Fundamental Movement Skills in Highland Areas Baturraden

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Abstract

This study addresses the limited understanding of fundamental movement skills (FMS) among primary school children living in highland environments. Unique physiological and environmental factors in mountainous regions can distinctively influence motor competence, yet empirical data remains scarce. The aim of this research was to assess locomotor performance and object control among children residing in highland areas. Employing a quantitative cross-sectional design, motor skill assessments were administered to 30 students using a standardized test battery. Quantitative data were analyzed using descriptive statistics. The results indicate that while children in highland areas demonstrate superior cardiovascular endurance and lower-body strength, their object control abilities lag behind expected developmental benchmarks; specifically, 60% (18 children) scored in the "Below Average" range, and 40% (12 children) scored in the "Poor" range. In conclusion, geographical and environmental conditions play a significant role in shaping specific aspects of motor competence. Furthermore, highland regions often lack the advanced educational innovations and sports clubs found in urban areas. These findings highlight the need for a tailored physical education curriculum that addresses local environmental constraints to foster balanced motor development within highland communities.

Keywords: Fundamental Movement Skills; Highland Areas; Children

I. INTRODUCTION

Mastery of fundamental movement skills in elementary school children is a crucial element underlying motor competence, long-term physical activity participation rates, and overall physical and psychological health (Branje et al., 2022). Conceptually, fundamental movement skills are divided into two main domains: locomotor skills, which involve moving the body from one point to another such as running, jumping, and sliding. For manipulative skills (object control), which involve the ability to project, receive, or control an object, such as hitting, catching, kicking, and throwing a ball (Ludyana et al., 2022).

Early to middle childhood (ages 3 to 10 years) represents a crucial phase in the human lifespan for building the foundation for optimal motor development. During this golden period, children ideally develop fundamental movement skills (FMS). FMS refers to organized movement patterns that serve as the alphabet or building blocks for mastering more complex sports skills, recreational activities, and lifelong movement habits. Mastery of FMS impacts not only physical performance alone but also has a systemic correlation with various aspects of holistic child development.

A high level of motor competence in children is positively associated with long-term physical activity participation rates, increased cardiorespiratory fitness, muscular strength, prevention of obesity risk, and enhanced physical literacy. Beyond the physical domain, mastery of basic movement also significantly contributes to psychosocial and cognitive domains, such as increased self-confidence, perceived motor competence, social integration

with peers, and executive brain functions (Bardid et al., 2016). Conversely, children who experience delays in FMS development tend to withdraw from group play activities, experience reduced physical self-confidence, and risk adopting a sedentary lifestyle into adulthood.

Physical education in elementary schools serves as a planned form of education aiming to build physical literacy, which encompasses motivation, confidence, and physical competence in students to remain actively engaged in lifelong movement. This subject is inclusively designed to develop basic motor skills, cognitive functions, and healthy living behaviors through adaptive and enjoyable movement-based learning experiences. During elementary school, students spend most of their time playing with peers in school and residential environments. Highland environments naturally shape children's physical adaptation and daily movement behaviors in mountainous regions. This challenging topography encourages optimal increases in cardiovascular endurance and lower extremity muscle strength. However, this regional condition also leads to limited formal sports facilities and a lack of innovative physical education learning compared to urban areas (Gustian et al., 2023).

Research conducted by Ramadhani et al. (2024) revealed that children in highland areas exhibit distinct physical adaptations due to habits of engaging in activities on steep and uneven terrain. However, their coordinated motor skill scores require improvement through variations in physical learning media due to limited sports facilities in mountain schools. According to Hidayat and Winarno (2022), children in high-altitude areas possess natural physical advantages in locomotor skills and physical endurance due to daily mobility demands, but require specialized interventions from physical education teachers to train manipulative skills such as throwing, catching, and hitting to ensure balanced development.

In modern theoretical perspectives on motor development, there is a common misconception that fundamental movement skills will develop automatically alongside increasing age and biological maturation. Ecological and dynamic systems perspectives strictly reject this deterministic view, emphasizing that motor development is the result of complex and dynamic interactions between the individual, the movement task, and the environment. Specifically, skills in object control subtests feature a significantly higher level of biomechanical and neuro-cognitive complexity compared to locomotor skills. Mastering manipulative skills such as throwing or striking a ball requires precise sensory-motor integration, spatial-temporal mastery, visual perception integration, and control over joint degrees of freedom.

Therefore, object control skills are instruction-dependent, meaning their mastery cannot be acquired spontaneously solely through directionless free play; rather, it requires structured pedagogical instruction, proper technical demonstration, continuous feedback, and specific, repeated practice (task-specific practice). Without targeted stimulation from a formal learning environment, children are highly vulnerable to adopting inefficient movement patterns (maladaptive patterns) that are difficult to correct at later age stages.

Based on the Socio-Ecological Model, living environments and geographic conditions play a powerful role in shaping children's physical activity patterns and motor competence. Differences in regional characteristics such as urban, rural, or specialized geographic areas like highlands and mountainous regions create a unique constellation of facilitators and barriers to motor development. Highland and mountain regions offer distinct natural conditions; from a physiological adaptation perspective, children raised in mountainous areas are naturally exposed to steep terrain, hilly contours, and challenging geographic elevations. Daily mobility, such as walking to school and exploring hillsides, acts as a form of natural conditioning that constantly trains cardiovascular capacity, respiratory systems, as well as lower body muscular strength and endurance.

On the other hand, mountainous geographic conditions often create significant physical and structural barriers to the development of manipulative skills. Most settlements and educational facilities in highland areas face limited availability of flat surfaces adequate for building standardized sports facilities. The absence of flat fields, limited variety of ball-based sports equipment, isolation from access to professional sports clubs, and lack of physical education learning innovations in rural mountain areas act as environmental constraints that hinder the frequency of object control practice in children.

Although literature regarding FMS has grown rapidly, the majority of published studies to date still focus on child populations in urban or lowland areas with relatively homogeneous and adequate educational infrastructure. There remains a gap in empirical data regarding how the specificity of highland environments affects children's motor competence profiles in detail, particularly in developing countries like Indonesia that possess vast mountainous regions. The highland region of Baturraden, situated on the slopes of Mount Slamet in Banyumas Regency, Central Java, represents an ideal model of a rural mountainous area. Elementary school children in this region live within a geographic environment characterized by high elevation and hilly terrain, where preliminary observations indicate a unique disparity: children in Baturraden possess high potential in physical endurance and leg strength, but their ability to control objects or play ball remains concerning and lags far behind standard benchmarks for their age development.

Based on this background and research gap, this study aims to comprehensively analyze fundamental movement skill profiles (locomotor and object control subtests) in elementary school students in the Baturraden highlands using the standardized Test of Gross Motor Development–Second Edition (TGMD-2) instrument, map Gross Motor Quotient (GMQ) achievement levels and frequency distributions of motor ability categories, and elaborate on the neuro-physiological, biomechanical, and socio-ecological factors driving this disparity. The findings of this study are expected to make a theoretical contribution to the development of physical education and geography-based exercise physiology sciences, while simultaneously serving as a practical foundation for formulating adapted physical education curricula and equipment modification strategies in highland regions.

Based on the problem description and referencing preliminary observations at elementary schools in the Baturraden highland area, teachers have delivered physical education instruction well and interactively, tailored to the school's available conditions and equipment. However, high-altitude regions frequently lack educational innovation and advanced sports clubs compared to urban areas. Students' motor development can be influenced by their school environment, as observed in highland regions.

This study aims to evaluate locomotor and object control performance in children residing in highland areas, particularly elementary school students in the Baturraden region. By objectively mapping children's fundamental movement skill profiles, this study seeks to understand how physiological adaptation and mountainous environments influence their motor competence. The findings of this study are intended to identify local barriers and provide an empirical basis for formulating tailored physical education curricula to overcome sports facility limitations in highland areas and foster balanced motor development in children.

II. METHOD

This study uses a quantitative cross-sectional research design with a survey method to obtain an objective overview of the fundamental movement skill profile of elementary school students in the Baturraden highland region. Quantitative data were analyzed using descriptive statistics.

This study utilized a testing instrument. A test is a data collection method involving structured tasks assigned to individuals or groups to generate numerical scores compared against specific standards. The research was conducted in September 2026. Motor skill assessments were performed on 30 students at Karangmangu State Elementary School, Baturraden.

The testing instrument used in this study was the Test of Gross Motor Development–Second Edition (TGMD-2). This instrument is designed to assess the quality and level of mastery of fundamental movement skills in children aged 3–10 years, specifically skills involving gross body movements through the evaluation of locomotor and object-control competencies. The TGMD-2 evaluates 12 fundamental movement skills divided into two primary subtests: six locomotor tests (run, gallop, hop, leap, horizontal jump, and slide) and six object-control tests (striking a stationary ball, stationary dribble, catch, kick, overarm throw, and underhand roll).

The TGMD-2 instrument possesses high validity and reliability. Testing of this instrument demonstrated significant validity, with a calculated t-value 2.27 > t table 1.65, and a high reliability coefficient of 0.765 (Apriyani et al., 2018). Test administration began with clear verbal instructions and movement demonstrations, and each student was given two trials to be evaluated on specific performance criteria using binary scoring (1 = criterion fulfilled, 0 = criterion unfulfilled). Each test item in the TGMD-2 is evaluated against item-specific performance criteria. The locomotor subtest encompasses six movements are run (4 criteria), gallop (4 criteria), hop (5 criteria), leap (3 criteria), horizontal jump (4 criteria), and slide (4 criteria). The object-control subtest consists of striking a stationary ball (5 criteria), stationary dribble (4 criteria), catch (3 criteria), kick (4 criteria), overarm throw (4 criteria), and underhand roll (4 criteria). Based on the accumulation of these criteria indicators, students can achieve a total raw score ranging from 0 to 48.

Subtest raw scores for locomotor and object control were converted using normative tables to derive standard scores ranging from 1 to 20 and percentiles rank ranging from ≤1 to ≥99. Subsequently, the two standard scores were summed and converted again to determine the Gross Motor Quotient (GMQ), which ranges from 46 to 160, along with the overall composite percentile rank. Quantitative data were analyzed using descriptive statistics to calculate percentages, frequency distributions, and the categorization of GMQ scores based on the *Sums of Standard Scores to Percentiles and Quotients*" normative table to comprehensively identify students' motor achievement levels.

Table 1. TGMD-2 Normative Table

Standard Score	Percentile Rank	Gross Motor Quotient (GMQ)	Kategori
17–20	≥ 99	≥ 130	Very Superior
15–16	95–98	120–129	Superior
13–14	84–94	110–119	Above Average
8–12	25–83	90–109	Average
6–7	9–24	80–89	Below Average
4–5	2–8	70–79	Poor
1–3	≤ 1	≤ 69	Very Poor

For the next, the data obtained through the Test of Gross Motor Development–Second Edition (TGMD-2) instrument were analyzed using percentage calculations with the following formula:

$$P = \frac{f}{n} \times 100\%$$

Remarks:

P : percentage score

f : observed frequency

n : total number of participants / total frequency

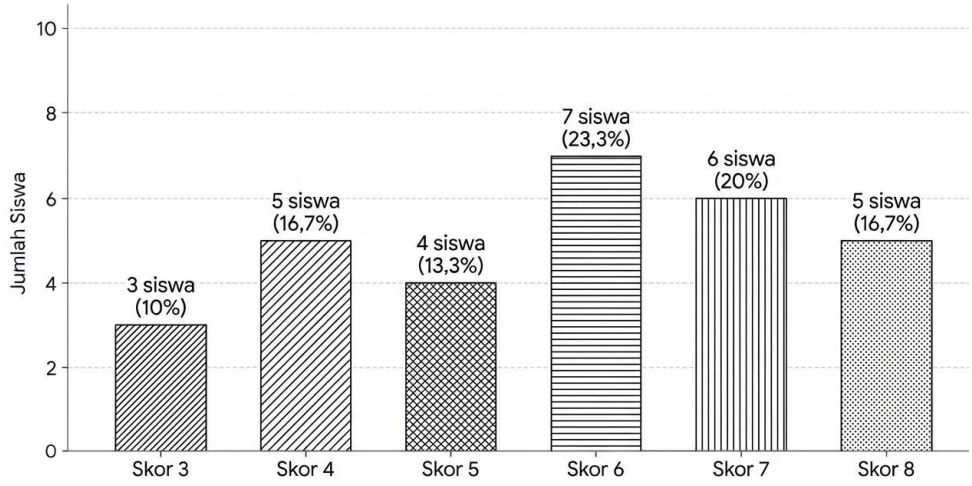
III. RESULTS AND DISCUSSIONS

A. Result

The assessment of fundamental motor skills in 30 students at Karangmangu State Elementary School, Baturraden, revealed a disparity between the physical capacity profile (cardiovascular endurance and lower body strength) and the level of object control mastery. Based on the evaluation of the object control subtest in the Test of Gross Motor Development–Second Edition (TGMD-2), the entire sample fell below the average standard for age-appropriate motor development.

The raw data of the object control subtest results are presented in Table 2, and the frequency distribution of the students' object control ability categories is presented in Table 3.

Table 2. Raw Data of Object Control Subtest Results



Based on the evaluation of 30 students at SD Negeri Karangmangu Baturraden, all students (100%) scored below the average standard on the TGMD-2 object control subtest, consisting of 18 students (60%) in the "Below Average" category and 12 students (40%) in the "Poor" category. The distribution of student scores ranges from 3 to 8, specifically with 3 students (10%) scoring 3, 5 students (16.7%) scoring 4, 4 students (13.3%) scoring 5, 7 students (23.3%) scoring 6 as the highest concentration, 6 students (20%) scoring 7, and 5 students (16.7%) scoring 8. This low mastery of object control skills contrasts sharply with their locomotor and physical fitness indicators, where students consistently demonstrated prime cardiovascular endurance and lower extremity muscle strength during the run, hop, leap, and horizontal jump tests.

Table 3. Frequency Distribution Data of Students' Object Control Ability Categories

No	Raw Score Range	Subtest Standard Score	Percentile Rank	Evaluation Category	Number of Students (*n*)	Percentage (%)
1	≥38	12 – 20	>75	Above Average	0	0%
2	28 – 37	8 – 11	25 – 75	Average	0	0%
3	20 – 27	6 – 7	9 – 24	Below Average	18	60%
4	≤19	1 – 5	<9	Poor	12	40%

Based on Table 3, a total of 18 students (60%) scored in the "Below Average" category, while 12 students (40%) fell into the "Poor" category. No students reached the "Average" or "Above Average" categories in the object control test, which encompasses striking, dribbling, catching, kicking, throwing, and rolling a ball. Conversely, in the analysis of locomotor criteria indicators and physical fitness, students consistently demonstrated excellent cardiovascular endurance and lower extremity muscle strength during the run, hop, leap, and horizontal jump tests.

Simply, the findings of this study reveal a unique contrast between the natural physical strength of the children in Baturraden and their ability to play with equipment or a ball. As they grow up and go about their daily lives in a hilly, mountainous region with steep slopes, these children possess remarkable stamina, strong legs, and are agile when running and jumping. Their living environment naturally fosters a fit physique and a resistance to fatigue.

However, the situation is very different when the children are asked to perform movements involving objects, such as throwing, catching, kicking, bouncing or hitting a ball. Not a single child was able to reach the average standard for their age; all pupils fell into the 'poor' to 'very poor' categories.

This indicates that ball-handling skills do not develop simply through the habit of walking or playing on hillsides. Playing with a ball requires precise hand-eye-foot coordination, as well as supporting facilities such as a flat pitch, suitable balls, and guidance on the correct way to play from a teacher. Without the necessary equipment and regular practice, children's ability to control an object will lag behind, even though they are actually physically very strong.

An in-depth explanation regarding qualitative deficits in specific TGMD-2 performance indicators reveals that students' low object control scores are predominantly caused by an inability to master basic biomechanical patterns. In the overarm throw skill, the majority of students failed to perform trunk rotation and step with the opposite foot; they tended to throw relying solely on arm thrust (arm-dominated throw). Similarly, in striking a stationary ball, most children showed no weight transfer from the back foot to the front foot, alongside an absence of effective hip rotation. In the catching task, children frequently exhibited a protective or rigid arm response due to a lack of familiarity with the ball's trajectory. The lack of mastery over these technical elements underscores that without guided kinesiological practice and structured repetition, children cannot independently discover efficient kinetic chain coordination.

Psychosocially, this lag in the object control domain carries serious implications for the formation of children's perceived motor competence and physical literacy. Manipulative skills such as kicking, throwing, and catching form the core foundation of most popular team-based

sports games, such as soccer, volleyball, and rounders. When children in highland areas become aware of their limitations in ball handling, a tendency arises to withdraw from group play activities or feel less confident when participating in structured sports activities. This systemic impact potentially triggers a spiral of disengagement, where a decline in perceived competence leads to reduced motivation to move, ultimately constraining opportunities for their motor skill development in adolescence.

Regarding ecological comparisons and motor development trajectories, when compared to the motor development dynamics of children in urban areas, these findings reveal a stark ecological contrast. Urban children generally enjoy much more abundant access to sports facilities, ball-based play equipment, and structured instruction through clubs or extracurricular activities, thereby tending to record higher object control scores even though their baseline physical fitness capacity may not match that of mountain children. Therefore, the disparity identified among students at SD Negeri Karangmangu, Baturraden should not be viewed as a limitation of the children's biological potential, but rather as a direct consequence of environmental deprivation in terms of manipulative movement experiences. This point reinforces the urgent need for learning environment engineering through targeted pedagogical interventions to align the natural physical capacity advantages of highland children with holistic motor skill mastery.

To address these environmental and instructional limitations, strategic interventions must prioritize pedagogical modifications and contextualized learning strategies tailored to the unique conditions of highland schools. Physical education practitioners should leverage the students' superior physical endurance and lower-body strength by integrating game-based manipulative tasks that demand dynamic movement, such as target-throwing and ball-tracking games adapted for non-standard or uneven spaces. Furthermore, in response to the scarcity of standardized sports infrastructure, teachers can utilize modified, low-cost equipment (e.g., lightweight soft balls, improvised target zones) to maximize repetition frequency and safely encourage proper kinetic chain execution. Implementing structured, task-specific instruction alongside these environmental adaptations will not only bridge the manipulative skill deficit, but also empower children in highland regions to achieve well-rounded motor competence and sustained engagement in physical activities.

B. Discussion

The study revealed a significant discrepancy between physical endurance and manipulative skills (object control) among elementary school students in the Baturraden highland region. Superiority in cardiovascular endurance and lower body strength is strongly influenced by geographical conditions and daily physical activity habituation. Highland students routinely engage in moderate-to-vigorous locomotor activities, such as walking across hilly and inclined terrain. This environmental adaptation triggers cardiorespiratory efficiency and functional hypertrophy of lower extremity muscles from an early age.

These findings align with research by Suherman and Firmansyah (2021) who found that children in highland areas exhibit higher levels of physical fitness and aerobic capacity compared to those in lowlands due to exposure to natural topography that demands continuous physical effort. However, geographical conditions alone do not automatically promote the maturation of manipulative motor skills, as mastering object control requires structured instructional stimuli and specific repetitions.

Physiologically, daily physical activity in highland areas exerts consistent metabolic and mechanical stress on the cardiovascular system and lower extremity muscle groups. This adaptation occurs naturally as a functional bodily response to the challenges of gravity and geographical elevation, thereby fostering superior aerobic capacity and robust muscular endurance. However, this physical fitness domain differs fundamentally from the domain of manipulative motor coordination. Object-control skills do not rely solely on muscle mass or oxygen utilization efficiency, but rather on the maturity of the central nervous system in integrating sensory information with precise motor responses.

Mastery of manipulative skills such as throwing, striking, catching, and kicking a ball heavily depends on the formation of motor patterns within the brain's motor cortex. This neuro-cognitive process requires a complex synergy among visual perception, spatio-temporal awareness, and neuromuscular coordination to control the body joints' degrees of freedom. For instance, striking a stationary ball requires a child to gauge the ball's position, shift body weight from the back foot to the front foot, sequentially rotate the hips and shoulders, and direct the bat to the exact contact point within milliseconds. This biomechanical complexity cannot be acquired spontaneously merely through habits of exploring or walking across hilly terrain.

Consequently, object-control skills are instruction-dependent, meaning that their movement maturity necessitates explicit pedagogical stimulation and correct technical demonstrations. Without structured instructional guidance from educators, children tend to adopt inefficient motor patterns. Furthermore, the motor learning process requires continuous feedback, encompassing both intrinsic feedback from sensory bodily perception and extrinsic feedback via technical corrections from teachers. This feedback enables the child's brain to make microscopic adjustments on each movement trial to achieve mechanical accuracy.

Another crucial factor differentiating the development of physical capacity from manipulative skills is the requirement for task-specific practice. The formation of stable neural pathways within the brain requires hundreds to thousands of quality movement repetitions. In highland regions, the scarcity of ball-based sports equipment and the lack of flat playing areas directly limit the frequency of practice trials available to children. When children rarely have opportunities to hold, throw, or bounce a ball within a structured learning environment, their nervous system does not receive adequate stimulation to consolidate these skills into automatic movement habits. As a result, despite highland children possessing a highly potential foundation of physical fitness and strength, deficits in object control will persist as long as their learning environment fails to provide adequate and targeted manipulative experiences.

The low level of object control achievement, specifically 60% Below Average and 40% Poor indicates a lack of motor learning experiences involving equipment manipulation (object-manipulative skills). Unlike locomotor movements that develop through natural environmental exploration, object control skills such as striking, overarm throwing, and underhand rolling depend heavily on the availability of sports facilities and equipment, varied Physical Education (PE) instructional modules, and specific practice opportunities (Hanief & Sugito, 2015). Limited sports equipment and a scarcity of flat playing areas in highland school environments are indicated as key factors hindering students' hand-eye and foot-eye coordination.

The asymmetrical motor achievement among students in the Baturraden highland area indicates that motor development is shaped by the interaction among individual, environmental, and task constraints. Among students at Karangmangu State Elementary School, Baturraden, individual constraints are characterized by excellent physical and physiological capacity, such as strong leg muscles and high stamina. However, environmental constraints—such as uneven mountainous topography and frequently wet, foggy weather,

limit the availability of flat open spaces for ball games. Coupled with a lack of varied task constraints involving external factors during development, children's motor development becomes asymmetrical; bodily functions adapt exceptionally well to environmental challenges but remain unaccustomed to tool-based mechanical tasks (Haywood & Getchell, 2019).

Beyond environmental constraints, this disparity is influenced by perceptual-motor integration and visual-spatial processing. Object control skills, such as overarm throwing and striking a ball, require complex hand-eye coordination as well as spatial-temporal awareness. In mountainous regions, children's sensory habituation is predominantly focused on foot-eye coordination to maintain body balance on slippery and stepped terrain. Children's eyes are more accustomed to predicting footing rather than tracking ball trajectories in the air. Consequently, their visual-spatial processing is highly mature for terrain navigation via locomotion, but has not been optimally integrated for manipulating airborne objects (Pratama & Sukoco, 2021).

The socio-cultural perspective regarding the rural play culture of children further reinforces these findings. Independent play activities undertaken by students outside school hours are generally exploratory and natural such as climbing trees, jumping over ditches, or roaming hills which do not require specialized play equipment. Conversely, games involving object manipulation, such as kasti (a traditional bat-and-ball game) or volleyball, require specific equipment and structured fields that children rarely access without adult supervision. Without a routine ball-playing culture in their living environment, the frequency of repetitive trials required by the central nervous system to form muscle memory for object control remains severely limited.

The phenomenon of divergent development between locomotor and object control skills illustrates that object control skills do not automatically mature with age, but rather must be explicitly taught. Children who do not receive appropriate instructional interventions and specific feedback tend to experience developmental delays in object control subtests, despite possessing adequate physical fitness and locomotor movement skills. The scientific implications of this study highlight the need to reorient the Physical Education curriculum in highland elementary schools. PE teachers should not rely solely on students' natural physical activity, but must systematically design specific intervention programs based on manipulative games to bridge the gap in fine and gross motor coordination for object control mastery.

Based on the synthesis of all the findings and theoretical reviews above, it is evident that targeted interventions are urgently needed in highland elementary schools. Physical Education (PE) teachers in Baturraden and other mountainous regions must not remain passive or merely rely on students' natural physical activity. There is a need to reorient learning strategies specifically designed to overcome local geographical and environmental barriers:

A. Implementation of Equipment and Facility Modification Strategies

To address equipment and land constraints, PE teachers should adopt a modified sports equipment approach. The absence of flat playing fields must not serve as a justification for halting object-control instruction. Teachers can utilize lighter foam balls, modified plastic balls, bats made of PVC or lightweight wood with wider contact surfaces, and leverage safe school walls or hallways as rebounding surfaces. Research by Firmansyah et al. (2022) demonstrates that using modified equipment significantly increases children's practice repetitions and success rates in striking or catching a ball, ultimately enhancing their self-confidence and perceived competence.

B. Design of Fun Manipulative Game Programs Based on TGMD-2 Criteria

Physical Education instruction should integrate enjoyable manipulative games while remaining aligned with TGMD-2 technical criteria. For example, to train the overarm throw,

teachers can design target-throwing games against walls with colorful targets that require students to execute an opposite-foot step. To train striking, the movement can be progressionally broken down, starting from hitting a large stationary ball to hitting a slow-moving ball.

C. Utilization of Natural Physical Potential as a Modality

Students' superior cardiovascular endurance and leg muscle strength should be leveraged as a foundational modality for acquiring more complex object-control skills. For instance, teachers can combine already mastered locomotor movements, such as jumping or running with manipulative tasks, such as catching a ball in mid-air or kicking a ball following an accelerated sprint.

D. Community Partnerships and Provision of Structured Play Spaces

Local governments and school administrations need to collaborate to allocate flat and safe green open spaces or public facilities in mountainous rural areas. Providing simple facilities such as table tennis tables, plastic volleyball courts, or traditional ball-based games can foster a healthy and balanced play culture outside of school hours.

Through planned pedagogical interventions adapted to environmental conditions, the deficit in object-control skills among children in the Baturraden highland region can be overcome ensuring they are not only physically resilient and fit, but also competent and confident in mastering a wide range of lifelong motor activities.

IV. CONCLUSION

The conclusions of this study confirm that geographical and environmental conditions play a highly significant role in shaping specific dimensions of children's motor competence, whereby superior physical capacity and locomotor skills are not automatically matched by maturity in object-control skills. Highland regions often face limitations in infrastructure, a lack of flat open spaces, and a dearth of pedagogical innovation and access to structured sports clubs, such as those that are rapidly developing in urban areas. This disparity in facilities and training experiences widens the gap in pupils' manipulative skill development. Consequently, these findings highlight the importance of adapting the physical education curriculum to local environmental characteristics through planned, manipulative-play-based programme interventions, to facilitate the achievement of holistic, comprehensive and balanced motor development for children in highland communities.

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