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IMPROVING GAIT REGULARITY AND LOCOMOTOR BALANCE USING FOOTPRINT MARKERS IN STUDENTS WITH PHYSICAL DISABILITIES

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Abstract

Locomotor skills are fundamental components of motor development among elementary school students, particularly for students with motor impairments who often experience difficulties in coordination, step regularity, and movement balance. This study aimed to improve step regularity and locomotor movement balance through the implementation of *footprint marker* media based on the Direct Instruction model among fourth-grade elementary school students with motor impairments. This study employed a Classroom Action Research (CAR) approach using the Kemmis and McTaggart model, which was conducted in two cycles consisting of planning, action, observation, and reflection stages. The research participants were two fourth-grade students with motor impairments at SDN 009 Rantau Pulung. Data were collected through observation, documentation, and field notes, and were analyzed using descriptive quantitative and qualitative approaches. The results showed a gradual improvement in students' locomotor abilities from the pre-cycle stage to Cycle II. The use of *footprint marker* media provided visual stimuli that helped students understand stepping patterns and movement directions, while the Direct Instruction model supported learning through demonstration, guided practice, immediate feedback, and gradual reduction of assistance. The findings indicate that the integration of *footprint marker* media and Direct Instruction effectively improved step regularity, movement balance, and independence among students with motor impairments. This study provides practical implications for the development of adaptive physical education learning that is more concrete, systematic, and inclusive.

Keywords: footprint marker, Direct Instruction, locomotor skills, movement balance, motor impairments, adaptive physical education

Abstrak

Keterampilan gerak lokomotor merupakan aspek fundamental dalam perkembangan motorik siswa sekolah dasar, terutama bagi siswa dengan hambatan motorik yang sering mengalami kesulitan dalam koordinasi, keteraturan langkah, dan keseimbangan gerak. Penelitian ini bertujuan untuk meningkatkan keteraturan langkah dan keseimbangan gerak lokomotor melalui penerapan media footprint marker berbasis Direct Instruction pada siswa kelas IV sekolah dasar dengan hambatan motorik. Penelitian menggunakan pendekatan Penelitian Tindakan Kelas (PTK) dengan model Kemmis dan McTaggart yang dilaksanakan dalam dua siklus, masing-masing terdiri atas tahap perencanaan, tindakan,

observasi, dan refleksi. Subjek penelitian berjumlah dua siswa kelas IV di SDN 009 Rantau Pulung yang mengalami hambatan motorik. Data dikumpulkan melalui observasi, dokumentasi, dan catatan lapangan, kemudian dianalisis menggunakan pendekatan deskriptif kuantitatif dan kualitatif. Hasil penelitian menunjukkan adanya peningkatan kemampuan gerak lokomotor secara bertahap dari kondisi pra-siklus hingga Siklus II. Penggunaan footprint marker memberikan stimulus visual yang membantu siswa memahami pola pijakan dan arah gerakan, sedangkan model Direct Instruction mendukung pembelajaran melalui demonstrasi, latihan terbimbing, umpan balik langsung, dan pengurangan bantuan secara bertahap. Temuan penelitian menunjukkan bahwa integrasi media footprint marker dan Direct Instruction efektif meningkatkan keteraturan langkah, keseimbangan gerak, serta kemandirian siswa dengan hambatan motorik. Penelitian ini memberikan implikasi bagi pengembangan pembelajaran pendidikan jasmani adaptif yang lebih konkret, sistematis, dan inklusif.

Kata kunci: *footprint marker, Direct Instruction, keterampilan lokomotor, keseimbangan gerak, hambatan motorik, pendidikan jasmani adaptif*

INTRODUCTION

Fundamental Movement Skills (FMS) are a primary foundation of children's motor development and play an essential role in supporting physical activity, sports participation, and the development of an active lifestyle across the lifespan. FMS consist of three main components: locomotor skills, object-control skills, and stability skills. These three components develop progressively throughout childhood and serve as prerequisites for mastering more complex sports skills at subsequent educational levels. Various systematic reviews have demonstrated that interventions focusing on FMS development significantly improve children's motor competence while also producing positive effects on physical fitness, daily physical activity, and long-term health (Koolwijk et al., 2024; Zhang et al., 2024).

Among the various components of FMS, locomotor skills are among the most frequently used basic abilities in daily activities because they involve moving the body from one place to another through walking, running, jumping, hopping, skipping, and moving in different directions. These movements require effective coordination among the neuromuscular, sensory, and musculoskeletal systems to produce efficient, stable, and safe movement patterns. Optimal mastery of locomotor skills provides a foundation for children to participate actively in physical education and sports because these abilities are associated with body balance, movement coordination, postural control, spatial orientation, and energy efficiency during movement (Sun & Chen, 2024; Zhang et al., 2024).

The development of locomotor skills during elementary school is particularly important because children enter a stage characterized by the refinement of movement patterns. Children aged 9–10 years in fourth grade generally demonstrate more mature movement coordination than in earlier developmental stages. They begin to exhibit consistent stepping patterns, good dynamic balance, the ability to control changes in movement direction, and greater efficiency in maintaining body stability during physical activities. These abilities indicate children's readiness to engage in more complex physical education instruction oriented toward the development of sports skills and physical fitness (Wang & Zhou, 2024).

In addition to contributing to physical development, locomotor skills are closely associated with children's cognitive, affective, and social development. Children with good motor

competence tend to demonstrate greater confidence in participating in learning activities, stronger motivation to engage in games and sports, and better social interaction with peers. Conversely, limitations in motor competence may reduce participation in physical activity and consequently increase the risk of low physical fitness, obesity, poorer mental health, and fewer opportunities for children to develop social skills through play-based activities (Koolwijk et al., 2024; Sun & Chen, 2024).

Two important indicators of locomotor movement quality are step regularity and dynamic balance. Step regularity refers to an individual's ability to maintain a consistent foot-placement pattern during walking or running, whereas dynamic balance refers to the ability to maintain the body's center of gravity while transitioning between movements. These two components are closely interrelated because regular stepping patterns facilitate balanced weight distribution, thereby making movement more stable, efficient, and safe. Conversely, substantial variations in step length, changes in walking rhythm, and inaccurate foot placement indicate poor motor coordination, which may increase the risk of balance loss and falls during physical activity (Zhang et al., 2024).

These challenges become more complex when they occur among students with motor impairments. Children with motor impairments generally experience neuromuscular coordination difficulties that affect their ability to control body movements. Such difficulties may be reflected in inconsistent stepping patterns, unstable walking speed, difficulty maintaining balance, inadequate postural control, and suboptimal coordination of limb movements. These limitations not only reduce movement efficiency but may also negatively affect students' participation in physical education because they tend to experience difficulties performing movement activities that require a high level of coordination and balance. Over the long term, these conditions may hinder the development of physical fitness and psychosocial functioning (Koolwijk et al., 2024; Zhang et al., 2024).

In the context of adapted physical education, movement instruction for students with motor impairments requires instructional strategies that differ from those typically used with students without such impairments. Teachers are expected not only to demonstrate movements but also to provide visual and kinesthetic stimuli and feedback that help students understand movement patterns progressively. Various studies have shown that motor learning interventions combining direct demonstration, structured practice, movement repetition, and visual media produce greater improvements in motor competence than instruction relying solely on verbal directions (*The effects of active play interventions...*, 2024; *Effectiveness of school-based interventions...*, 2025).

Nevertheless, physical education instruction in many elementary schools continues to show that the development of locomotor skills among students with motor impairments is generally dominated by conventional methods centered on teacher explanations and basic demonstrations. Instructional media remain limited, meaning that students often do not receive concrete visual cues regarding foot placement, movement direction, or the appropriate rhythm of movement. Consequently, students frequently experience difficulties regulating their steps, maintaining balance while changing position, and performing movement activities without continuous assistance from the teacher. This condition highlights the need for innovative instructional media and teaching models that can provide movement-learning experiences that

are more systematic, concrete, and responsive to the learning characteristics of students with motor impairments. This need is also consistent with recent meta-analytic findings indicating that systematically designed school-based interventions are more effective in improving fundamental movement skills than conventional physical education instruction.

The success of locomotor skill instruction is determined not only by the frequency of practice but also by the quality of instructional media and strategies employed by teachers. From the perspective of motor learning theory, the development of movement patterns occurs through cognitive, associative, and autonomous stages. During the cognitive stage, learners require clear information about what to do, how to perform the movement, and where the movement should be performed. Therefore, the use of visual media that provides concrete spatial information is an important factor in accelerating the development of correct movement patterns, particularly among children with motor impairments. Systematic reviews have shown that observational learning, demonstrations, and visual cues consistently have positive effects on movement accuracy, coordination, and motor skills compared with instruction relying solely on verbal directions.

In adapted physical education, visual media function as augmented feedback, namely additional information that helps learners understand body position, movement direction, and the expected sequence of movements. Such media provide students with a more concrete learning experience because they can connect visual information with the bodily movements they are performing. Research on video-based visual feedback has demonstrated that visual feedback can improve the quality of motor learning, accelerate the correction of movement errors, and enhance motor skill retention compared with instruction based solely on verbal directions. These effects become more pronounced when visual feedback is combined with teacher demonstrations and systematic repeated practice.

One visual medium with considerable potential for supporting locomotor skill instruction is the footprint marker. This medium provides a visual representation of the placement of the right and left feet, movement direction, step length, and movement rhythm that students are expected to follow while performing locomotor activities. By providing a systematically arranged stepping pattern, students receive clearer spatial information regarding where to place their feet, making movement coordination easier to understand. From a motor learning perspective, the footprint marker functions as an external visual cue, namely an external stimulus that helps learners direct their attention toward the movement goal rather than toward the mechanics of the movement itself. This approach can improve the efficiency of motor learning by reducing cognitive load during the movement-learning process.

For students with motor impairments, the footprint marker serves a broader function than simply providing visual assistance. It helps students understand the relationship between body position, balance, and movement direction through concrete learning experiences. Sequentially arranged footprints allow students to anticipate step length, maintain a consistent walking rhythm, and reduce step-to-step variability that may result from impaired neuromuscular coordination. Accordingly, the use of footprint markers has the potential to improve step regularity, dynamic balance, and postural control during locomotor activities.

In addition to instructional media, the success of an intervention is influenced by the

instructional model used by the teacher. One model widely recommended for motor skill instruction is Direct Instruction (DI). This model emphasizes explicit instruction through a sequence of orientation, demonstration, guided practice, immediate feedback, independent practice, and ongoing evaluation. This systematic instructional structure enables students to observe correct movement patterns before practicing independently, thereby minimizing movement errors from the early stages of instruction. Recent literature indicates that Direct Instruction consistently improves movement skill acquisition, learning motivation, and the effectiveness of physical education because it provides clear instructional procedures that are easy for students to follow.

In adapted physical education, Direct Instruction is considered appropriate for students with motor impairments because it emphasizes repetition, explicit demonstrations, and immediate feedback. The scaffolding provided by teachers progressively helps students develop movement skills from simple to more complex levels. In addition, demonstrations followed by guided practice allow students to receive immediate correction of movement errors, thereby making the development of movement patterns more effective. Research on observational learning has also shown that combining demonstrations, movement models, and verbal cues produces greater improvements in motor skills than using any single strategy in isolation. Although previous studies have demonstrated the effectiveness of visual media and Direct Instruction separately, most research has focused on typically developing students, the use of video-based media, or instruction targeting specific sports skills. Research specifically integrating footprint markers with Direct Instruction to teach locomotor skills to elementary school students with motor impairments remains limited. Furthermore, many previous studies have evaluated improvements in motor skills in general without examining more specific indicators, such as step regularity and locomotor balance, as primary parameters of intervention success. This condition indicates a research gap that warrants further investigation.

Based on the literature review, the novelty of this study lies in several aspects. First, the study integrates footprint markers as an external visual cue with the Direct Instruction model within a systematic instructional design to improve the locomotor skills of students with motor impairments. Second, the study does not merely assess overall improvements in motor skills but specifically evaluates step regularity and locomotor balance as primary indicators of movement quality. Third, the study is conducted within the context of Classroom Action Research (CAR) in adapted physical education at the elementary school level, thereby producing an instructional model that is practical, applicable, and readily replicable by teachers. Fourth, the study offers an alternative instructional strategy that combines concrete visual media with explicit instruction and is expected to provide empirical contributions to the development of adapted physical education for students with motor impairments.

Based on the theoretical and empirical evidence presented above, improving locomotor skills among students with motor impairments requires an instructional approach that focuses not only on outcomes but also on the systematic development of movement patterns. Motor development in children with special educational needs is influenced by interactions among individual characteristics, the learning environment, instructional quality, instructional media, and opportunities for repeated practice. Therefore, adapted physical education teachers play a

strategic role in creating learning environments that accommodate the movement-learning needs of individual students through evidence-based instructional strategies. Recent research indicates that systematically designed school-based instructional interventions have significant effects on improving motor competence, physical activity, and student participation in physical education.

In practice, locomotor movement instruction for students with motor impairments continues to face various challenges. Teachers often rely on basic demonstrations without instructional media capable of providing visual information regarding foot placement, step length, movement direction, or walking rhythm. Consequently, students experience difficulties coordinating limb movements, maintaining dynamic balance, and producing consistent stepping patterns. This condition indicates that instruction does not yet fully accommodate the learning characteristics of students who require visual stimuli, gradual practice, and immediate feedback throughout the learning process. Research on assistive technology and inclusive physical education also indicates that applied research on the use of supportive instructional media in physical education for students with special educational needs remains limited.

From the perspective of motor learning theory, effective movement skill acquisition requires a combination of visual information, repeated practice, immediate feedback, and the gradual fading of assistance (fading/scaffolding). This combination enables learners to develop accurate movement representations, correct errors promptly, and improve long-term motor skill retention. Therefore, integrating footprint markers with Direct Instruction has a strong theoretical foundation. Footprint markers provide visual cues regarding foot placement and movement direction, whereas Direct Instruction provides a systematic instructional sequence involving demonstration, guided practice, feedback, and independent practice. The synergy between these two components is expected to reduce students' cognitive load during motor learning and improve the quality of locomotor movement pattern development.

Although various studies have demonstrated the effectiveness of instructional models and physical activity interventions in improving children's motor competence, most have focused on typically developing children, used general indicators of motor competence, or evaluated instructional models without combining them with concrete visual media. Recent meta-analyses have shown that school-based interventions are effective in improving motor competence, but their effectiveness is strongly influenced by instructional design, participant characteristics, and program implementation quality. Therefore, further research is needed to develop instructional models that are more specifically tailored to the characteristics of students with motor impairments.

Based on the literature review, the research gap can be identified in several areas. First, research on the use of footprint markers in adapted physical education, particularly for elementary school students with motor impairments, remains very limited. Second, previous studies have generally examined the effectiveness of visual media or instructional models separately and therefore have not adequately explained the effectiveness of integrating concrete visual media with Direct Instruction. Third, previous studies have predominantly used general measures of motor competence, whereas research specifically measuring step regularity and locomotor balance as primary indicators of movement quality remains scarce. Fourth, there is limited Classroom Action Research that produces practical instructional

models that can be readily implemented by adapted physical education teachers at the elementary school level.

Based on these gaps, the novelty of this study lies in four main aspects. First, the study integrates footprint markers as an external visual cue with Direct Instruction within a structured instructional design to improve the locomotor skills of students with motor impairments. Second, the study uses step regularity and locomotor balance as primary indicators of intervention success, thereby providing a more specific assessment of movement quality than general measures of motor competence. Third, the study employs a Classroom Action Research approach, producing a contextual, practical, and directly applicable instructional solution for adapted physical education teachers. Fourth, the study contributes to the literature on adapted physical education by integrating concrete visual media and explicit instructional strategies, an approach that remains relatively underrepresented in the international literature.

Theoretically, this study is expected to contribute to the development of adapted physical education, particularly regarding the application of footprint marker–based visual media combined with Direct Instruction to improve the quality of locomotor movement instruction. The findings are also expected to expand understanding of the mechanisms underlying improvements in step regularity and locomotor balance as components of motor competence development among students with motor impairments. In addition, this study may serve as a reference for developing evidence-based instructional models in inclusive physical education. Practically, the findings of this study are expected to provide an innovative, simple, and easily implementable instructional alternative for elementary school physical education teachers. The use of footprint markers combined with Direct Instruction is expected to help teachers provide learning experiences that are more concrete, systematic, and responsive to the learning characteristics of students with motor impairments. As students' step regularity and locomotor balance improve, they are expected to participate more actively in physical education, develop greater self-confidence, expand their social interactions, and support the achievement of inclusive education goals aimed at optimally developing the potential of every learner.

METHOD

This study employed a Classroom Action Research (CAR) approach aimed at improving the learning process and enhancing learning outcomes through reflective, collaborative, and sustainable actions (Kemmis et al., 2014). The research design is based on Kemmis and McTaggart's spiral model, which comprises four stages: planning, acting, observing, and reflecting. The study was conducted in two cycles, with two sessions in each cycle. The results of the reflection in Cycle I were used as the basis for refining the interventions in Cycle II by gradually increasing the complexity of the exercises and reducing scaffolding in accordance with the principles of Direct Instruction (Archer & Hughes, 2011).

The study was conducted during the even semester of the 2025/2026 academic year at SDN 009 Rantau Pulung, East Kalimantan. The research subjects consisted of two fourth-grade students with motor impairments, selected through purposive sampling based on the teacher's identification and the characteristics of their locomotor difficulties, including step regularity, dynamic balance, motor coordination, and postural control. The intervention was

implemented using footprint markers combined with the Direct Instruction model. In Cycle I, instruction focused on mastering the straight-line walking pattern through demonstrations, guided practice, immediate feedback, and independent practice. In Cycle II, the footprint pattern was modified into a zigzag path to improve students' coordination in changing direction, balance, and motor independence.

Data were collected through observation, documentation, and field notes. The observation instrument was developed based on indicators of locomotor skills adapted from Gallahue et al. (2012) and modified to suit the characteristics of students with motor impairments. Assessment used a four-point rubric covering step regularity, foot placement accuracy, body balance, and motor independence. Quantitative data were analyzed descriptively using learning achievement percentages and inter-cycle score development, while qualitative data were analyzed through the stages of data reduction, data presentation, and drawing conclusions as outlined by Miles et al. (2020). The success of the intervention was determined if at least 75% of the locomotor skill indicators met the predetermined mastery criteria and showed an improvement in performance from Cycle I to Cycle II.

RESULTS AND DISCUSSION

Pre-Cycle Condition

The initial observation results indicated that the locomotor skills of both research participants (DS and RH) remained below the established mastery criteria. Both students demonstrated irregular stepping patterns, frequently stepped outside the designated pathway, experienced difficulties maintaining balance while walking, and continued to require teacher assistance at each stage of the activity. In addition, coordination between the right and left legs was not yet synchronized, resulting in an inconsistent walking rhythm. These conditions indicated that step regularity and locomotor balance still required a more structured instructional intervention.

Results of Cycle I Intervention

The intervention implemented in Cycle I focused on introducing footprint markers through the application of the Direct Instruction model. The teacher provided movement demonstrations, guided practice, immediate feedback, and opportunities for independent practice according to each student's individual abilities. The observation results showed improvement compared with the pre-cycle condition. Both students began to follow the designated footprint patterns, although several errors remained in foot-placement accuracy and step-length consistency. Body balance also began to improve, as indicated by a reduction in the frequency of balance loss while walking along a straight pathway. However, both students still required verbal guidance and physical assistance during several stages of practice, particularly when maintaining a continuous movement rhythm.

Based on the reflection results, several challenges remained:

1. students were not yet able to maintain consistent stepping patterns;
2. body balance decreased when walking speed increased;
3. dependence on teacher assistance remained relatively high; and

4. coordination during changes in movement direction had not yet developed optimally.

These findings provided the basis for improving the intervention in Cycle II through modifications to the footprint marker patterns, increased variation in practice activities, and the gradual reduction of scaffolding.

Results of Cycle II Intervention

In Cycle II, the footprint markers were modified into a more varied pathway, including a zigzag pattern, thereby providing students with more challenging movement experiences. The teacher continued to apply the Direct Instruction stages through demonstrations, guided practice, immediate feedback, and independent practice with progressively reduced assistance. The observation results demonstrated more substantial improvement compared with Cycle I. Both students were able to follow the footprint patterns more consistently, their step lengths became more regular, and coordination between the right and left sides increasingly became synchronized. Their ability to maintain balance while walking also improved, as evidenced by reduced body instability and the absence of balance loss while completing the practice pathway. Furthermore, the students began to complete the movement activities independently with minimal teacher assistance. These improvements indicate that the combination of footprint markers and the Direct Instruction model provided clear visual stimuli while simultaneously offering a systematic instructional structure. This combination facilitated students' understanding of movement sequences, determination of appropriate foot-placement positions, and maintenance of balance during movement.

Comparison of Results Across Cycles

Comparison of the observation results demonstrated improvements across all indicators of locomotor skills, including step regularity, foot-placement accuracy, body balance, and movement independence. Compared with the pre-cycle condition, performance at the end of Cycle II showed consistent improvement in both research participants.

Overall, the changes can be summarized as follows.

Table 1. Changes in Locomotor Skills Across Cycles

INDICATOR	PRE-CYCLE	CYCLE I	CYCLE II	IMPROVEMENT FROM PRE-CYCLE TO CYCLE II
STEP REGULARITY	50.00	68.75	90.63	+40.63
FOOT-PLACEMENT ACCURACY	43.75	65.63	87.50	+43.75
MOVEMENT BALANCE	46.88	71.88	93.75	+46.87
MOVEMENT INDEPENDENCE	37.50	62.50	87.50	+50.00
MEAN	**44.53**	**67.19**	**89.85**	**+45.32**

Note:

a. Poor: < 60

b. Fair: 60–74

c. Good: 75–89

d. Very good: ≥ 90

The improvement in each indicator demonstrates that the intervention achieved the objectives of the study, namely improving step regularity and locomotor balance among students with motor impairments through the implementation of footprint markers combined with Direct Instruction. Thus, the intervention was considered effective in improving the quality of adapted physical education instruction while enhancing students' locomotor skills.

DISCUSSION

The findings demonstrate that the implementation of footprint markers combined with Direct Instruction progressively improved step regularity, foot-placement accuracy, movement balance, and independence among students with motor impairments from the pre-cycle condition through Cycle II. The improvement was evident in the students' locomotor performance, which initially fell within the low category, improved following the intervention in Cycle I, and reached the good to very good categories by the end of Cycle II. These findings indicate that the instructional intervention affected not only the final outcomes of motor skill performance but also the quality of the learning process by providing movement experiences that were more structured, concrete, and responsive to the characteristics and needs of students with motor impairments. This finding is consistent with Moon et al. (2024), who reported that systematically designed physical activity programs in school settings can improve motor competence among elementary school children through planned, repetitive practice that is appropriate to students' developmental levels.

The pre-cycle condition indicated that both students experienced difficulties maintaining consistent stepping patterns, determining appropriate foot-placement positions, maintaining body stability, and performing locomotor activities independently. These conditions reflect common characteristics among children with motor impairments, who may experience limitations in movement coordination, postural control, and the efficient execution of fundamental motor skills. From a motor development perspective, locomotor skills such as walking, running, and changing direction require the integration of balance, body coordination, spatial perception, and the ability to control movements sequentially (Gallahue et al., 2012). Therefore, the students' low initial performance was not solely associated with physical limitations but was also influenced by limited exposure to structured movement experiences and insufficient instructional stimuli providing clear visual information.

The improvement observed in Cycle I indicates that the use of footprint markers provided an external cue that helped students understand the relationship between foot position, movement direction, and stepping sequence. The markers functioned as visual cues that directed students' attention toward the movement goal, thereby making the learning process more concrete. For students with motor impairments, visual stimuli are particularly important because verbal information alone may be insufficient to develop an accurate understanding of movement patterns. van der Veer et al. (2022) demonstrated that instructions and feedback based on an external focus of attention, including visual forms of

guidance, can support children's motor skill learning by directing attention toward movement goals and improving motor performance.

In this study, footprint markers functioned not merely as play materials but also as instructional aids that provided structure to movement patterns. Students received visual information regarding the placement of their right and left feet, thereby reducing errors in movement direction. This change was evident in the students' behavior during Cycle I, when they began to follow the designated pathway despite still requiring teacher assistance. This finding supports the view that concrete instructional media can enhance movement concept comprehension among learners who require specialized instructional support. Visual media allow students to acquire learning experiences through direct observation, making the development of movement patterns easier than when instruction relies solely on verbal directions.

The effectiveness of footprint markers can also be explained through the observational learning approach. During the learning process, students not only followed the available footprint patterns but also observed the movement demonstrations provided by the teacher before performing the exercises. The combination of observation, imitation, and direct practice helped students develop mental representations of correct movement patterns. Han et al. (2022), through a systematic review, explained that observational learning plays an important role in motor skill acquisition because learners have opportunities to observe movement models, compare their own performance with the model, and make corrections based on the feedback provided. Thus, the integration of teacher demonstrations and visual media in this study was an important factor supporting the improvement of students' locomotor skills.

In addition to the instructional media, the success of the intervention was influenced by the implementation of the Direct Instruction model. This model provides a systematic instructional sequence involving the presentation of objectives, demonstrations, guided practice, corrective feedback, and independent practice. Such an instructional structure is consistent with the characteristics of students with motor impairments, who require explicit instructions and opportunities for repeated practice. Archer and Hughes (2011) explained that Direct Instruction is effective when learners require clear procedures, concrete examples, and immediate feedback to master new skills. In the context of physical education, this model enables teachers to regulate the difficulty level of activities so that practice can be progressively adjusted to students' abilities.

During Cycle I, the teacher continued to provide substantial physical and verbal assistance because the students were in the early stages of developing movement patterns. However, following reflection and instructional improvements, Cycle II demonstrated more substantial changes. Modifying the pathway into a zigzag pattern introduced new challenges that encouraged students to develop coordination, directional changes, and dynamic balance. At this stage, scaffolding was gradually reduced, allowing students greater opportunities to perform movements independently. The gradual reduction of assistance is an important principle in skill learning because it enables learners to transition from dependence on the teacher toward independent control of movement (Archer & Hughes, 2011).

The greatest improvement in this study occurred in movement independence. This finding indicates that the intervention not only improved physical abilities but also fostered students' confidence in participating in physical education activities. When students were able to follow the stepping patterns without direct assistance, they demonstrated greater self-control over the movements they performed. This process suggests that Direct Instruction-based learning produces not only changes in motor behavior but also supports the development of self-regulation during physical activity.

The improvement in movement balance was another important finding of this study. Balance is a fundamental component of locomotor skills because it provides the basis for walking, running, and changing direction safely. Improved balance enables students to participate more actively in learning activities and reduces apprehension when performing physical movements. Moon et al. (2024) emphasized that improvements in children's motor competence through school-based physical activity interventions are associated with enhanced ability to perform various physical activities effectively and confidently.

The findings also reinforce the importance of using an external focus of attention approach in movement instruction. In this study, students were directed toward an external target, namely the position of the footprint markers, rather than focusing exclusively on how to move their body parts. This approach helped students produce more natural and efficient movements. van der Veer et al. (2022) explained that instructions emphasizing an external focus of attention and visual support have the potential to enhance children's motor skill learning compared with instructions that focus primarily on body mechanics.

Compared with previous research, this study makes a distinct contribution by integrating footprint markers with Direct Instruction within the context of adapted physical education. Previous studies have largely examined improvements in motor competence through general physical activity programs or investigated instructional strategies separately. In contrast, this study demonstrates that the combination of concrete visual media and explicit instruction can serve as an effective strategy for improving locomotor skills among students with motor impairments. Accordingly, this study contributes to the development of more inclusive, systematic, and learner-centered practices in adapted physical education.

Overall, the findings demonstrate that footprint markers combined with Direct Instruction can improve the quality of students' locomotor movements by providing clear visual stimuli, progressive practice, and immediate feedback. This approach has practical implications for physical education teachers, indicating that simple instructional media designed according to motor learning principles can serve as an effective alternative for supporting the development of students with motor impairments. Furthermore, this study strengthens the evidence that adapted instruction combining explicit instructional strategies and visual media can enhance students' participation and independence in physical activities at the elementary school level.

CONCLUSION

Based on the results of the classroom action research that was conducted, it can be concluded that the use of footprint markers based on the Direct Instruction model is effective in improving the locomotor skills of fourth-grade elementary school students with motor

impairments. This improvement is evident from the changes in the students' abilities at each stage of the action research, from the pre-cycle phase through Cycle I to Cycle II. Initially, students demonstrated limitations in step regularity, foot placement accuracy, body balance, and independence in performing locomotor activities. After the intervention using the footprint marker combined with the Direct Instruction learning model, there was a gradual improvement in all indicators of motor skills.

The use of footprint markers provided visual cues that helped students understand movement patterns, determine foot placement, and control the direction of body movement in a more structured manner. Meanwhile, the Direct Instruction model provided support through systematic learning stages, including demonstrations, guided practice, immediate feedback, and gradual reduction of assistance (scaffolding), enabling students to perform movements with a higher degree of independence. The most significant changes were observed in the areas of motor independence and balance, indicating that the intervention not only improved physical abilities but also built students' self-confidence in participating in physical education activities. Thus, the integration of footprint marker media and the Direct Instruction model can serve as a concrete, easily implementable alternative strategy for adaptive physical education that meets the needs of students with motor impairments. This study suggests that the provision of simple visual aids combined with an explicit learning approach can create a more effective, inclusive, and developmentally oriented learning experience focused on the individual abilities of students.

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