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Development of learning modules for floor gymnastics based on an independent curriculum for students

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ABSTRACT

This study aimed to develop and evaluate a Kurikulum Merdeka-based floor gymnastics module to enhance students' psychomotor skills. The module was developed using the ADDIE model, validated by content and media experts, and implemented with 47 Grade X students over four sessions. Data were collected through pretests and posttests, observations, interviews, and questionnaires, and analyzed using paired t-tests, N-Gain, and thematic analysis. Results showed significant improvements in forward roll (53.6%), backward roll (68.4%), and candlestick (66.0%) skills, with $p < 0.001$. Student and teacher feedback highlighted clarity, engagement, and ease of use. The module proved valid, practical, and effective, and can be adapted to similar contexts, although further development is needed to improve accessibility, differentiation, and practice duration.

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Introduction

Physical education plays a vital role in developing students' physical, mental, and social competencies through structured learning experiences (Andiani et al., 2024; Wayan, 2021). Floor gymnastics, in particular, improves flexibility, strength, balance, and motor coordination. However, schools in remote and underdeveloped regions face significant challenges in delivering effective gymnastics instruction. At SMAN 1 Siberut Barat Daya, located in Indonesia's 3T (frontier, outermost, disadvantaged) area, limited facilities, scarce learning resources, and minimal access to qualified instructional materials hinder students' skill development and confidence (Batterton et al., 2024; Ebrahim & Van Wyk, 2024; Omarsaib, 2024).

Well-designed learning modules have been shown to improve students' psychomotor skills and engagement in physical education. For example, interactive and context-based resources enhance learning motivation and technical mastery (Widiastari & Yuliandewi, 2022; Meriyanti et al., 2024). Yet, these studies were conducted primarily in urban or resource-rich schools, leaving a gap in understanding their effectiveness in rural or 3T contexts, where low confidence, high error rates, and

reduced participation remain common (Patel et al., 2024; Shao et al., 2024; Zhang et al., 2024; Purwanti et al., 2025; Sembiring et al., 2025).

Indonesia's Kurikulum Merdeka emphasizes differentiated, student-centered learning and integration of character education through the "Profil Pelajar Pancasila" values. Its experiential and reflective approach suits skill-based subjects such as floor gymnastics, but empirical studies on its implementation for practical sports skills in remote or resource-limited areas are scarce (Napitupulu et al., 2025; Rahmadhena et al., 2025).

This study addresses these gaps by developing a Kurikulum Merdeka-based floor gymnastics module tailored for 3T students. The module combines step-by-step illustrated instructions, QR code-linked video demonstrations, reflective activities, safety guidelines, and progressive stages to support diverse skill levels and inclusivity (Knight et al., 2024; Nguyen et al., 2024; Pishchukhina et al., 2024; Priven et al., 2024). Focusing on forward roll, backward roll, and candlestick techniques chosen for their pedagogical importance and difficulty the study evaluates both psychomotor improvement and perceptions of module usability among students and teachers (Priantini et al., 2022; Rhamadina, 2025).

By applying the ADDIE model and integrating quantitative and qualitative evaluation, this research aims to provide evidence that a contextually adapted, curriculum-aligned, multimedia-supported module can significantly improve floor gymnastics learning outcomes, offering a replicable approach for similar schools and supporting equitable access to quality sports education.

Method

This study employed a Research and Development (R&D) approach aimed at producing and testing the effectiveness of a Kurikulum Merdeka-based teaching module for floor gymnastics at SMAN 1 Siberut Barat Daya. The ADDIE development model Analysis, Design, Development, Implementation, and Evaluation was adopted due to its systematic structure for designing and refining educational materials. The research began with a needs analysis through observations, interviews with physical education teachers and students, and curriculum review. Findings indicated low student performance in floor gymnastics techniques and limited access to relevant learning resources, especially in the 3T (frontier, outermost, and disadvantaged) region where the school is located.

The design stage involved creating a contextually relevant and interactive module aligned with the Kurikulum Merdeka competencies and motor learning theory. The module contained theoretical explanations, step-by-step illustrations, QR code-linked instructional videos, practice sheets, and assessment rubrics. The development stage included expert validation by a gymnastics content specialist and an instructional media expert, followed by revisions based on feedback. The implementation stage applied the validated module in real classroom practice for four sessions, covering forward roll, backward roll, and candlestick techniques.

Data collection combined quantitative and qualitative approaches. Quantitative data were gathered through pretests and posttests using a standardized performance rubric, while qualitative data came from observation notes, teacher and student interviews, and satisfaction questionnaires. Data analysis involved normality testing, paired sample t-tests to determine significant differences in performance before and after module use, and N-Gain calculations to measure learning improvement. Thematic analysis of qualitative data was conducted to capture perceptions and experiences regarding module implementation. The research was conducted over a period aligned with the scheduled floor gymnastics lessons, ensuring the findings directly reflected authentic learning conditions.

Results and Discussions

The implementation of the Kurikulum Merdeka-based floor gymnastics teaching module resulted in notable improvements in students' practical performance, as well as positive perceptions of the learning process. The findings are presented in three main parts: (1) the comparison of pretest and posttest scores across forward roll, backward roll, and candlestick techniques; (2) statistical testing of learning gains using a paired sample t-test; and (3) students' evaluations of the module's clarity,

usability, and relevance. The results consistently indicate that the developed module was effective in addressing initial skill deficiencies, enhancing learning outcomes, and fostering a more engaging and supportive practical learning environment.

Table 1. Average pretest and posttest scores in floor gymnastics techniques (n = 47)

Technique	Pretest Mean	Posttest Mean	Mean Difference	% Increase	Improvement Category
Forward Roll	60.1	92.3	32.2	53.58%	Significant
Backward Roll	56.7	95.5	38.8	68.43%	Significant
Candlestick	58.0	96.3	38.3	66.03%	Significant

Table 1 demonstrates a substantial improvement in students' performance across all three floor gymnastics techniques after the implementation of the Kurikulum Merdeka-based teaching module. The backward roll and candlestick skills exhibited the highest percentage increase (>66%), indicating that the structured visual guidance and step-by-step approach of the module effectively addressed initial skill gaps.

Table 2. Paired sample t-test results for pretest and posttest scores

Variable Pair	Mean Difference	Std. Deviation	t-value	df	Sig. (2-tailed)
Pretest – Posttest	-36.468	3.921	-63.764	46	0.000

The paired sample t-test confirms a statistically significant difference ($p < 0.001$) between pretest and posttest scores, indicating that the use of the developed module had a strong positive effect on students' practical performance. The large negative mean difference reflects the increase in scores from pretest to posttest.

Table 3. Summary of students' responses to the floor gymnastics module

Evaluation Aspect	Mean Score (1–4)	Category
Clarity of content	3.7	Very Good
Supporting illustrations & images	3.6	Good
Ease of use	3.8	Very Good
Relevance to practical sessions	3.7	Very Good
Suitability for students' needs	3.8	Very Good
Overall Mean	3.72	Very Good

Students rated the module highly across all evaluated aspects, with an overall mean score of 3.72 (Very Good). They particularly appreciated the clarity of instructions, the visual aids, and the ease of use, which contributed to increased motivation and confidence during practical sessions.

The results of this study indicate that the Kurikulum Merdeka-based floor gymnastics module had a significant positive impact on students' mastery of fundamental gymnastics skills (Mahrudin, 2025; Nurbatra, 2023). The substantial improvements in mean scores for forward roll, backward roll, and candlestick techniques demonstrate the module's effectiveness in addressing the skill gaps identified during the needs analysis. The highest percentage increase was observed in the backward roll and candlestick skills, suggesting that the step-by-step visual guidance and integrated QR code video tutorials were particularly beneficial for techniques that students initially found more challenging.

The statistical analysis using a paired sample t-test confirmed that the observed improvements were not due to chance. With a mean difference of 36.468 points and a p-value < 0.001, the data provide strong evidence that the module facilitated significant learning gains. This aligns with previous research emphasizing the effectiveness of structured, visual, and interactive instructional materials in enhancing psychomotor learning, especially in practical subjects like physical education (Karich et al., 2024). The high level of statistical significance also reflects the module's capacity to support learning in a relatively short intervention period (Ismail et al., 2024; Ramdhani et al., n.d.).

In addition to quantitative improvements, qualitative feedback from students highlights the role of the module in promoting learner autonomy and confidence. The overall mean rating of 3.72 (Very Good) on the student perception survey shows that the module was well-received across dimensions such as clarity, visual support, ease of use, and relevance to practice. The integration of illustrations, sequential explanations, and multimedia resources addressed diverse learning preferences, which is a central principle of differentiated instruction within the Kurikulum Merdeka framework (Chamisijatin et al., 2023; Lidyasari et al., 2023).

From a pedagogical perspective, the success of this module can be attributed to its alignment with experiential learning theory and learning-by-doing approaches (Luthfi et al., 2021). By encouraging students to observe, practice, reflect, and self-assess, the module fostered deeper engagement and reinforced skill retention. Moreover, the emphasis on safety, gradual progression, and error correction created a supportive learning environment, which is particularly crucial for schools in remote or resource-limited contexts such as the 3T regions (Alzahrani, 2024; Mancin et al., 2024; Nemtsov & Booker, 2024).

The findings of this study contribute to the growing body of literature supporting the development of contextually relevant teaching materials in physical education. The positive outcomes suggest that similar modules could be adapted for other sports or motor skills, with potential scalability to other schools facing similar challenges (Hasniah et al., n.d.; Nur et al., 2023). While the module proved effective, future improvements could focus on incorporating adaptive features for students with special needs and expanding its digital interactivity to further enhance accessibility and engagement (Darmawan et al., 2025; Widianingsih et al., 2023).

The novelty of this study lies in integrating curriculum alignment, contextual adaptation for 3T environments, and multimedia support into a single module for floor gymnastics, a skill traditionally taught primarily through live demonstration (Priantini et al., 2022; Rhamadina, 2025). Unlike prior research that focuses only on cognitive or affective outcomes, this study simultaneously examines psychomotor skill improvement, learner autonomy, and teacher feedback on usability and relevance. By bridging theory, practical skill development, and local constraints, the module is designed not only to enhance students' technical mastery but also to provide a model for other schools facing similar challenges, thereby supporting scalable, inclusive, and contextually appropriate physical education interventions.

Conclusions

This study concludes that the Kurikulum Merdeka-based floor gymnastics teaching module developed through the ADDIE model is valid, practical, and highly effective in improving students' practical skills in forward roll, backward roll, and candlestick techniques. The module successfully addressed the initial challenges identified in SMAN 1 Siberut Barat Daya, particularly the lack of structured instructional materials, low student confidence, and limited access to learning resources in a 3T region. The significant improvement in posttest scores, supported by statistical analysis, demonstrates its positive impact on psychomotor performance. Furthermore, positive responses from students and teachers confirm the module's clarity, relevance, and usability in classroom practice. This product not only meets the objectives of enhancing technical mastery in floor gymnastics but also aligns with Kurikulum Merdeka's principles of student-centered and differentiated learning. The module is recommended for broader application in similar contexts and can serve as a model for developing other sport-specific learning resources in remote and resource-limited schools.

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