriers such as limited classroom space and restricted instructional time are common structural constraints that reduce practice intensity and limit task variation. Environmental intervention literature highlights that space and time constraints often require adaptive strategies such as micro zoning, rotating stations, and embedding motor practice within daily routines (Neshteruk et al., 2025; UNESCO, 2020). Additionally, the child's initial adaptation period reflects a typical challenge in implementing structured interventions, where resistance can occur during early stages due to unfamiliarity with new routines (Hume et al., 2021; implementation fidelity review, 2024). This suggests the importance of gradual introduction, consistent cues, and reinforcement strategies during the transition into structured systems.

Scientific Contribution, Practical Implications, and Limitations

This study contributes to inclusive early childhood education by strengthening evidence that environment-based interventions can support gross motor development among children with physical-motor disabilities. Specifically, it demonstrates that structured environment components activity zoning, visual schedules, routine consistency, and systematic scaffolding operate as feasible mechanisms to increase participation and practice opportunities in authentic inclusive classroom contexts. The findings also expand motor learning evidence by highlighting participation and emotional engagement as mediators linking environmental structuring to motor outcomes (Wang et al., 2024; Hume et al., 2021; Selman et al., 2024).

Practically, the results suggest that inclusive kindergarten teachers can implement structured environments using low cost strategies (visual schedule boards, floor markers, cone pathways, station rotation, and routine scripts). These approaches are realistic in many Indonesian school contexts where resources may be limited. Schools and policymakers should consider supporting teacher training and resource provision to improve implementation fidelity and sustainability (UNESCO, 2020; Bulotsky-Shearer et al., 2025).

Nevertheless, several limitations should be acknowledged. First, the study used a single-case design, which limits generalizability across children and settings. Second, the eight-week duration may not capture long-term maintenance or more complex motor development trajectories. Third, the evaluation relied primarily on qualitative observation rather than standardized quantitative motor scores. Future studies should involve multiple participants, longer follow-up, and mixed-method designs to quantify motor gains while

maintaining context-rich understanding of implementation processes (Neshteruk et al., 2025; Zulauf-McCurdy et al., 2024).

CONCLUSION

This study concludes that implementing a structured environment can effectively enhance gross motor skills in young children with physical motor disabilities within an inclusive kindergarten setting. Evidence from the case study at TK BPI Bandung shows that systematic classroom structuring through clear activity zoning for motor tasks, organized motor equipment, consistent routines, and the regular use of visual schedules and task sequencing was associated with measurable improvements in the child's gross motor performance, particularly in static balance, purposeful walking with minimal assistance, and movement coordination during jumping and rolling activities. Beyond motor outcomes, the structured environment also increased the child's engagement in classroom activities, supported more positive emotional responses, and strengthened confidence during motor sessions. The main contribution and novelty of this research lie in documenting the practical mechanisms of structured environment implementation in a real inclusive kindergarten classroom, including changes in classroom organization before and after intervention and their linkage to specific motor skill improvements. These findings highlight that structured environments function as an integrated instructional strategy that supports participation and learning opportunities for children with physical-motor challenges. Therefore, inclusive kindergarten teachers are recommended to adopt structured environmental components as feasible, low-cost practices to improve motor participation, such as establishing motor zones, maintaining predictable routines, and using visual supports consistently. Future research should involve multiple participants and longer implementation periods to strengthen generalizability and examine long term outcomes.

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