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Developing a gymnastics-based fundamental movement model to enhance motor development in elementary school students

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Abstract

This study aims to develop an engaging and innovative fundamental gymnastics movement model for elementary school students in Phases A (ages 6–8) and B (ages 8–10), with an emphasis on safety and practical applicability. Using the ADDIE development framework, Analysis, Design, Development, Implementation, and Evaluation, the research followed a Research and Development (R&D) approach. Expert validation was carried out by seven raters, consisting of five media experts and two gymnastics and fitness specialists, and their assessments were analyzed using Aiken's V. Product trials were conducted on a small scale at the UNY sports laboratory school (3 participants) and on a large scale at Pakem State Elementary School (8 participants). The model demonstrated strong feasibility, validity, and reliability, with an average expert judgment score of 89.46%. Content validity ranged from high to very high (V = 0.762–0.952), and internal consistency reliability was excellent (Cronbach's α = 0.890). Trial results were also positive, increasing from 93.33% in the small-scale trial to 95.93% in the large-scale trial, reflecting a 2.6% improvement in practicality. These findings indicate that the developed gymnastics-based fundamental movement model can serve as an effective instructional tool in Physical Education, Sports, and Health (PJOK), supporting motor development and increasing learning engagement among young learners.

Keywords: Fundamental gymnastics movements, motor development, elementary school students, physical education.

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INTRODUCTION

Motor learning is fundamentally understood as a process in which individuals develop the capacity to perform movements with increasing accuracy and efficiency. This improvement occurs through sustained practice and experience, leading to relatively permanent changes in performance (Sharma et al., 2016; Soderstrom & Bjork, 2015). The development of motor skills relies on the interaction between physical execution and cognitive processing, as learners must interpret cues, build mental representations, and refine their movement patterns. Explicit and developmentally appropriate instruction shapes these internal representations, particularly for children who depend heavily on structured guidance when acquiring new skills (Giguere, 2021; Mitsea & Drigas, 2022). Therefore, motor learning environments must integrate physical practice with cognitive scaffolding to optimize children's ability to understand, adapt, and master movement sequences.

Within early childhood education, this integrative perspective becomes increasingly important because children’s developmental readiness directly influences how they perceive and process movement tasks. Their ability to focus attention, interpret stimuli, and coordinate responses is still maturing, making them sensitive to the quality of instructional design (Hutter et al., 2023). When learning experiences are aligned with these developmental characteristics, children are not only able to perform movements better but also to engage more meaningfully with the learning process. Play-based and exploratory approaches, when combined with structured practice, have been shown to produce more robust motor outcomes because they stimulate curiosity and intrinsic motivation. This balance between structure and exploration helps support sustainable learning and encourages children to internalize movement skills rather than memorizing them mechanically.

In the context of Physical Education, gymnastics provides a rich platform for developing foundational movement competencies. It integrates locomotor, non-locomotor, and manipulative movements that collectively

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contribute to balance, coordination, flexibility, strength, and spatial awareness (Sriwahyuniati et al., 2022; Yu et al., 2025). For elementary school students, these skills are crucial because they impact not only immediate performance in PE but also their longer-term physical literacy and confidence in movement. However, recent national findings reveal a decline in the fundamental motor skills of Indonesian children, particularly in balance, coordination, and locomotor tasks (Kemenpora, 2023; Mustafa et al., 2021). Many PJOK classrooms still rely on repetitive, teacher-centred instruction, which limits student engagement and reduces opportunities for exploratory learning (Rohmansyah, 2022). Teachers have repeatedly cited the lack of structured, practical, and age-appropriate gymnastics models as a barrier to improving learning quality, highlighting the need for instructional designs that can be easily implemented regardless of school resources.

Given these challenges, fundamental gymnastics movements present a strategic solution. Their dominant patterns, such as landing, jumping, swinging, static positions, locomotion, and rotation, directly address the motor domains in which students exhibit the most significant deficits. These movement patterns also resonate with young learners' natural tendencies to explore, imitate, and learn through playful experiences. When organized into developmentally appropriate sequences, fundamental gymnastics can enhance children's motor competence, stimulate cognitive engagement, and foster positive attitudes toward physical activity. Thus, a well-designed gymnastics model has the potential not only to improve motor skills but also to support broader educational goals, including physical fitness, learning motivation, and active participation.

Despite the recognized benefits of gymnastics-based learning, the existing literature still lacks models that have been systematically developed, validated, and tested in real classroom settings. Most previous studies on fundamental movement interventions focus on controlled or small-scale experimental environments (Cimen et al., 2024; Goodway et

al., 2025). Consequently, little is known about how such models perform when implemented across diverse school contexts, where teacher competence, facility availability, and student characteristics vary widely (Dobson, 2023; Resmana et al., 2024). These contextual variations play a crucial role in determining whether an instructional model can be feasibly scaled, sustained, and adapted. This gap suggests that current gymnastics-based approaches may not sufficiently address practical constraints in schools, and further validation is needed to ensure their broader applicability.

To address this gap, the present study aims to develop and validate a fundamental gymnastics movement model tailored to elementary school students in Phases A and B. The model is designed to enhance motor development, increase learning engagement, and provide teachers with structured and developmentally appropriate instructional guidance. Through this approach, the study seeks to contribute to the improvement of PJOK practice in Indonesia by offering an instructional solution that is empirically grounded, contextually relevant, and responsive to the developmental needs of young learners.

METHOD

This chapter explains the development model and the procedural steps used in this Research and Development (R&D) study. While the ADDIE model is widely referenced in education and instructional design literature (Crompton et al., 2024; Sial et al., 2024), its application in this research is tailored specifically to the needs of creating a fundamental gymnastics movement model for early-grade elementary school students. This refined use of ADDIE ensures that each stage contributes directly to the production of a developmentally appropriate, safe, and pedagogically relevant movement model. The emphasis is not on the generic framework, but on how each phase operationalizes evidence-based procedures that align with the characteristics of physical education learning in Indonesia.

The ADDIE model consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Martatiyana et al., 2023)

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and each phase was carried out with specific methodological decisions. In the Analysis phase, data were collected from curriculum documents, teacher interviews, and preliminary classroom observations to identify the most pressing challenges in teaching fundamental movement skills. A notable pattern across schools was the consistent difficulty students experienced in balance, coordination, and basic locomotor abilities. The selection of children aged 7–9 years as trial participants was grounded in developmental motor theory, which identifies this age range as a transitional period of motor proficiency, where children are especially receptive to skill refinement and movement pattern consolidation. This provides a scientifically valid basis for choosing the target group and strengthens the internal consistency of the study design.

In the Design phase, the initial structure of the movement model was created by mapping core gymnastics movement patterns to learning goals, developmental indicators, and safety standards. Instead of a generic design description, the planning process included constructing visual flowcharts, designing progressive activity levels, and determining scaffolding strategies for children with varying motor readiness. This phase also involved selecting media formats such as printed modules, sequential illustrations, and simple visual cues based on teacher feedback regarding classroom practicality and students' preferred learning styles. Design decisions were grounded in both pedagogical alignment and feasibility in real school environments.

During the Development phase, the prototype was produced and iteratively refined. This stage involved more than simply creating materials; it required aligning each movement sequence with evidence-based safety considerations, ensuring that instructions were child-friendly, and establishing clear teacher guidelines to avoid misinterpretation. The prototype was then subjected to expert validation. Instead of an informal review, a structured validation protocol was used, requiring experts to assess accuracy, developmental alignment, clarity, safety risks, and instructional coherence. Each expert reviewed the prototype

independently to prevent bias, and qualitative comments were provided to strengthen conceptual clarity and practical usability.

In the Implementation phase, the model was tested in real learning environments. Before conducting the trials, short orientation sessions were held with teachers to standardize delivery and ensure that the implementation was consistent across sessions. The product trial was conducted with two groups of users, allowing researchers to observe differences in comprehension, engagement, and movement execution. Observations focused on how students responded to instructions, how easily they followed movement progressions, and whether the learning media supported or hindered their participation. This phase generated rich field notes that provided insight into how children interacted with the model beyond theoretical assumptions.

The Evaluation phase served to assess the model's overall quality through a combination of quantitative and qualitative data. Quantitative evaluation included expert feasibility scores and practicality percentages derived from the implementation phase. Meanwhile, qualitative evaluation captured nuanced insights regarding clarity, safety, developmental suitability, and real-time classroom challenges. This dual approach ensured that the final product exceeded minimum validity thresholds and addressed practical concerns identified during trials. The evaluation results directly informed refinements to the model, ensuring its relevance for broader classroom use.

This development research involved three participant groups. Content Experts (n = 2) were selected based on academic credentials, specialization in physical education or gymnastics pedagogy, and publication records in motor learning or curriculum design. Their expertise ensured that the model's content was accurate, developmentally appropriate, and aligned with national curriculum standards. Media Experts (n = 2) were selected based on proven experience in instructional media development, learning technology, and visual communication design. They assessed readability, visual clarity, layout consistency, and

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the appropriateness of media formats for early-grade learners. The Product Trial Users (n = 30) consisted of children aged 7–9 years, representing early-grade elementary classes. This age group was deliberately chosen due to its relevance in motor skill refinement phases, making them ideal evaluators of clarity, usability, and movement appropriateness.

The expert validation process followed a structured series of steps, including the provision of prototype materials, independent assessment using standardised rubrics, rating via feasibility questionnaires, and written suggestions for improvement. The data collection process used three instruments: (a) an expert feasibility questionnaire with a 5-point Likert scale, (b) a practicality questionnaire administered to PJOK teachers and gymnastics coaches following product use, and (c) observational notes and feedback forms gathered during children's trial sessions. Data analysis combined quantitative approaches—Aiken's V coefficient for validity and percentage calculations for practicality—with thematic content analysis of qualitative feedback. This comprehensive analytical approach ensured that revisions were grounded in both empirical evidence and professional insights from multiple perspectives.

RESULT

The results of this study were obtained through expert validation, practicality testing, and product trials involving students in Phase A and Phase B. Expert assessments from content and media evaluators were processed using Aiken's V formula, showing that all components met acceptable validity criteria and were judged appropriate, clear, and safe for elementary school use. Practicality testing by PJOK teachers and gymnastics coaches yielded high percentage scores, indicating that the model was easy to understand and feasible to apply in classroom settings. Product trials involving 30 students provided observational evidence that the training patterns could be performed effectively, supporting the intended motor skill outcomes. Overall, the combined quantitative and qualitative findings confirm that the developed fundamental gymnastics

movement model is feasible, practical, and ready for implementation in real learning environments.

Table 1. Analyzed Phase Development

Aspect Analyzed	Findings
Needs of Teachers and Students	Teachers require a gymnastics model that is safe, engaging, and aligned with the characteristics of students in Phases A and B.
Literature on Fundamental Skills	Dominant movement patterns in gymnastics include: landing, jumping, swinging, static positions, locomotion, and rotation.
Characteristics of Students	Children aged 7–9 enjoy learning through play and need enjoyable and safe physical activities.

The data in this study were collected through a structured needs analysis process that involved teachers, a literature review, and an examination of student characteristics. Needs analysis data were collected by asking teachers to describe the challenges they face in teaching gymnastics and to identify the type of learning model required for students in Phases A and B. These qualitative inputs were then grouped and categorized, resulting in the conclusion that teachers require a safe, engaging, and developmentally appropriate model. The literature review data were processed by identifying recurring concepts across credible sources and synthesizing them into six dominant fundamental movement patterns: landing, jumping, swinging, static positions, locomotion, and rotation. Analysis of student characteristics was carried out by reviewing developmental indicators for children aged 7–9 years, and these findings were classified to determine learning tendencies, such as the need for playful, enjoyable, and safe physical activities. All data were analyzed descriptively by organizing findings into thematic aspects—teacher needs, dominant movement patterns, and student characteristics—which then informed the formulation of the fundamental gymnastics movement model.

Table 2. Designed Component

Designed Component	Description
Learning Objectives	To develop fundamental gymnastics skills through dominant movement patterns safely and enjoyably.
Model Structure	Composed of six dominant movement patterns: landing, jumping, swinging, static positions, locomotion, and rotation.
Validation Instruments	Expert judgment questionnaires and surveys for PE teachers and coaches.

The results of this study were generated through a structured process of needs analysis, design formulation, and expert validation. Data

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were first obtained through teacher feedback, literature review, and analysis of student characteristics, which were then categorized into three key aspects: teacher needs, dominant movement patterns, and learner characteristics. Teacher input was processed by grouping similar responses, revealing a clear need for a gymnastics model that is safe, engaging, and aligned with the developmental profile of Phase A and Phase B students. Literature data were synthesized by identifying repeated concepts across references and organizing them into six dominant movement patterns: landing, jumping, swinging, static positions, locomotion, and rotation. Student characteristic data were analyzed descriptively by classifying behavioral and developmental tendencies of children aged 7–9 years, confirming the importance of play-based, enjoyable learning activities. These findings informed the formulation of the designed components, which include clearly defined learning objectives, a structured arrangement of the six movement patterns, and the preparation of validation instruments such as expert judgment questionnaires and surveys for teachers and coaches. The overall data processing and analysis follow a descriptive and thematic approach, ensuring that every design decision reflects the actual needs identified in the analysis phase.

Table 3. Expert Judgment

Activity	Findings
Expert Material Validation	Average score = 89.46% (categorized as appropriate); Aiken's V = 0.762–0.952 (high to very high validity).
Media Expert Validation	Media is judged as attractive, communicative, and appropriate for students' characteristics.
Reliability Test	Cronbach's Alpha = 0.890 (high internal consistency).

The data in this phase were obtained through structured expert judgment procedures involving content experts and media experts. Content experts assessed the feasibility, clarity, accuracy, and developmental appropriateness of each item in the model by completing a validation questionnaire. Their quantitative scores were then processed using Aiken's V formula to determine item-level content validity. The calculation produced V values ranging from 0.762 to 0.952, which fall within the high to very high validity category. A percentage analysis of the

same expert scores yielded an average feasibility score of 89.46%, indicating that the material components were deemed appropriate for use in elementary education. Media experts provided evaluations using a similar structured instrument, and their qualitative inputs were categorized and summarized to reflect judgments of attractiveness, communicativeness, and suitability for student characteristics. To assess the internal consistency of the instrument, a reliability test was conducted using Cronbach's Alpha, resulting in $\alpha = 0.890$, which indicates a high level of reliability. These analytic processes—combining percentage analysis, Aiken's V, and reliability testing—demonstrate that the data were systematically processed and analyzed, leading to the conclusion that the model is feasible, valid, and psychometrically reliable.

Table 4. Implementation

Trial Scale	Findings
Small-Scale Trial (3 students)	Overall score = 93.33% (very good), indicating readiness for large-scale trial.
Large-Scale Trial (8 students)	Overall score = 95.93% (very good), with a 2.6% improvement from the small-scale trial.
Teacher and Coach Observations	The model was easy to implement; students were active, enthusiastic, and able to follow movement patterns effectively.

The implementation data were obtained through two stages of product trials—small-scale and large-scale—supported by direct observations from teachers and coaches. In a small-scale trial involving 3 students, data were collected using a structured practicality assessment form, and the scores were analysed using percentage calculations, resulting in an overall score of 93.33%, categorised as "very good." The large-scale trial, conducted with 8 students, used the same assessment instrument to ensure consistency. The data were again processed using percentage analysis, producing an overall score of 95.93%, which represents a 2.6% improvement compared to the small-scale trial. In addition to quantitative scoring, qualitative data were collected through observational checklists and narrative notes from teachers and coaches. These qualitative responses were then grouped and analyzed thematically, revealing consistent patterns such as ease of implementation, high student engagement, and smooth execution of the movement patterns. The combination of quantitative percentage scores

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and qualitative thematic findings indicates that the model functions effectively during implementation, demonstrating readiness for broader application.

DISCUSSION

The findings of this study indicate that the gymnastics-based fundamental movement model developed for elementary school students is feasible, valid, reliable, and effective in enhancing motor development and learning engagement. These results emerged because the model was deliberately designed to address the developmental needs of children in Phases A and B, who learn best through activities involving play, variation in movement, and simple yet structured patterns (Barnett et al., 2016). By incorporating movement activities that align with children's natural tendencies to explore and experiment with their bodies, the model fosters attention, intrinsic motivation, and sustained participation. This alignment between developmental needs and instructional design explains why students demonstrated consistent enthusiasm, active engagement, and improved motor responses throughout implementation.

Compared with previous studies, the distinctiveness of this study lies in combining structured gymnastics movement patterns with a developmentally appropriate play-based format. Earlier works acknowledged the importance of fundamental motor skills but often relied on repetitive, teacher-centred drills that could not sustain student interest or motivation (Zhang et al., 2024). In contrast, the present model integrates six dominant movement patterns landing, jumping, swinging, static positions, locomotion, and rotation into cohesive and enjoyable sequences (Baskora et al., 2022). This integration represents a unique contribution, providing both technical rigour and developmental relevance. While earlier research supported the significance of such movement patterns, this study expands existing knowledge by demonstrating that embedding these skills into play-based structures significantly increases student engagement and enhances movement quality. Thus, the findings confirm and extend prior evidence by showing that structured gymnastics

activities can be both instructionally strong and intrinsically motivating for young learners.

The theoretical implications of this study are also noteworthy. Several theories of motor development including dynamic systems theory and physical literacy frameworks emphasize that effective motor learning occurs when children engage in rich, varied, and meaningful movement experiences. The present findings support these theories by demonstrating that children exhibit better motor responses when instructional models emphasize exploration, variability, and cognitive involvement rather than mere repetition. Furthermore, the model reinforces the notion that motor skill acquisition in early childhood is not only a physical process but also a cognitive and affective one. Students in this study displayed heightened concentration, decision-making behaviors, and positive emotional responses during implementation, suggesting that the model stimulates integrated development across learning domains.

The model's uniqueness is further reinforced through expert validation and practical trials. Content experts confirmed that the movement patterns were appropriate and safe, while media experts emphasized that the instructional materials were visually communicative and age-appropriate. These expert assessments, coupled with strong trial results, indicate that the model successfully bridges a persistent gap in physical education literature namely, the gap between theoretical recommendations for fundamental movement skills and the absence of concrete, developmentally aligned instructional models. Previous studies have highlighted declining student motivation due to monotone teaching approaches (Kurniawan & Yuliawan, 2021), yet they rarely offer validated, implementable solutions. The model from this study provides such a solution by presenting a structured, feasible, and engaging approach that teachers can apply even in schools with limited facilities.

In practical terms, this model generates strong pedagogical implications for elementary gymnastics learning. Movement models based on dominant gymnastics patterns have been shown to simultaneously

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support motor development, problem-solving abilities, spatial awareness, and learning engagement (Ata, 2021; Liu & Wang, 2022). The findings of this study reinforce and expand these theoretical propositions by demonstrating that children not only perform the movements effectively but also show elevated enthusiasm and sustained involvement. This suggests that integrating locomotor and non-locomotor skills within a play-based gymnastics structure can enhance both physical literacy and cognitive engagement, thereby strengthening the holistic purpose of PJOK learning.

Nonetheless, certain limitations should be acknowledged. Although the model demonstrated strong results in small-scale and large-scale trials, the sample size was relatively small and limited to Pakem State Elementary School. While the sample is developmentally appropriate for model testing, its limited size restricts broader generalization. Additionally, the successful implementation depended on the teacher's readiness and familiarity with the model. Teachers with limited backgrounds in gymnastics may require additional training to effectively deliver the model. Facility constraints also emerged as contextual challenges; certain movement patterns may require adjustment in schools with restricted physical space. These limitations highlight the need for future studies to explore scalability, regional adaptability, and long-term sustainability across more diverse school settings.

Overall, this study strengthens existing literature by offering an evidence-based, developmentally grounded instructional model that meaningfully combines technical movement structure with playful, child-centred delivery. Compared with previous approaches, the model emphasizes safety, developmental appropriateness, engagement, and instructional clarity, resulting in improved motor competence and enhanced learning motivation. The findings not only confirm previous research but also extend theoretical perspectives on how fundamental movement skills can be taught more effectively in early childhood education. Future research should expand the implementation contexts, assess long-term outcomes, and investigate how the model can be

integrated into PJOK curricula nationwide, potentially incorporating digital tools or adaptive frameworks to enhance accessibility and sustainability.

CONCLUSION

This study successfully developed a gymnastics-based fundamental movement model that is valid, reliable, safe, and developmentally appropriate for students in Phases A and B. The model's effectiveness arises from the close alignment between its six dominant movement patterns and the motor, cognitive, and affective profiles of early-grade learners. Improvements noted during expert validation and trial phases indicate that structured yet playful movement sequences enable students to perform skills with better coordination, accuracy, and confidence. These outcomes highlight that children respond more positively to instructional designs that emphasize variation and exploration rather than repetitive drills, demonstrating the model's capacity to transform fundamental movement learning into a more meaningful and engaging experience.

Practically, the model provides PJOK teachers with a feasible and adaptable tool that can be implemented even in limited-resource environments. However, a successful application requires teacher readiness, familiarity with gymnastics principles, and consistent institutional support. The positive trial results show that the model can enhance instructional clarity, promote student motivation, and support safer movement execution in classroom settings. To strengthen its broader impact, future research should involve more diverse school populations, examine the long-term effects on children's physical literacy and attitudes toward physical activity, and investigate how technology-assisted features, such as digital demonstrations or feedback-based applications, can expand the model's accessibility, accuracy, and scalability across different educational contexts.

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