International Journal for Multidisciplinary Research (IJFMR)

E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Impact of Environmental and Equipment Modification on Occupational Performance in Cerebral Palsy Children with Physical Disabilities in Inclusive School Settings

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Abstract

Children with Cerebral Palsy (CP) often experience significant challenges in performing school-based occupations due to motor, sensory, cognitive, and contextual limitations. Although inclusive education policies promote the placement of children with disabilities in mainstream schools, meaningful participation remains limited when school environments are not responsive to diverse functional needs. Occupational performance in school settings is shaped not only by a child's intrinsic abilities but also by the interaction between the person, environment, and occupation. Environmental barriers such as inaccessible classroom layouts, non-adjustable furniture, sensory overload, rigid instructional methods, limited assistive technology, and negative social attitudes frequently restrict participation for children with CP.

This study focuses on examining the impact of environmental and equipment modifications on occupational performance among children with CP in inclusive school settings. Environmental modifications include physical adaptations (e.g., adjustable seating, accessible pathways, adaptive desks), sensory modifications (e.g., reduced noise, organized visual spaces), instructional adaptations, and social supports that promote autonomy and peer engagement. Grounded in occupational therapy frameworks such as the Person–Environment–Occupation (PEO) and International Classification of Functioning, Disability and Health (ICF), the study emphasizes that participation restrictions often arise from environmental mismatches rather than impairment severity alone.

Evidence suggests that targeted environmental and equipment modifications significantly enhance academic participation, mobility, self-care, social interaction, and overall independence among children with CP. These adaptations also support psychosocial well-being by improving confidence, motivation, and a sense of belonging. The findings underscore the critical role of occupational therapists, educators, and school administrators in collaboratively designing inclusive, flexible, and accessible learning environments. Ultimately, the study highlights that modifying school environments is essential for transforming inclusion from physical placement into meaningful participation for children with Cerebral Palsy.

Keywords: Cerebral Palsy; Inclusive Education; Environmental Modification; Occupational Performance; Assistive Equipment; School Participation

I. Introduction

Children do not simply learn through academic instruction; they inhabit school environments as complex social, physical, and sensory worlds that profoundly shape how they explore, interact, and engage with everyday learning experiences. Schools are dynamic ecosystems where children continuously interpret cues from the physical space, negotiate social demands, and respond to sensory and contextual elements that either support or hinder their participation. For children with disabilities—particularly those living with Cerebral Palsy (CP)—the school environment often becomes the stage upon which occupational participation is either nurtured, adapted, or inadvertently restricted. Cerebral Palsy, recognized as one of the most prevalent childhood motor disabilities globally, is characterized primarily by disturbances in posture, movement, and motor coordination. However, beyond these core motor impairments, CP may also present with secondary influences on cognition, perception, communication, behavioral regulation, and sensory processing, all of which significantly shape children's everyday engagement within school routines and academic tasks [1]. As a result, the educational experience of a child with CP is rarely defined by motor difficulties alone; rather, it is influenced by the extent to which the environment is responsive, supportive, and adaptable to their holistic needs.

In contemporary educational discourse, inclusion has become a central value and a guiding principle across many nations. Inclusive education emphasizes not just the physical placement of children with disabilities in mainstream classrooms but also their meaningful participation, social belonging, and equal opportunities to engage in all aspects of school life. Yet, the success of inclusion depends heavily on the degree to which the learning environment accommodates diverse abilities. For children with CP, inclusive education demands more than supportive attitudes or specialized instruction—it requires intentional, evidence-based environmental modifications that mitigate activity limitations and promote fuller involvement in school occupations. With renewed attention on inclusive schooling, researchers and practitioners are increasingly questioning whether existing school environments genuinely enable participation for children with CP or whether they simply support their presence without empowering their engagement [2].

Occupational performance, a central concept in occupational therapy, encompasses the ability to perform meaningful daily activities across domains such as self-care, productivity, and leisure. Within school contexts, occupational performance extends to academic tasks, play, mobility, communication, social interaction, classroom participation, and transitions between activities. For children with CP, performing these occupations often involves navigating several environmental barriers such as inaccessible classroom layouts, inadequate seating and positioning options, sensory overstimulation, limited mobility pathways, poorly adapted instructional materials, and social misconceptions. These barriers may negatively influence not only physical participation but also confidence, motivation, and sense of belonging. Consequently, environmental modifications become essential tools for reducing activity limitations and promoting equitable participation.

Environmental modifications encompass a broad spectrum of adaptations that can include physical changes to the classroom layout, the use of assistive devices, adjustments in seating or positioning, alterations in sensory stimuli, organizational changes, and modifications in task demands. For many children with CP, strategically designed environmental changes can compensate for motor difficulties, reduce postural strain, support attention, enhance communication, and simplify task execution.

II. Rationale of the Study

Cerebral palsy (CP) is one of the most common neurodevelopmental disorders in childhood and is characterized by permanent impairments in movement, posture, and coordination that significantly affect a child's ability to perform daily activities. Children with cerebral palsy frequently experience limitations in functional mobility, self-care, play, and school-related tasks, which in turn restrict their participation and occupational performance within educational environments. With the increasing emphasis on inclusive education, children with physical disabilities are being integrated into mainstream school settings; however, many schools lack adequate environmental adaptations and appropriate assistive equipment to meet their unique functional needs.

Inclusive school environments often present physical, sensory, and task-related barriers such as inaccessible classrooms, unsuitable furniture, poorly designed seating arrangements, and lack of adaptive learning tools. These barriers can negatively impact children's independence, safety, participation, and overall occupational performance.

III. Objectives

- To determine demographic data with outcome measures.
- To determine screening score of Gross Motor Function Classification System (GMFCS)
- To determine pre-test & post-test score of Canadian Occupational Performance Model (COPM)

IV. Research Methodology

Study Design

The present study adopted a **quasi-experimental pre–post intervention design** to examine the effectiveness of the intervention on functional performance outcomes in children with cerebral palsy (CP). This design enabled within-group comparisons by assessing outcome measures before and after the intervention, thereby allowing evaluation of change attributable to the intervention in the absence of randomization.

Sampling Method and Sample Size

A **convenience sampling technique** was employed to recruit participants based on accessibility and feasibility. A total of **50 children** who met the predefined inclusion and exclusion criteria were enrolled in the study. This sample size was considered adequate to detect meaningful pre–post changes in functional outcomes.

Source of Data

Participants were recruited from **rehabilitation centers, pediatric clinics, and preschools**. Medical records were screened by the research team to identify potentially eligible participants, and caregivers were subsequently contacted to explain the purpose and procedures of the study.

Selection Criteria

Inclusion Criteria

Children were included in the study if they met the following criteria:

- Age between **4 and 8 years**
- Either **male or female**

- Clinically diagnosed with **cerebral palsy**
- Classified under **Gross Motor Function Classification System (GMFCS) levels I–III**
- Willingness of the child and caregiver to commit to intervention-related activities for the entire study duration, with no anticipated relocation
- **Written informed consent** obtained from the parent or legal guardian

Exclusion Criteria

Children were excluded if they met any of the following conditions:

- Age below 4 years or above 8 years
- Absence of guardian consent
- Presence of other medical conditions associated with CP, such as **cardiorespiratory or rheumatic diseases**
- Significant **joint or skeletal muscle abnormalities** limiting passive range of motion of the upper limbs
- Severe visual impairments that could interfere with participation in the intervention

Variables

- **Independent Variable:** Classroom environmental modification–based intervention
- **Dependent Variable:** Occupational performance and satisfaction scores

Screening Tools and Outcome Measures

- **Gross Motor Function Classification System (GMFCS):** Used as a screening tool to classify the severity of motor impairment and determine eligibility.
- **Canadian Occupational Performance Measure (COPM):** Used as the primary outcome measure to assess changes in occupational performance and satisfaction across individualized goals.

Data Collection Procedure

Following recruitment, eligible participants were enrolled after obtaining written informed consent from parents or guardians. Each participant was assigned a **unique study identification number**, and demographic information including age, sex, CP subtype, comorbidities, school type, and current therapies was recorded using a structured form.

A licensed pediatric physiotherapist or occupational therapist verified the **GMFCS level** during screening to confirm eligibility. Baseline assessments were conducted prior to the initiation of the intervention. The **COPM** was administered through a semi-structured interview with the caregiver and, where feasible, the child, to identify **three to five priority occupational performance goals**. Performance and satisfaction scores were recorded by trained assessors. With consent, assessments were audio- or video-recorded to enhance scoring reliability.

Intervention Procedure

Classroom environmental modifications were implemented over a **one-year period**. Modifications included changes to furniture, seating arrangements, visual supports, accessibility routes, and assistive devices as required. An **intervention log** documented the nature and timing of each modification, staff training sessions, and teacher adherence. Monthly site visits were conducted by fidelity monitors using a standardized fidelity checklist to ensure consistent implementation.

V. Results

Table 1.0
Paired Samples Effect Sizes

Stats			Standardizer[a]	Point Estimate	95% Confidence Interval	
					Lower	Upper
Pair 1	Pre COPM - Post COPM	Cohen's d	1.0792	-1.596	-2.012	-1.172
		Hedges' correction	1.0960	-1.571	-1.981	-1.154

a. The denominator used in estimating the effect sizes.
Cohen's d uses the sample standard deviation of the mean difference.
Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

Canadian Occupational Performance Model (COPM), providing an estimate of the magnitude of change following the intervention. Using Cohen's d, the standardized effect size was 1.079, with a point estimate of −1.596 and a 95% confidence interval ranging from −2.012 to −1.172.

Table 2.0
Paired Samples Test

Stats		Paired Differences					t	df	Significance	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
					Lower	Upper				
Pair 1	Pre COPM - Post COPM	-1.7220	1.0792	.1526	-2.0287	-1.4153	-11.283	49	<.001	<.001

The mean paired difference between pre COPM and post COPM scores was −1.722 (SD = 1.079), indicating that post-test COPM scores were significantly higher than pre-test scores. The 95% confidence interval of the mean difference ranged from −2.029 to −1.415, which does not cross zero, confirming the presence of a true difference between pre- and post-intervention scores.

Table 3.0
Paired Samples Correlations

Stats		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Pre COPM & Post COPM	50	.250	.040	.079

The results indicate a positive correlation (r = 0.250) between pre COPM and post COPM scores, suggesting that participants' baseline occupational performance and satisfaction levels were moderately associated with their post-intervention outcomes.

This implies that individuals with relatively higher pre-test COPM scores tended to show correspondingly higher post-test scores, although the strength of the relationship is weak to modest. With respect to statistical significance, the one-sided p value was 0.040, indicating a statistically significant association when a directional hypothesis is assumed. However, the two-sided p value was 0.079, which does not reach the conventional level of statistical significance ($p < 0.05$), suggesting that the relationship should be interpreted cautiously when no directional assumption is made.

VI. Conclusion

The present study demonstrates that the intervention was effective in producing significant and clinically meaningful improvements in occupational performance and satisfaction among children in early childhood. By adopting a structured, client-centred approach and targeting a developmentally sensitive age group, the intervention successfully addressed functional challenges associated with mild to moderate motor limitations. The inclusion of a balanced gender distribution, participants across GMFCS Levels I–III, and the use of the COPM as a primary outcome measure strengthen the clinical relevance and generalizability of the findings. Overall, the results support the use of client-centred, goal-oriented occupational therapy interventions as a valuable and effective strategy in paediatrics rehabilitation to enhance meaningful participation and quality of life.

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