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(*) Corresponding author
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A MULTIDIMENSIONAL FRAMEWORK FOR PSYCHOMOTOR REHABILITATION AND INCLUSIVE EDUCATION IN CHILDREN WITH CEREBRAL PALSY

Denis Arsovski*
University "St. Kliment Ohridski" - Bitola, Higher Medical School - Bitola
ORCID: https://orcid.org/0000-0003-4992-686X
denis.arsovski@uklo.edu.mk

Natasha Chichevska Jovanova
University Ss. Cyril and Methodius Skopje, Faculty of Philosophy, Institute of Special education and rehabilitation
ORCID: https://orcid.org/0000-0001-9324-8117
natasac@fzf.ukim.edu.mk

Goran Ajdinski
University Ss. Cyril and Methodius Skopje, Faculty of Philosophy, Institute of Special education and rehabilitation
ORCID: https://orcid.org/0000-0003-0527-7677
goran@fzf.ukim.edu.mk

Gabriel Zhivkovikj
Clinical hospital Dr. Trifun Panovski Bitola, Department of otorhinolaryngology, Demonstrator at Higher medical school Bitola, University "St. Kliment Ohridski" - Bitola
ORCID: https://orcid.org/0009-0003-7612-3023
gabriel.zhivkovikj@gmail.com

ABSTRACT

This research used an interdisciplinary model that integrates psychomotor rehabilitation with inclusive education for students with cerebral palsy. The research revealed the need for individualized, specific rehabilitation that supports functional independence and active participation in learning environments. A case study design was used including a nine-year-old girl with spastic diplegic cerebral palsy attending a regular school. Standardized instruments such as the Gross motor function classification system, Manual ability classification system, Modified Ashworth scale, and Pediatric evaluation of disability inventory were used. Cognitive, communicative, social and emotional functioning were assessed through classroom observations, evaluations, and interviews. The results showed moderate motor limitations and dysarthric speech but preserved visual perception, motivation, and symbolic understanding. Environmental and systemic barriers such as fragmented rehabilitation services and insufficient interprofessional collaboration limited her progress. The results clarify the relevance of coordinated, family-centered intervention integrating rehabilitation, education, and social support to improve inclusion and general development in children with cerebral palsy.

Keywords: cerebral palsy; psychomotor rehabilitation; inclusive education; motor learning; special education; child development; multidisciplinary approach.

INTRODUCTION

Cerebral palsy is one of the most common causes of motor impairment in childhood and it's characterized by chronicmovement abnormalities and posture resulting from static disfunctions in the developing brain (Patel et al., 2020). Children with this condition experience combined functional disabilitiesincluding gross and fine motor control, coordination, balance, and speech, combined with cognitive, perceptual, and socio-emotional problems (Himmelmann et al., 2006; Al-Nemr& Abdelazeim, 2017). These complex problems affect the skills level of the child for independent functioning and participation in daily life and educational activities, making early and continuous rehabilitation important for improving developmental results and social inclusion (Pashmdarfard et al., 2021;Albesher et al., 2025).

Psychomotor rehabilitation stands as a principal component in improving the quality of life and daily functioning of persons with cerebral palsy (Poursadoughi et al., 2015; Dogruoz Karatekin& Icagasioglu, 2022). Within this context, rehabilitation is not limited only to physiotherapy but develops into an integrative approachincluding occupational therapy, special education, communication support, and family involvement in the rehabilitation process (Faccioli et al., 2023). Effective psychomotor rehabilitation consequently relies on collaboration between various professionals such as physiotherapists, special educators, psychologists, and speech therapistworking together aiming at common functional objectives (Sacaze et al., 2013; Dončevová et al., 2016).

At the same time, inclusive education gives the pedagogical and social structure necessary to maintain that children with disabilities participate in learning environments (Budnyk& Sydoriv, 2019). It focuses on equal access, adaptation of curricula, individualized educational plans, and a supportive school culture that values diversity and participation (Ranbir, 2024; Dewi, 2034). For children with cerebral palsy, inclusion is not simply about physical presence in classrooms - it includes removing attitudinal, architectural, and methodological barriers that limit their involvement and learning (Carrillo-Sierra et al., 2025). Inclusive education therefore becomes a fundamental context where the results from rehabilitation lead to everyday practice, social interaction, and academic progress (Kefallinou et al., 2020).

Children with cerebral palsy continue to meet considerable resistance in achieving functional independence and educational inclusion due to inconsistent rehabilitation, insufficient interprofessional coordination, and limited adaptation of school environments (Casseus& Cheng,2021; Rashikj Canevska & Chichevska Jovanova, 2020). This research intends to develop and analyze a multidimensional framework that unites psychomotor rehabilitation with inclusive education, focusing on the integration of medical, psychological, and pedagogical approaches. The main objective is to create a comprehensive model that improves functional capacity, learning participation, and social inclusion of children with cerebral palsy with help of coordinated action among health, educational, and family systems. The importance of this researchis defined by its potential to fill the gap between rehabilitation and education by promoting sustainable inclusion practices, improving interdisciplinary cooperation, and strengthening strategies that support holistic child development.

METHODS

Study design

This research was designed as a case-based descriptive analysis integrating quantitative and qualitative methods to examine the psychomotor, cognitive, and socio-emotional functioning of a child with spastic diplegic cerebral palsy within an inclusive educational environment. The investigation combined psychomotor assessments and contextual educational observations to construct a multidimensional rehabilitation and

inclusion framework. The research was conducted at the Primary Resource School "Kocho Racin" in Bitola.

Participants

The participant was a nine-year-old girl diagnosed with spastic diplegic cerebral palsy and included in a primary school program with individualized educational support. She showed moderate to severe psychomotor impairments including muscle spasticity, postural instability, and dysarthric speech. The family environment was supportive but characterized by limited access to continuous rehabilitation. Inclusion criteria included confirmed diagnosis of cerebral palsy and current admission in an inclusive school program; exclusion criteria included comorbid intellectual disabilities or uncontrolled epilepsy.

Materials and instruments

A series of standardized and adapted instruments were used to assess psychomotor and functional performance:Gross motor function classification system (GMFCS) and Manual ability classification system (MACS) for motor functioning.Modified Ashworth scale (MAS) for spasticity grading.Pediatric evaluation of disability inventory (PEDI) for functional independence.Subiran, Buche, and Reye coordination tests for postural, manual, and fine motor control.Cognitive and gnostic assessments (classification, seriation, correspondence, conservation tasks) taken from Piagetian developmental scales.Behavioral and emotional functioning was evaluated through systematic observation and teacher-parent interviews with focus on adaptability, participation, and motivation in the school context.

Procedure

Data collection took place over a six-week observation and evaluation period during the 2024/2025 academic year.Initial assessment was conducted at the Clinical Hospital "Dr. Trifun Panovski" -Bitola from neurologist where the diagnosis was established. Psychomotor evaluation was performed by a multidisciplinary team including a special educator, physiotherapist, and speech therapistfollowing standardized protocols for upper and lower limb coordination, fine motor differentiation, and praxis organization.Educational observation was implemented within classroom sessions, individualized instruction, and free-play contexts to document participation and social integration.Environmental and family assessments evaluated accessibility, parental involvement, and emotional climate.Intervention recommendations were designed based on the observed strengths and limitations, pointing out individualized psychomotor stimulation, structured routines, and collaborative work between rehabilitation and educational teams.

Data analysis

Descriptive and interpretative analyses were performed. Quantitative data from psychomotor and functional scales were presented into frequency and performance tables, while qualitative data (teacher and parent reports, observational notes) were thematically analyzed to identify patterns of adaptive behavior, barriers, and facilitators of inclusion. Results were integrated into the proposed Multidimensional framework for psychomotor rehabilitation and inclusive education, connecting motor, cognitive, and emotional development dimensions into a cohesive intervention model.

RESULTS

The results presents the child's psychomotor, cognitive, communicative, and social-emotional development based on standardized assessments, observational data, and functional evaluations. The results are organized thematically to show the multidimensional approach of this research, integrating motor function, perceptual and cognitive abilities, communication skills, and adaptive behavior within the educational and family context.

Table 1: General functional classification of the child with spastic diplegic cerebral palsy.

Category	Assessment tool	Result orlevel	Functional description
Gross motor function	GMFCS (Gross motor function classification system)	Level II	Walks with limitations, independent mobility in short distances, difficulties with balance and running.
Manual ability	MACS (Manual ability classification system)	Level II-III	Handles most objects with reduced speed and precision, needs minimal assistance for complex manipulations.
Muscle tone	Modified Ashworth scale	Grade 2 (moderate spasticity)	Increased tone in lower limbs, especially hip flexors and adductors; mild asymmetry of upper limbs.
Functional independence	Pediatric disability inventory	Moderate dependence	Requires partial assistance in dressing, hygiene, and classroom tasks.
Communication function	Observational and speech assessment	Partially functional	Expressive speech limited by dysarthria; comprehension preserved for simple instructions.

Table 1 shows the starting point of functional profile of the child according to internationally recognized classification systems. The results indicate moderate spasticity, partial independence in daily activities, and maintained cognitive comprehension despite expressive speech limitations.

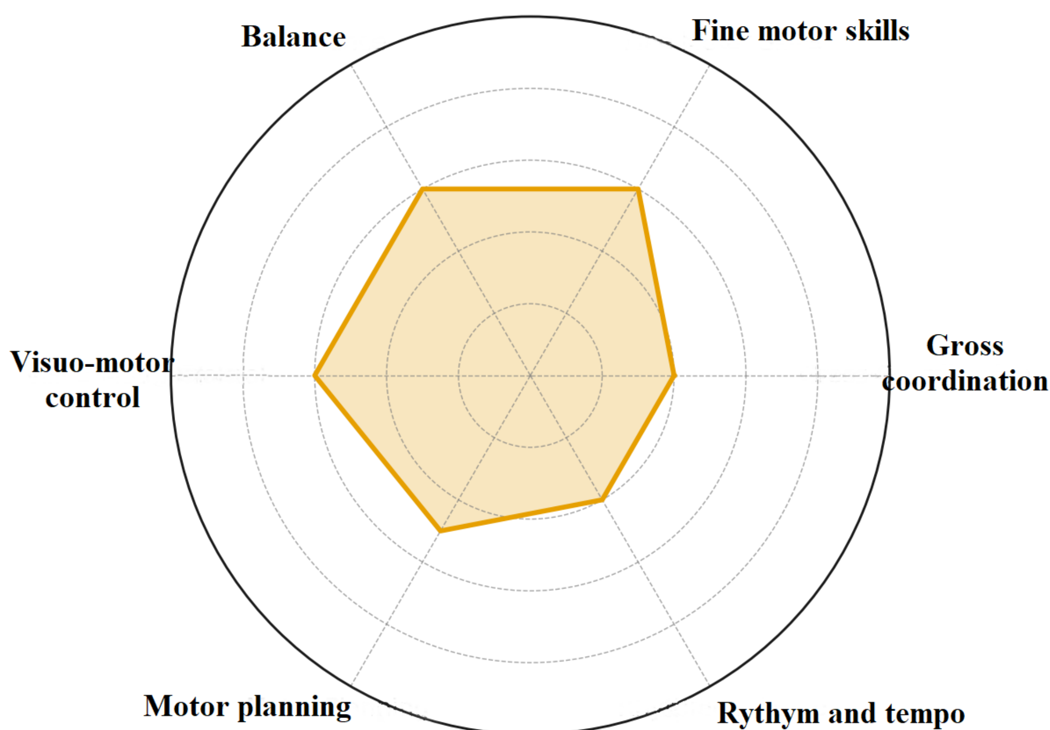

Figure 1: Psychomotor function radar profile of the child.

Figure 1 shows the psychomotor performance across six categories: balance, fine motor skills, gross coordination, visuo-motor control, motor planning, and rhythm and tempo. The results show moderate functional limitations in coordination, rhythm, and balance. Some strengths are visual-motor integration and fine motor adaptation, which remain relatively preserved when guided by visual models. This figure also shows the interdependence of motor, perceptual, and planning abilities, defining the need for a multidimensional therapeutic approach integrating physical, cognitive, and educational interventions.

Table 2: Speech, communication, and cognitive profile of the child.

Category	Summary of the performance	Observation
Speech and language	Dysarthric, limited fluency	Articulation slow and imprecise; expressive output brief but contextually appropriate.
Comprehension	Preserved for simple commands	Understands concrete instructions; needs repetition for complex verbal input.
Cognition	Low-average range	Visual reasoning stronger than verbal; benefits from structured and visual tasks.
Attention and memory	Inconsistent	Short attention span; visual memory more reliable than auditory.

Table 2 shows that the child's communication is partially functional, with evident motor-speech and articulation difficulties due to dysarthria. While expressive speech remains limited, comprehension of familiar verbal instructions is relatively intact, allowing successful participation in guided tasks. Cognitive assessment indicates heterogeneous abilities, with strengths in visual perception and task imitation, compensating for weaker auditory processing and attention control.

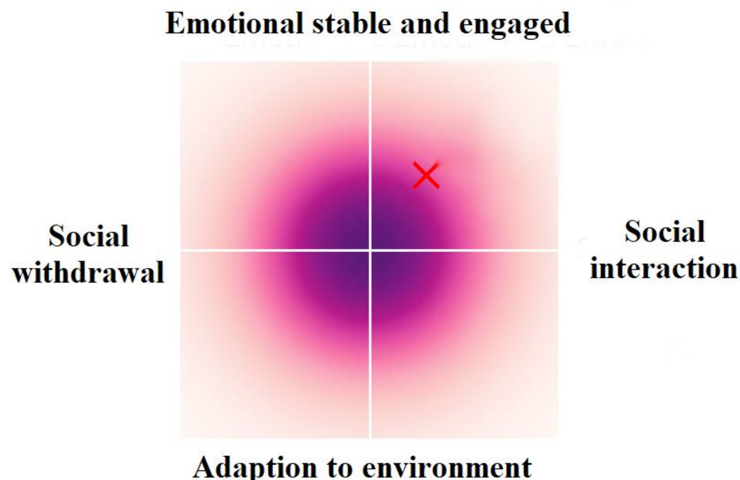

Figure 2: Emotional landscape diagram for social engagement and emotional stability.

Figure 2 uses a two-dimensional heatmap to show how the child balances inner emotional stability with social engagement and environmental adaptation. The vertical axis extends over from high emotional stability and engagement at the top to adaptation to environment at the bottom, while the horizontal axis ranges from social withdrawal on the left to social interaction on the right. The shaded centre show areas of moderate adaptation and emotional activity, with lighter regions showing greater stability and engagement. The red marker placed in the upper right quadrant shows that the child is mostly emotionally stable and socially engaged, suggesting strong resilience and active participation in social contexts. At the same time, the gradient around the centre show that environmental adaptation and coping

skills are less developed, coordinating support to strengthen adaptability while maintaining the child's positive emotional and social profile.

Table 3: Summary of therapeutic and educational interventions applied to the child.

Category	Applied methods	Summary of the effects
Physiotherapy	Bobath and Vojta techniques, balance and stretching exercises	Improved trunk control and gait stability
Occupational therapy	Fine motor and activities of daily living training	Greater independence in self-care and classroom tasks
Speech therapy	Articulation drills, breathing control, augmentative and alternative communication support	Better expressive clarity and vocabulary use
Cognitive stimulation	Visual sequencing and memory tasks	Increased attention and task persistence
Emotional–Social Training	Role-play and peer interaction games	Enhanced emotional regulation and group adaptation
Educational inclusion	Individualized education plan	Continuous academic participation and social integration

Table 3 shows a multidimensional and coordinated rehabilitation plan that shows both clinical and educational aspects. Combined therapeutic efforts have led to improvements in motor coordination, communication, emotional stability, and functional independence, while inclusion in the schoolmaintain sustained progress and active participation in daily activities.

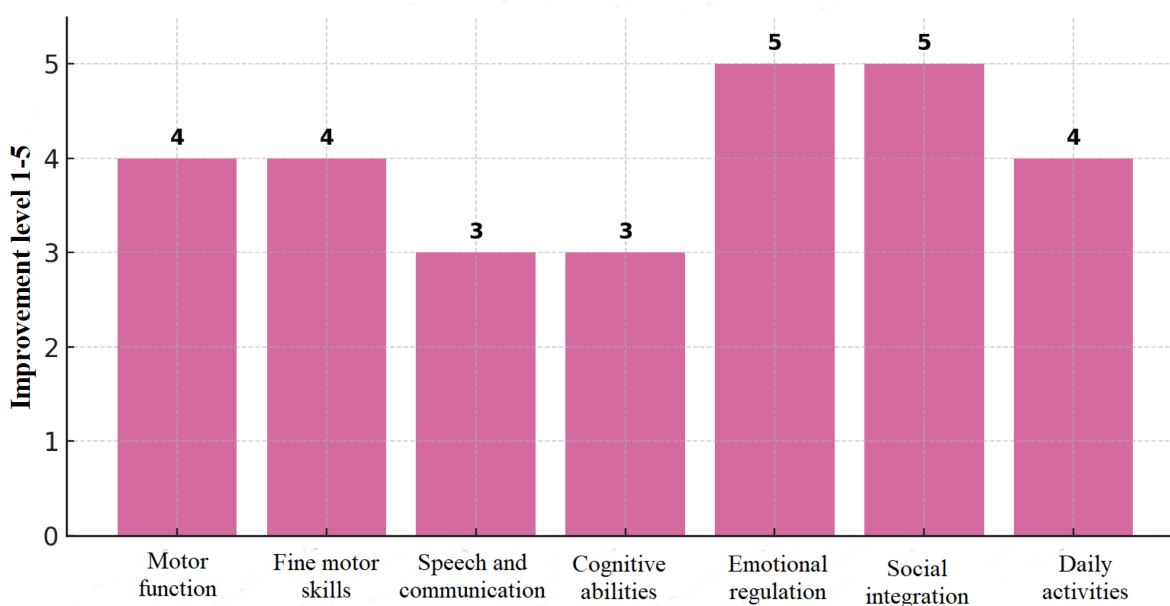

Figure 3: Evaluation of the progress of the child.

Figure 3 shows the path of the developmental growth achieved through a structured, interdisciplinary rehabilitation plan. This shows clear differentiation across seven categories such as motor function, fine motor skills, speech and communication, cognitive abilities, emotional regulation, social integration, and daily living activitieseach showing specific dimension of psychomotor and adaptive growth of the child.The most pronounced gains are observed in emotional regulation and social integration, indicating the child's improved ability to maintain emotional balance and participate in peer and social interactions. These improvements are important given the initial difficulties with communication and adaptive functioning, showing that emotional stability and social motivation have become supporting factors for therapeutic progress.Moderate but consistent improvement is evident in motor and fine motor categories, confirming the positive results of sustained physiotherapeutic and

occupational interventions focusing on balance, coordination, and self-care activities. Speech and communication show steady but slower advancement and this is an expected trend in children with spastic diplegic cerebral palsy due to persisting articulatory and respiratory control limitations. Cognitive development also shows gradual improvement, primarily in structured reasoning and visual memory, showing effective use of visual-motor integration strategies.Finally, the category of daily activities confirms growing independence in functional routines such as dressing, feeding, and school participation. The pattern across categoriesshows that emotional and social stability act as facilitators for functional independence, improving the adaptability of the child within both therapeutic and educational environments.

DISCUSSION

The results of this researchshow the interaction between psychomotor limitations and educational participation in children with spastic diplegic cerebral palsy. The results confirm that motor impairments such as reduced balance, coordination, and manual dexterity are the main barrier to functional independence and active participation in the classroom. Despite these challenges, the child showed adaptive capacities - strong visual perception, symbolic comprehension, and consistent motivation when supported through individualized and visually structured activities.

From a rehabilitation perspective, the integration of neurodevelopmental approaches and task-specific exercises improved both trunk stability and functional movement patterns, creating a foundation for improved learning performance. On the educational side, inclusive teaching practices, visual aids, and environmental adjustments were found to increase participation and self-confidence within the classroom. The interaction between therapeutic and pedagogical strategies shows the necessity of a coordinated multidisciplinary model, where healthcare workers, educators, and families design interventions with aim tomaximize functional independence and academic achievement.

One research by Setaro et al., (2025)strengthens the literature byfocusing on the importance of multidimensional and integrative rehabilitation such as the AMIRA model in promoting development among children with cerebral palsy. Similar to AMIRA's focus on early, adaptive, and environment-based intervention, our results confirm that individualized rehabilitation programscombining psychomotor therapy, cognitive stimulation, and inclusive educationlead to improvements across motor, emotional, and social categories. The integration of physical rehabilitation with educational and emotional support proved to be the most influential factor in improving functional independence and participation in daily and classroom activities.

Comparable to the principles of the A.MO.GIOCO model, which focuses on task-oriented motor learning through play and parent involvement, the results of Foscan et al., (2024)show the value of play-based and functionally meaningful activities in improving psychomotor results in children with cerebral palsy. The A.MO.GIOCO approach, developed as a structured yet flexible framework focused on child motivation and active participation, aligns closely with our research. Both approaches prioritize contextual learning, sensory-motor integration, and emotional engagement as important components of neuroplastic change and functional improvement.

The study by Klaić et al. further shows the concept that multidimensional assessment is important for effective educational and rehabilitation planning for students with cerebral palsy. Their contextual evaluationconducted both in clinical and school environmentsconfirms that understanding the abilities of the child requires an integrative perspective including motor, cognitive, emotional, and environmental factors. Similarly, our resultsshow that comprehensive assessment and individualized intervention are inseparable

processes; only by analyzing both internal and contextual conditions can teachers and therapists design interventions that truly promote learning participation and inclusion.

The Porridge-Like Framework proposed by Provenzi et al. (2021) adds an important family-centered dimension to the understanding of multidimensional rehabilitation and education in children with developmental disabilities. By conceptualizing the parent-child dynamic through the ABCD model including affective, behavioral, cognitive, and disability-related components, the authors show that effective child rehabilitation must also include emotional and psychological support for families. This connects with our results where parental involvement and emotional stability were found as important determinants of the adaptive progress and motivation of the child.

Limitations and future directions

This research is based on a single case analysis, which limits the generalizability of the results. Although the multidimensional framework provided informationabout the interaction between psychomotor rehabilitation and inclusive education, its applicability to broader populations of children with cerebral palsy requires further validation. The assessment tools and observations were context-specific, and the absence of long-term follow-up data restricts the evaluation of sustained outcomes.

Future research should focus on larger longitudinal researches that combine quantitative and qualitative methodologies to explore the effects of integrated special education and rehabilitation programs. Comparative research across various educational environments would help identify the contextual factors that enhance inclusion and functional independence. Future researches should examine family-centered and digital-supported rehabilitation with aim to optimize accessibility and continuity of care within both clinical and school environments.

CONCLUSION

This researchshowed that a multidimensional framework integrating psychomotor rehabilitation, cognitive stimulation, emotional regulation, and inclusive education can improve functional independence and participation in children with cerebral palsy. The resultsshow that coordinated collaboration among rehabilitation workers, teachers and families creates the most favorable conditions for developmental progress. The structured assessment of motor, emotional, and learning abilities allowed for individualized goal and measurable improvements across all domains.

The results view rehabilitation and education not as separate entities, but as interdependent components of an integrated developmental system. Future rehabilitation programs should continue to integrate physical, emotional, and educational interventions in natural environments, making sure that therapeutic gains translate into daily functioning and school success. The multidimensional framework presented here serves as both a clinical and educational model for promoting inclusion, autonomy, and lifelong learning in children with cerebral palsy.

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