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Multilateral Movement Analysis in Elementary School Students Using Fundamental Movement Skill Method based on Territory

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ABSTRACT

Developing Fundamental Movement Skills (FMS) is critical for a child physical, cognitive, and social growth. While previous studies have explored FMS in general, the influence of territorial environments remains underexamined. This study used a territorial-based approach to compare the elementary school student multilateral movement skills in highland and lowland areas of Banyumas Regency, Indonesia. The research employed an ex-post facto descriptive method with one group post-test design. The participants were 40 students aged 6–8 from grade 1 to 3, divided equally between highland (n = 20) and lowland (n = 20) schools. FMS was assessed by using standardized instruments covering stability, locomotor, and manipulative skills. The descriptive results indicated that both groups performed in the good category, with mean scores of 3.90 ± 0.85 for highland students and 3.60 ± 1.12 for lowland students. A paired samples t-test showed no significant difference between the two groups (p = .682). These findings suggest that an equal access to structured physical education and similar opportunities for physical activity may minimize territorial disparities. The study underscores the importance of sustaining diverse and engaging physical education programs to strengthen a child motor foundation, promote lifelong physical activity, and support holistic development in school settings.

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INTRODUCTION

Physical activity is essential for a child physical and motor development during the growth period. Physical activity and multilateral basic movements could stimulate the development of body organs, strengthen immunity, and contribute to rehabilitating or normalizing disabilities (García-Jaén et al., 2018). For elementary school students, physical activity is beneficial for physical and motor development and support intellectual growth (Putranto & Ulfah, 2020). The growth and development of children involve complex and interconnected factors shaped by innate characteristics and environmental conditions.

Physical education is a core component of the elementary school curriculum and is critical in promoting physical literacy, cognitive development, and social-emotional skills. One essential aspect of physical education is multilateral movement, which encompasses a variety of movement forms such as running, jumping, throwing, and catching (Budi et al., 2019; Macintyre, 2019; Yuniko, 2018). Multilateral movement develops motor competence and physical fitness and influences cognitive functions, social skills, and emotional well-being (Akbar & Awalludin, 2021). Despite its importance, multilateral movement is repeatedly overlooked in favor of specialized or sport-specific activities. However, research has consistently shown that varied physical activity in childhood provides a foundation for lifelong engagement in physical activity and overall health (Koolwijk et al., 2024). Studies also link multilateral movements to improvements in concentration, memory, and problem-solving skills (Capio et al., 2015; Putranto & Ulfah, 2020).

Motor development in childhood reflects physical and psychological changes across growth stages and is strongly influenced by environmental conditions (Sajid et al., 2021). One significant environmental factor is the school location and the physical context in which children practice. Mastering multilateral movement skills benefits student physical development while supporting social, emotional, and cognitive outcomes (Carballo-Fazanes et al., 2022; Gustiawati, 2016). However, these skills are shaped not only by age, gender, and physical conditions but also by external conditions, including access to facilities, open spaces, parental supports, and community physical cultures (Dewi & Yufiarti, 2021; García-Jaén et al., 2018). Students with better access to sport facilities and open spaces tend to be more active and show higher motor competence (Kusnandar et al. 2021).

The territory-based Fundamental Movement Skill (FMS) method emphasizes development motor skills by adapting physical education to local environmental characteristics. This approach enables the design of programs aligned with the needs of students in specific contexts (Yoda et al. 2024). For example, outdoor running and games are more suitable in open rural spaces, while urban contexts with limited spaces require creative and innovative movement-based activities. Physical cultures in local communities and social supports from parents, teachers, and peers further reinforce participations in physical activities. Parental involvement has significantly enhanced a child engagement in physical activity and motor skill development (Jeynes, 2017).

Although previous studies have demonstrated the importance of multilateral movements and the effectiveness of the FMS framework, little attention has been given to how territorial differences, such as highland and lowland environments, shape a child motor development. This gap highlights the need for research examining how environmental and contextual conditions influence multilateral movement abilities in diverse territorial settings. This would be the first study comparing the multilateral movement abilities of elementary school students across highland and lowland areas using the territorial-based FMS method systematically.

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This research examined the influence of territorial environments, specifically highland and lowland settings, on developing elementary school student multilateral movement abilities by applying the territorial-based Fundamental Movement Skill method. This study provided two main contributions. Theoretically, it extended the literature on motor development by clarifying the role of territorial environments in shaping FMS acquisition and demonstrating how environmental contexts interact with developmental processes in childhood. Practically, it would also offer evidence-based insights for educators and policymakers to design more adaptive, inclusive, and responsive physical education programs for the student local conditions, thereby supporting their holistic development and long-term engagement in physical activity.

METHODS

This study employed an ex-post facto descriptive method with a group post-test design (Sugiyono, 2022). This study did not include a control group and participants were not randomly assigned. The main strength of this design is that the post-test allows the observed differences in outcomes to be linked to the applied treatment. However, the absence of a control group limits internal validity because alternative explanations for the findings cannot be entirely ruled out. Similarly, the lack of randomization introduces the risk of selection bias, as pre-existing differences between groups may influence results. To mitigate these limitations, the researcher ensured that the two group demographic characteristics were comparable in age, grade level, and school conditions. In addition, standardized measurement instruments and consistent data collection procedures were applied to minimize measurement bias and enhance the reliability of the findings.

Participants

The target population consisted of elementary school students in Purwokerto, Indonesia. The sample included 40 students from Grade 1 to Grade 3, aged 6–8 years. The samples were selected by using the purposive sampling to represent students living in different territorial contexts. A total of 20 students were drawn from highland areas and other 20 were from lowland areas. However, the statistical power and justifications of the sample size were not formally established, which would weaken the robustness of the inferential analysis. The relatively small number of participants would limit the ability to detect subtle differences between groups and reduce the generalizability of the findings. Future research should address this limitation by involving larger samples and formal power calculations. In addition, reporting effect sizes, such as Cohen's d or eta squared, would help provide a clearer understanding of the magnitude of observed differences, even when statistical significance is not reached.

Sampling Procedures

Participants were recruited through collaborations with local schools. At the beginning, 46 students were approached and 40 students agreed to participate, resulting in an 87% participation rate. No payment was provided to participants or schools. The parental consent and school approval were obtained prior to the data collection. Data were collected in the school environment under the supervision of physical education teachers. Although the design did not include random assignment, the balance of participants across the two territorial groups helped minimize bias.

Materials and Apparatus

The study used Fundamental Movement Skill (FMS) instruments covering three main categories, namely stability, locomotor, and manipulative skills. Each category consisted of sub-movements assessed according to standardized criteria. Movements were classified into

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initial, elementary, and advanced developmental stages. This classification allowed for a detailed evaluation of the student motor skill proficiency across groups. The assessment provisions for Fundamental Movement Skills are described in Table 1.

Table 1. FMS Assessment Criteria

Movement Criteria	Points
Movement according to the development (Good)	3
The movement is entirely by the development (Enough)	2
Movement criteria do not match the development (Poor)	1

Source: Gallahue & Donnelly (2012)

Procedures

Implementing the Multilateral Movement test on elementary school students using the Fundamental Movement Skill (FMS) method requires a systematic and structured planning and implementation. The procedure for implementing the Multilateral Movement test for elementary school students utilizing the FMS method consists of the preparation stage, test implementation stage, data collection stage, data analysis stage, and conclusion of test result stage. At the preparatory stage, the activity consisted of determining the objectives of the Multilateral Movement test, preparing the necessary tools and materials, determining the location and time of the test, and preparing data collection instruments.

The implementation of the Multilateral Movement test was carried out by utilizing the FMS method. This method included analyzing the student ability to perform basic movements (such as running, jumping, throwing, and catching), analyzing the student ability to perform complex movements (such as running by changing direction, jumping by changing height, and throwing by changing speed), and analyzing the student ability to perform movements that require coordination (such as running by changing direction and jumping by changing height) (Eddy et al., 2020; Kasanen et al., 2023).

The data collection instrument used in the Multilateral Movement Test consisted of an observation sheet containing criteria for assessing the student ability to perform basic and complex movements. The instrument also operated a camera to record the movements of the students (Macintyre, 2019). Another equipment was a stopwatch to measure the time of the assignment completion. The Multilateral Movement test results could be used to determine the student ability to perform basic and complex movements. The results of this test could also be used to determine the student weaknesses and strengths when accomplishing these movements.

Design or Data Analysis

The data collection procedure was accomplished by conducting a basic movement test on elementary school students. After the data were obtained, the bivariate analysis was administered with data normality and homogeneity tests by using the Shapiro-Wilk test. After the prerequisites were met, a comparative analysis using the paired t-test method was followed.

RESULTS

Based on the measurement procedure carried out on 20 elementary school students in the highlands using the Fundamental Movement Skill instrument, the results are described in Table 2.

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Table 2. Results of the Fundamental Movement Skills Test for Highland Elementary School Students

No.	Category	Total	Percentage
1	Excellent	6	30%
2	Good	7	35%
3	Intermediate	6	30%
4	Poor	1	5%
5	Bad	0	0%
Total		**20**	**100%**

Table 2 presents the results of the Fundamental Movement Skill (FMS) test for 20 elementary school students in the highlands. The distribution showed that 30% achieved excellent category, 35% achieved good category, 30% achieved intermediate category, and 5% achieved poor category. None of the students fell into the bad category. The descriptive statistics indicated a mean score of 3.90 ± 0.85 (mean ± SD), reflecting an overall good performance level.

The high percentage of students who scored in the excellent and good categories suggests that the students had a good understanding of fundamental motor skills. It is encouraging as these skills are essential for participating in various physical activities. The low percentage of students who scored in the poor and bad categories suggests that many students might need additional supports in developing their fundamental motor skills. The support may include individualized instructions, extra practices, or access to specialized resources.

Overall, the results of the Fundamental Movement Skill test are positive. Most students understood the fundamental motor skill essential for physical development and well-being. However, it is vital to provide supports to the students who are struggling with these skills. The result of the multilateral movement test of elementary school students in the lowlands using Fundamental Movement Skills (FMS) can be observed in Table 3.

Table 3. Results of the Fundamental Movement Skill Test for Lowland Elementary School Students

No.	Category	Total	Percentage
1	Excellent	5	25%
2	Good	8	40%
3	Intermediate	2	10%
4	Poor	4	20%
5	Bad	1	5%
Total		**20**	**100%**

Table 3 shows the results for 20 elementary school students in the lowlands. The result found that 25% scored excellent, 40% scored good, 10% scored intermediate, 20% scored poor, and 5% scored bad. The descriptive statistics indicated a mean score of 3.60 ± 1.12, slightly lower than the highland group. Table 3 also highlights that 20% of the students scored as poor. These students might need additional supports for developing fundamental movement skills. Additionally, only 5% of the students scored in the bad category, indicating that a smaller group required more attention. It is important to note that the test only assessed fundamental movement skills. Therefore, the results might partially depict the student overall physical development or motor skills. Additionally, the sample size should be specified, making it difficult to generalize the findings.

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The results suggest that most lowland elementary school students understood fundamental movement skills well. However, it is essential to provide additional supports to students who were struggling with these skills. Future research should focus on exploring the factors that contribute to the different performance levels of students on the Fundamental Movement Skill test. The research could also investigate other factors, such as socioeconomic status, access to physical activity, and teaching practices.

A comparative test was conducted to determine the difference in the Fundamental Movement Skills retained by elementary school students in the highlands and lowlands. The test was carried out by using a simple paired t-test. When the value of sig < 0.05, there would be a difference in appearance. The comparative test results between high and lowland elementary school students can be seen in Table 4.

Table 4. Results of the FMS Skill Difference Test for Highland and Lowland Elementary School Students

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Dev.	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	FMS SD High – FMS SD Low	.0290	.31194	.06975	-.11699	.17499	.416	19	**.682**

The paired sample t-test was used to determine the significance of the difference in FMS skills between the highland and lowland elementary school students. The test results indicated no significant difference in FMS skills between the two groups (t = .416, df = 19, p = .682). The mean difference in FMS skills between the two groups was .02900, with a standard deviation of .31194. The 95% confidence interval for the difference in means ranged from -.11699 to .17499, indicating that the actual difference in means could be anywhere between these two values.

The findings of this study suggest no significant difference in Fundamental Movement Skills (FMS) between elementary school students in highland and lowland areas. This result is consistent with prior research showing that FMS proficiency does not vary significantly when children have similar opportunities for physical activities (Hardy et al., 2013; Logan et al., 2018). The absence of significant differences indicates that the geographic location alone is not a decisive factor in shaping FMS development. Structured physical education, community supports, and cultural practices that promote active plays may be more influential.

Several limitations should be acknowledged when interpreting these findings. The sample size was small (N = 40), reducing the statistical power and limiting the generalizability. The participants were within a narrow age range of 6–8 years. This limitation made capturing developmental variations across middle and late childhoods challenging. The study was conducted in one regency in Indonesia, which might limit the representation of broader geographic and cultural contexts. Using a single standardized test also restricted the assessment, as it did not capture context-specific movements or psychological and motivational factors.

The lack of significant differences between highland and lowland students must be viewed in terms of environmental and contextual conditions. Both groups had regular physical

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education classes in line with the national curriculum, providing 105 minutes of activities each week. The consistency in the curricular provision may explain the similarity in outcomes. Access to playgrounds, open spaces, and informal physical activities in daily life may also reduce disparities across regions. International studies report similar results. When structured and unstructured opportunities are equal, differences in motor competence across regions or socioeconomic groups tend to diminish (Barnett et al., 2016; Okely et al., 2017). These findings confirm that contexts and cultures are central to a child motor development.

The results have several practical implications. Schools should strengthen physical education by integrating varied and enjoyable activities that could build motor competence and sustain engagement. Tailored supports may be needed for lower-performance students, including individualized instructions, peer learning, or extra practices. Policymakers should invest in accessible facilities and safe play spaces to ensure equal opportunities for all children. Future research should use larger and more diverse samples. It should also explore socioeconomic conditions, nutrition, and parental involvements. These efforts can provide deeper insights into how childhood Fundamental Movement Skills are developed and supported.

DISCUSSION

Multilateral movement skills are essential for elementary school student physical development, motor control, and cognitive functions (Carballo-Fazanes et al., 2022). These skills involve the coordinated use of multiple body segments and systems. They enable children to perform various movements with precision, balance, and fluidity (Kasanen et al., 2023). Previous research has consistently demonstrated that developing multilateral movement skills at an early age positively influences multiple domains of life (O'Brien et al., 2023). The present findings confirm this evidence and extend it to the context of elementary school students in both highland and lowland areas of Banyumas Regency.

The results align with earlier studies that linked multilateral movement activities, such as dancing, gymnastics, and sports, with enhanced balance, coordination, agility, and flexibility (Nurulfa et al. 2021; Scott et al.2024). These activities are strongly associated with improved cardiovascular health and reduced injury risks. Cognitive research further highlights that multilateral movement stimulates brain regions responsible for motor control, spatial awareness, and problem-solving (Bikalawan et al., 2024; García-Jaén et al., 2018). The current findings show similar outcomes in both highland and lowland contexts, suggesting that the benefits of multilateral movement are consistent across geographic settings. It extends the work of O'Brien et al. (2023), who emphasized the importance of these skills in broader learning contexts, including mathematics and science.

Group-based movement activities also promote social interaction, cooperation, and teamwork. Children participating in team sports learn to communicate effectively, respect diverse perspectives, and work collaboratively towards shared goals. These outcomes support the arguments of García-Marín & Fernández-López (2020) and Liu et al. (2024), who documented the psychological benefits of cooperative physical activities. The present study reinforces these claims by showing that students in both geographic areas strongly engaged in physical activities. The results further confirm findings by Komaini et al. (2023), who identified improvements in emotional regulation, self-esteem, and self-efficacy through physical activities.

Despite the general consistency with prior research, some distinctions are worth noting. While Scott et al. (2024) found that fun-based sport activities could enhance enjoyment and sustained participations, the current study highlights that the curricular structure might also

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play an important role. As mandated by the elementary school curriculum, the fulfillment of three lesson hours (105 minutes) of physical education each week contributes significantly to positive outcomes. This observation extends the findings of Bikalawan et al. (2024) and Hadiana et al. (2023), who emphasized the motivational role of varied and engaging learning materials by pointing to the structural dimension of instructional time as an enabling factor.

The paired sample t-test results revealed no significant difference in multilateral movement skills between students in the highlands and lowlands, with a p-value of .682. This outcome contrasts with studies that reported environmental differences in motor skill development based on geographic and cultural contexts. For example, some research suggested that rural or highland areas could provide greater outdoor activity and physical engagement opportunities than urban or lowland settings. Similarities in access to physical activity opportunities across both regions, including playgrounds, parks, and organized sport programs, may explain the absence of such differences in this study. Cultural practices that value physical activity regardless of location may also account for the similarity in outcomes. This finding contributes to the literature by suggesting that the geographic location alone may not strongly determine the multilateral movement skill development when structural and cultural factors are comparable.

The paired samples t-test indicated no significant difference in Fundamental Movement Skills (FMS) between highland and lowland elementary school students ($t = .416$, $df = 19$, $p = .682$). This result is consistent with previous studies showing that when children have similar opportunities for physical activities, FMS proficiency tends not to vary significantly across geographic or socioeconomic backgrounds (Hardy et al., 2022; Logan et al., 2018). The absence of differences suggests that structured physical education, community supports, and cultural practices that encourage active plays may be more decisive factors than the location alone. Nevertheless, some students scored in the poor and bad categories. International research indicates that such outcomes may be associated with the limited access to facilities and equipment (Hardy et al., 2022), low levels of fitness or overweight conditions (Wiersma et al., 2023), insufficient parental supports or community engagement in physical activities (Zhang et al., 2024), and low perceived motor competence or motivations in physical education contexts (Williams et al., 2022).

Several limitations must be noted. The small sample size ($N = 40$), the narrow age range (6–8 years), and the focus on a single regency reduced the generalizability of findings. In addition, using one standardized FMS test may not fully capture the complexity of motor development across cultural and psychological dimensions. The relatively similar provision of physical education, 105 minutes per week mandated by the national curriculum, and the access to play opportunities may explain the lack of territorial differences, as reported in international studies (Barnett et al., 2016; Okely et al., 2017). These findings underscore that environmental and cultural contexts are central mediators of motor development. Practically, schools should design more varied and engaging physical education programs and provide tailored supports for low-performing students. At the same time, policymakers should invest in accessible facilities and safe play spaces to ensure equal opportunities for all children.

Several limitations must be acknowledged. The sample size was relatively small, 40 students, which would restrict the generalizability of the findings. The geographic scope was limited to one regency in Indonesia, which might not represent broader regional or national variations. The participants were elementary school students aged 6–8 years, so the results might not apply to older age groups or to different stages of motor development. These limitations suggest that the findings should be interpreted cautiously and viewed as preliminary evidence rather than definitive conclusions.

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Future research should build on this study in several directions. Larger and more diverse samples across different geographic regions of Indonesia and beyond would strengthen the external validity of the findings. Cross-cultural studies could provide valuable insights into how cultural values, traditions, and social practices shape the development of multilateral movement skills. Future studies should also examine the role of teaching practices, particularly the quality and structure of physical education instructions, in fostering skill acquisitions. In addition, socioeconomic factors should be considered, as differences in household resources and parental involvements may influence access to physical activities. Longitudinal research could also track how multilateral movement skills evolve across developmental stages and contribute to academic performance, emotional regulations, and long-term health outcomes.

In conclusion, this study contributes to the growing body of evidence on the importance of multilateral movement skills for elementary school student physical, cognitive, social, and emotional development. The findings suggest that geographic locations, in this context, had a relatively minor influence on these skills when opportunities for physical activities and curricular structures are comparable. The study underscores the significance of structured physical education in supporting the student health and character formation. These insights hold important implications for theory by refining understandings of motor skill development and for practice by informing the design of effective school-based physical education programs as well as for policy by reinforcing the importance of maintaining or expanding the curricular time devoted to physical education in elementary schools.

CONCLUSION

This study examined multilateral movement skills among elementary school students in highland and lowland areas. The findings indicated that students from both groups achieved results in the good category, with no significant differences observed between locations. These findings suggest that the geographic setting alone may not be decisive in shaping multilateral movement skills. However, the conclusions should be interpreted cautiously due to the limited sample size, narrow age range, and reliance on a single standardized test. Despite these limitations, the study underscores the importance of multilateral movement activities in enhancing a child motor development. It also highlights the role of structured physical education in supporting physical literacy, cognitive development, and social-emotional growth during elementary school periods. Future research should involve larger and more diverse samples across different geographic, cultural, and socioeconomic contexts. It should also examine the influence of teaching practices, family supports, and school environments in shaping a child movement skills. The findings provide valuable insights for educators, policymakers, and curriculum developers. Strengthening opportunities for varied and enjoyable physical activities can help build strong motor foundations, promote lifelong engagement in physical activity, and support broader health promotion goals in elementary education.

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AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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