



Development of a Project-Based Learning Model Based on Manipulative Fundamental Movement Skills for Physical Education in Elementary Schools

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

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Received 15 August 2026

Accepted 26 October 2026

DOI <https://doi.org/10.26740/jses.v9n2.p141-151>

ABSTRACTS

Purpose	This study aimed to develop a valid and practical Project-Based Learning (PBL) model for teaching fundamental manipulative movement skills in elementary school physical education.
Materials and Methods	This study employed a Research and Development (R&D) approach using the ADDIE model: analysis, design, development, implementation, and evaluation. The study was conducted at State Elementary School 11 Bima City and involved two academics, two physical education teachers, 20 students in the initial trial, and 40 students in the final trial. Data were collected through observations, interviews, and questionnaires. The Test of Gross Motor Development-Third Edition (TGMD-3) framework was used to organize manipulative movement content and guide formative observation rather than for statistical comparison of motor scores. Analyses included model validation and descriptive analysis of student and teacher activities.
Result	Student activity during final implementation achieved a mean score of 23.73 out of 25 (94.9%), categorized as “very good.” Communication and reflection each reached 100%. Teacher activity reached 96–100%, indicating consistent model implementation. Initial trial assessment scores ranged from 60% to 84%, with a mean of 75.8%, while final trial scores ranged from 88% to 100%, with a mean of 93.9%, after model revisions. These findings support the validity, feasibility, practicality, and implementation quality of the developed PBL model without claims regarding statistically significant improvement in students' motor skills.
Conclusion	The developed PBL model provides a valid, feasible, and highly practical framework for teaching fundamental manipulative movement skills in elementary school physical education. The model supports active participation, collaboration, communication, problem solving, reflection, and systematic teacher implementation.
Keywords	Project-based learning; Fundamental manipulative movement skills; Physical education; Elementary school; Model development.



INTRODUCTION

Physical Education in elementary schools is crucial for developing fundamental manipulative movement skills, which serve as the foundation for children's motor abilities. These skills help enhance movement capabilities, physical fitness, and lifelong physical activity habits. There is a strong link between manipulative skills, physical activity levels, and fitness levels among school-aged children. Physical Education lessons are often teacher dominated, leaving students with limited active involvement in complex movement activities. This results in a lack of fundamental movement skills, particularly manipulative skills, among elementary school students (Lambert et al., 2022; Chen et al., 2021; Ridwan & Chen, 2024). To address these challenges, Project-Based Learning (PBL) provides structured opportunities for students to engage in authentic movement tasks and participate actively in the learning process (H. Yılmaz & Karadeniz, 2024; Lavado-Anguera et al., 2024; Rehman et al., 2024; M. Yılmaz & Karadeniz, 2024). To address these challenges, Project-Based Learning (PBL) provides structured opportunities for students to engage in authentic movement tasks and participate actively in the learning process (H. Yılmaz & Karadeniz, 2024; Lavado-Anguera et al., 2024; Rehman et al., 2024; M. Yılmaz & Karadeniz, 2024).

Project-Based Learning (PBL) has been extensively studied across various disciplines, including physical education, as an instructional approach that organizes learning around authentic and context-relevant tasks (Boss & Krauss, 2023; Kim et al., 2024). Within manipulative movement learning, PBL provides a framework through which students can undertake structured projects involving movement exploration, object control, and interaction with peers (Luo et al., 2024; Muñoz-Alvarez et al., 2025; Prawesti et al., 2024). Such a structure enables manipulative movement activities to be incorporated into contextual learning experiences rather than taught only as isolated movement exercises (Thompson & Ruiz, 2022; Oliveira et al., 2023). Research on teaching fundamental movement skills has often focused on simple methods and instructional media, yet it has not fully integrated innovative learning models that incorporate meaningful projects. Previous studies have demonstrated the applicability of project-based learning models in educational settings (Utami, 2022; Santoso & Adi, 2023; Rahayu et al., 2025; Perdana & Wijaya, 2024).

This model is expected to meet curriculum requirements for comprehensively developing fundamental motor skills and to serve as a practical guide for teachers in designing meaningful and sustainable physical education lessons. Accordingly, the research questions are: 1) What is the feasibility and practicality of the Project-Based Learning model developed for teaching fundamental manipulative movement skills? 2) How does the implementation of Project-Based Learning influence learning motivation, collaboration, and reflection regarding manipulative fundamental movements? 3) What is the validity and practicality of developing a Project-Based Learning model centered on manipulative fundamental movements? The urgency of this study lies in the need for physical education instruction in elementary schools that systematically facilitates fundamental motor competencies. Teachers require innovative and practical learning models that can be implemented according to student characteristics and instructional conditions (Veldman & al., 2025; Majud & Jamaludin, 2024; Sánchez-garcía & Reyes-de-cózar, 2025). For students, project-based learning offers experiences relevant to their daily lives, fostering curiosity, collaboration, and mastery of manipulative movement skills which serve as a foundation for lifelong physical activity. Consequently, this study integrates a project-based learning model with manipulative fundamental movements utilizing the Test of Gross Motor Development (TGMD-3) within the physical education curriculum for elementary school students.

The problem-solving approach in PBL places students at the center of learning activities through structured projects related to movement situations. In physical education, students identify movement-related problems, devise methods to address them, test possible solutions, and evaluate their physical activities. These stages provide an instructional structure for communication, collaboration, decision-making, and reflection within the learning process. Consequently, instruction emphasizes both the completion of project tasks and the processes through which students construct an understanding of movement. In the context of fundamental movement instruction, these characteristics provide a pedagogical basis for organizing manipulative movement activities into systematic learning projects (Peng et al., 2024; Yusuf et al., 2023; Priyohutomo et al., 2025; Rusli et al., 2025). Thus, PBL provides an instructional framework in which students can participate in movement tasks, interact with peers, and collaboratively complete structured physical activities.

PBL represents a contemporary learning approach that positions students as participants in completing structured real-world projects. In the present study, its relevance lies specifically in organizing manipulative movement learning rather than reiterating its general educational benefits. The integration of manipulative skills focuses on object-control activities, such as catching, throwing, kicking, and striking, which can be incorporated into projects relevant to students' physical education experiences (Mulya, 2023; Nuur & Chamidah, 2025; Septaliza et al., 2024; Yulianasari & Sukiman, 2024; Ismaiedh Cukarso et al., 2024). Accordingly, the proposed model structures these manipulative movement activities through project stages, learning tasks, teacher facilitation, and formative observation. This approach provides a specific pedagogical framework for developing a PBL model centered on fundamental manipulative movement skills in elementary school physical education.

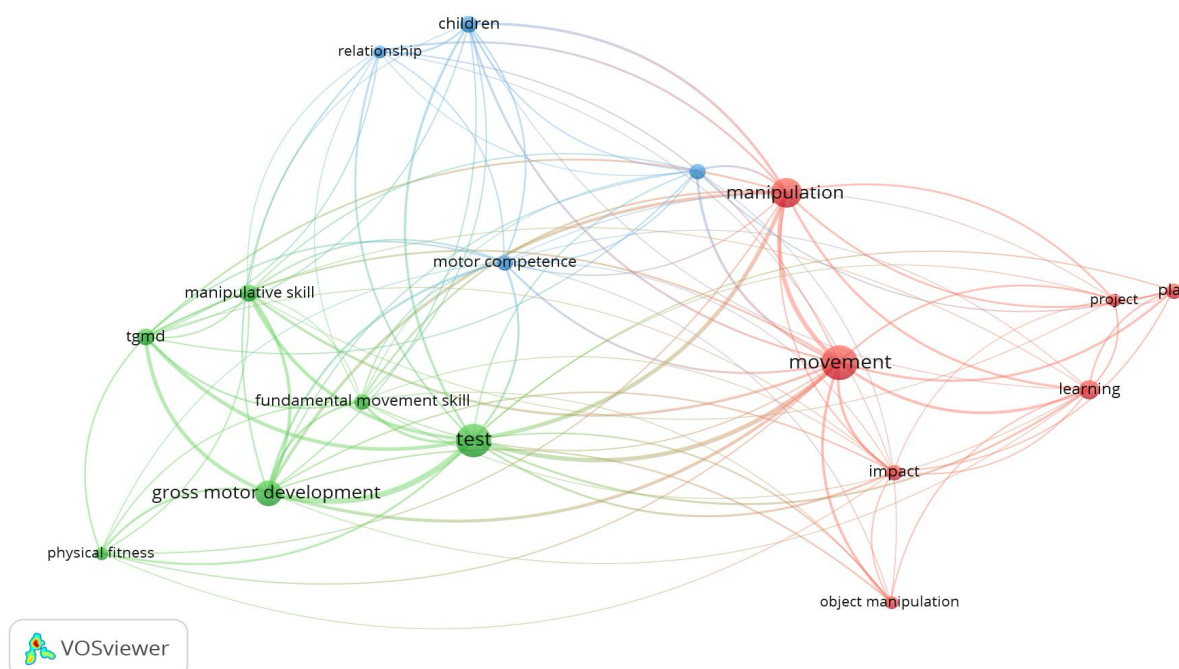


Figure 1. VOSviewer bibliometric analysis of PBL

Figure 1 presents a VOSviewer bibliometric mapping conducted using publications retrieved from the Scopus database. The search used the keyword PBL motor and covered publications from 2021 to 2025. The mapping illustrates the relationships among research terms associated with

project-based learning, motor skills, fundamental movement skills, manipulation, physical activity, and related educational concepts.

Previous research, based on the results of the VOSviewer bibliometric analysis, has been more closely associated with basic movements, manipulation, skills, and physical activity. The bibliometric mapping indicates an opportunity for developing a project-based learning (PBL) model specifically centered on fundamental manipulative movement skills in elementary school Physical Education. The novelty of this research therefore lies in combining an authentic project structure with a specific manipulative motor context that has not been widely integrated in previous research. Rather than positioning PBL only as a general strategy for improving learning outcomes, the developed model embeds manipulative skills as the core content of project activities. Students engage in structured experiences involving object control, motor coordination, collaboration, and reflection on the learning process. PBL continues to develop as an instructional approach in skills-based education and student learning contexts (Scott et al., 2024; Mardiansyah et al., 2024; Bartolo et al., 2024). The integration of TGMD-3 into the model provides a standardized framework for identifying and formatively observing fundamental movement patterns rather than serving as evidence of effectiveness that is not reported in the Results section (Smith, 2023; Aliriad et al., 2025; Nguyen, 2025). Therefore, the novelty of this research lies in the systematic and contextual development of a PBL model for fundamental manipulative movement learning with TGMD-3-informed observation. The research produces a practical framework for elementary school physical education that emphasizes structured project activities, active involvement, collaboration, reflection, and manipulative movement learning.

METHODS

Study Participants

The research sample from Bima City Elementary School 11 consisted of two academics, two teachers, 20 students for the initial trial, and 40 students for the final trial. The sample was selected based on participation in the first phase of the study, which focused on a project-based learning approach utilizing fundamental manipulative movement skills to support students' learning experiences in physical education.

Study Organization

This study employs the Research and Development (R&D) method to create a learning product that is valid and practical in meeting specific needs (Stebbins, 2025; Siregar, 2025). The development research adopts the ADDIE model, which comprises five systematic stages: analysis, design, development, implementation, and evaluation. The ADDIE model was selected because it provides an organized and repeatable framework for instructional development that focuses on accurate and tangible learning outcomes. This model is also well-suited for physical education, as it emphasizes the integration of cognitive, affective, and psychomotor aspects (Branch & Dousay, 2021; Molenda, 2022; Lee & Hannafin, 2021).

The analysis stage identifies learning needs, characteristics of elementary school students, variations in fundamental manipulative movement skills, and the alignment of the physical education curriculum; this is achieved through document analysis, classroom observations, and literature reviews to establish a foundation for the Project-Based Learning model. The design stage involves outlining learning objectives, material delivery methods, project activities, equipment, and instruments for evaluating the developed learning model. The development stage encompasses the

creation of initial products, specifically the learning model, modules, and supporting materials, which are subsequently reviewed by physical education and instructional design experts. The implementation stage involves piloting the model with elementary school students to assess the ease and practicality of its application. The evaluation stage is conducted formatively and summatively to assess the validity, feasibility, and practicality of the developed learning model (Aldoobie, 2020; Tegeh et al., 2021).

Statistical Analysis

Data analysis utilizes a qualitative approach aimed at summarizing observations and interview findings regarding how students participate in fundamental manipulative movement learning within the project-based learning context, thereby providing information about the implementation process. Quantitative analysis was used to examine model validation and descriptive data concerning student and teacher activities. Content validity was analyzed using Aiken's V, based on the validators' assessments of the components of the developed model. The Aiken's V analysis is directly linked to the validation process, as represented by data from the initial and final validation stages. This data is used to determine the validity and feasibility of the model and serves as a basis for revisions, guided by the evaluators' feedback (Setiawan et al., 2024; Restu et al., 2022; Zhu et al., 2025). Accordingly, the quantitative analysis in this study was not intended to statistically compare pre-test and post-test TGMD-3 motor scores.

Procedure

To ensure student understanding, orientation and demonstrations of throwing, catching, kicking, and striking movements were conducted as part of the instructional activities. The Test of Gross Motor Development-Third Edition (TGMD-3) was used as a reference rubric for organizing the instructional content of fundamental manipulative movement skills and as a guide for formative observation during the learning process. It was not used as an instrument for statistical comparative testing of students' pre-test and post-test motor scores in this study. The instructional activities were organized around fundamental manipulative movement patterns referenced in the TGMD-3 framework. During the implementation of the Project-Based Learning model, students participated in manipulative movement projects emphasizing active participation, collaboration, communication, problem solving, and reflection. Teachers used the TGMD-3-informed rubric as a formative observational guide to monitor movement patterns and provide instructional feedback rather than to generate comparative effectiveness data. The validation procedure involved expert and practitioner assessment of the developed model. Ratings obtained during the initial validation were analyzed using the Aiken's V approach to determine the adequacy of the model components and identify aspects requiring revision. The model was subsequently revised according to evaluator feedback and subjected to final validation.

RESULT

The research results are presented in accordance with the objectives of developing a valid and practical Project-Based Learning (PBL) model for fundamental manipulative movement skills in elementary school physical education. The findings include student activities during model implementation, teacher activities, and assessment data from the initial and final trials. The results are presented descriptively to demonstrate the practicality, feasibility, and implementation quality of the developed model. The TGMD-3 framework was used as a reference rubric for instructional

content and formative observation rather than as an instrument for statistical comparative testing of students' motor performance.

Student Activities

Table 1. Student Activities During Final Model Implementation

Indicator	Maximum Score	Mean Score	(%)	Category
Active Participation	5	4.68	93.5	Very Good
Collaboration	5	4.48	89.5	Very Good
Communication	5	5.00	100.0	Very Good
Problem Solving	5	4.55	91.0	Very Good
Reflection	5	5.00	100.0	Very Good
Overall Average	25	23.70	94.8	Very Good

The analysis of the 40 student activity records showed that student participation during the final implementation of the developed model was categorized as “Very Good,” with an overall mean score of 23.73 out of 25 (94.9%). Communication and reflection achieved the highest mean scores of 5.00 (100%), indicating consistently high performance across these two indicators. Active participation achieved a mean score of 4.68 (93.5%), while collaboration and problem solving each obtained a mean score of 4.53 (90.5%). The analysis of the 40 student activity records showed that student participation during the final implementation of the developed model was categorized as “Very Good,” with an overall mean score of 23.73 out of 25 (94.9%). Communication and reflection achieved the highest mean scores of 5.00 (100%), indicating consistently high performance across these two indicators. Active participation achieved a mean score of 4.68 (93.5%), while collaboration and problem solving each obtained a mean score of 4.53 (90.5%). The distribution of total student activity scores further showed that four students obtained 25/25, 22 students obtained 24/25, 13 students obtained 23/25, and one student obtained 22/25. Overall, these findings indicate that the developed learning model facilitated a highly active, collaborative, communicative, problem-solving, and reflective learning environment

Teacher activities

Table 2. Teacher activities During Two Classroom Observations

Observation	Introduction	Presentation	Classroom Management	Feedback	Closing	Total Score	Percentage	Category
Observation 1	5	5	5	5	5	25/25	100%	Very Good
Observation 2	5	5	5	4	5	24/25	96%	Very Good

Numbers 1 and 2 refer to the first and second classroom observations during model implementation, respectively. They represent two observation occasions and should not be interpreted as the number of observers or validators. Teacher activity during model implementation also demonstrated consistently high implementation quality. During Observation 1, the teacher obtained the maximum score of 25 out of 25 (100%), indicating that introduction, presentation, classroom management, feedback, and closing were implemented optimally. During Observation 2, the teacher obtained 24 out of 25 (96%). The feedback indicator received a score of 4, whereas all other indicators received the maximum score of 5. Both observations were categorized as “Very Good.” These findings demonstrate that the developed PBL model could be implemented consistently and systematically by the teacher during physical education instruction.

Initial and Final Trial Assessment of the Developed Model

Table 3. Initial Trial Assessment

Score Obtained	Maximum Score	Percentage	Category	Frequency	Proportion
21	25	84%	Very Good	2	10%
20	25	80%	Good	10	50%
19	25	76%	Good	3	15%
18	25	72%	Good	1	5%
16	25	64%	Good	2	10%
15	25	60%	Fair	2	10%
Total				20	100%

The initial trial involved 20 student assessment records. Scores ranged from 15 to 21 out of 25 (60–84%), with a mean score of 18.95 out of 25 (75.8%). The most frequently obtained score was 20/25, recorded for 10 students (50%). Three students (15%) obtained 19/25, two students (10%) obtained 21/25, two students (10%) obtained 16/25, two students (10%) obtained 15/25, and one student (5%) obtained 18/25. These findings provided descriptive information for identifying aspects of the model that required refinement before the final trial.

Table 4. Final Trial Assessment

Score Obtained	Maximum Score	Percentage	Category	Frequency	Proportion
25	25	100%	Very Good	9	22.5%
24	25	96%	Very Good	9	22.5%
23	25	92%	Very Good	14	35.0%
22	25	88%	Very Good	8	20.0%
Total				40	100%

The final trial involved 40 student assessment records. Scores ranged from 22 to 25 out of 25 (88–100%), with a mean score of 23.48 out of 25 (93.9%). Nine students (22.5%) obtained the maximum score of 25, nine students (22.5%) obtained 24, 14 students (35.0%) obtained 23, and eight students (20.0%) obtained 22. All final-trial assessment records were categorized as “Very Good.” Descriptively, the distribution of scores shifted from 60–84% in the initial trial to 88–100% in the final trial following revisions to the developed model. These findings indicate improved feasibility and practicality of model implementation. However, these descriptive differences should not be interpreted as evidence of statistically significant improvement in students' motor skills because no statistical pre-test–post-test comparison of TGMD-3 motor scores was conducted in this study.

DISCUSSION

The findings demonstrate that the developed Project-Based Learning (PBL) model provided a practical and feasible structure for teaching fundamental manipulative movement skills in elementary school physical education. Student activity during the final implementation was categorized as very good, with an overall mean score of 23.73 out of 25 (94.9%), while teacher activity reached 96–100%. These results primarily indicate the quality of student participation and the consistency of model implementation rather than statistical improvement in motor performance. The findings are consistent with the student-centered characteristics of PBL, in which students participate actively in authentic tasks, interact with peers, and reflect on their learning experiences (Simonton et al., 2021).

During field-based instruction, students participated in concrete manipulative movement projects organized around throwing, catching, kicking, and striking. Rather than practicing these skills only as isolated technical drills, students completed structured movement tasks involving

object control and interaction with peers. In throwing and catching projects, students worked with partners or groups to coordinate the direction, timing, and control of the ball while completing the assigned movement task. Kicking activities required students to control the ball and direct it toward the designated task target, whereas striking activities required students to coordinate body movement with object contact. Through these field-based projects, students were required to participate actively, cooperate with peers, communicate during task completion, solve movement-related problems, and evaluate the activities they had performed. The teacher facilitated these activities through demonstrations, monitoring, and formative feedback using the TGMD-3-informed observational framework (Endrawan & Aliriad, 2023).

The maximum score for reflection (100%) can also be explained by the way reflection was integrated into the project process. Classroom observations showed that after completing movement tasks, students were given opportunities to review their activities, identify difficulties encountered during task performance, and consider how their movements or strategies could be adjusted in subsequent attempts. Teacher feedback further supported this process by directing students' attention to movement execution and task completion. Consequently, reflection was not limited to an end-of-lesson activity but became part of the cycle of performing, receiving feedback, evaluating performance, and attempting the movement task again. The combination of hands-on movement experiences, peer interaction, and opportunities for self-evaluation contributed to the consistent implementation of reflection. This pattern is relevant to previous findings that meaningful and enjoyable PBL experiences can support students' engagement in physical education (Ginanjar et al., 2024).

The communication and reflection scores should therefore be interpreted as evidence of the successful implementation of these learning-process components, rather than as direct evidence of improvement in students' manipulative motor competence. Similarly, the overall student activity score indicates that the developed model created an active, collaborative, and reflective learning environment. The concrete movement projects provided students with opportunities to learn manipulative skills through direct practice while simultaneously engaging in interaction, problem solving, and reflection. This finding strengthens the practical contribution of the developed model because it demonstrates how PBL can be operationalized specifically within fundamental manipulative movement instruction rather than being applied only as a general pedagogical concept.

The development process also showed improvement in the feasibility and practicality of the model. Initial trial assessment scores ranged from 60% to 84%, whereas the final trial scores ranged from 88% to 100% after revisions. This descriptive shift indicates that the model was refined through an iterative development process based on evaluation and field implementation. Such a process is consistent with physical education model development, in which expert review, revision, and practicality testing are important for producing instructional models suitable for school implementation (Nurfauzan et al., 2025). Previous research has also demonstrated the relevance of structured learning models for supporting motor learning, cooperation, and discipline among elementary school students (Fizi et al., 2023).

The TGMD-3 framework strengthened the substantive organization of the developed model by providing a standardized reference for fundamental movement patterns. In the present study, however, TGMD-3 was used to organize manipulative movement content and guide formative classroom observation rather than to statistically compare pre-test and post-test motor performance. This distinction is important because the findings support the feasibility, practicality, and implementation quality of the developed model but do not establish statistical effectiveness in

improving students' motor competence. The use of TGMD-3 as an observational reference remains appropriate because of its established psychometric properties for fundamental movement assessment (Magistro et al., 2020). Thus, the developed model offers a structured approach that integrates concrete manipulative movement projects, peer communication, problem solving, formative feedback, and reflection within elementary school physical education.

CONCLUSION

This study demonstrates that the developed Project-Based Learning (PBL) model provides a valid, feasible, and highly practical framework for teaching fundamental manipulative movement skills in elementary school physical education. Student activity during implementation was categorized as very good, while teacher activity reached 96–100%, indicating consistent implementation of the model. The assessment results also increased from 60–84% in the initial trial to 88–100% in the final trial following model revisions. These empirical findings confirm that the developed model meets the required standards and can be implemented systematically in elementary school physical education. Therefore, the model is considered valid and highly practical for supporting active, collaborative, communicative, problem-solving, and reflective learning of fundamental manipulative movements.

ACKNOWLEDGMENT

The researcher expresses gratitude to Universitas Muhammadiyah Bima, State Elementary School 11 Bima City, the validator, teachers, and students for their support during this research.

CONFLICT OF INTEREST

There are no conflicts of interest in this study.

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CITE THIS ARTICLE AS

Irfan, Nasrullah, & Mulyadin. Development of a Project-Based Learning Model Based on Manipulative Fundamental Movement Skills for Physical Education in Elementary Schools. *JSES : Journal of Sport and Exercise Science*, 9(2), 141–151. <https://doi.org/10.26740/jses.v9n2.p141-151>