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Development of website-based deep learning media for backward roll gymnastics instruction

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ABSTRACT

This study aimed to develop and evaluate website-based gymnastics learning media integrated with a deep learning approach to improve backward rolling skills among Physical Education students at Universitas Negeri Padang. This research employed a Research and Development (R&D) design using the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages. The product was validated by material and media experts, followed by small-scale and large-scale trials. Effectiveness testing involved an experimental group (n = 30) and a control group (n = 27) using a pretest–posttest control group design. Material and media expert validation scores reached 93.34% and 95.00%, respectively. Practicality scores were 86.81% in the small-scale trial and 85.90% in the large-scale trial. Significant differences were found between the experimental and control groups for backward roll angle ($t = 4.721$, $p < 0.001$) and backward roll round performance ($t = 3.586$, $p = 0.001$). The developed website-based learning media was valid, practical, and effective in improving students' backward rolling skills and can serve as an innovative instructional tool in gymnastics learning.

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Introduction

Physical Education in higher education aims to develop students' cognitive, affective, and psychomotor competencies through integrated learning. In sports education, learning success depends not only on theoretical knowledge but also on the mastery of practical motor skills. Gymnastics is a fundamental course because it develops strength, flexibility, balance, coordination, spatial awareness, and motor control, which support various physical activities and sports performance (Handayani et al., 2026; McMurray et al., 2025). Consequently, effective instructional approaches supported by educational technology are required to promote interactive, student-centered learning and improve motor skill acquisition.

Backward rolling is one of the most challenging gymnastics skills because it requires coordination, body awareness, flexibility, balance, and confidence (Ariansyah & Usra, 2025; Plancher et al., 2024). Observations in the Physical Education, Health, and Recreation Study Program at Universitas Negeri Padang revealed that many students failed to achieve the expected competency standards due to fear of injury, limited independent practice, and inadequate understanding of correct movement patterns. Similar challenges have also been reported in previous studies (Cosper et al., 2024; Invernizzi et al., 2020). These conditions highlight the need for

innovative learning media that support repeated practice, accurate movement demonstrations, and active student engagement.

Recent developments in educational technology have enhanced practical learning through mobile applications, e-learning platforms, multimedia systems, and video-assisted instruction, all of which improve learning motivation, conceptual understanding, and motor skill performance (Ghorbel et al., 2026; Xu et al., 2024). In gymnastics education, technology-enhanced learning has been shown to improve forward rolls, handstands, and rhythmic gymnastics through multimedia-based instruction (Chen & Jacques, 2024; Fan et al., 2025; Li et al., 2024). However, previous studies have mainly focused on Android-based or video-based learning, while website-based learning for gymnastics instruction remains limited.

Although digital learning media have demonstrated positive outcomes, important research gaps remain. Most previous studies focused on product feasibility or user satisfaction rather than comprehensively evaluating validity, practicality, and effectiveness (Finteel et al., 2022; Fitriliyanto et al., 2022; Ooi et al., 2024; Silveira et al., 2024). In addition, the integration of deep learning principles meaningful learning, mindful learning, and joyful learning and the Flipped Classroom approach into website-based gymnastics learning has received limited empirical attention, despite their potential to improve conceptual understanding and motor skill acquisition (Dewi et al., 2026; Mahdi et al., 2024).

To address these gaps, this study developed website-based gymnastics learning media integrated with deep learning principles for backward rolling instruction. The website provides structured learning materials, tutorial videos, independent learning modules, formative evaluations, and supports a Flipped Classroom approach, enabling students to study independently before practical sessions. This design promotes meaningful, mindful, and joyful learning while strengthening conceptual understanding and motor skill development (Ghorbel, Trabelsi, et al., 2025; Schoville et al., 2024).

The novelty of this study lies in three aspects: developing a website-based learning media specifically for backward rolling, integrating deep learning principles into practical gymnastics learning environment, and comprehensively evaluating the product through validity, practicality, and effectiveness testing (Chaniago et al., n.d.; Storli et al., 2024). Therefore, this study contributes to technology-enhanced learning in physical education by providing an evidence-based instructional model and aims to evaluate the validity, practicality, and effectiveness of the developed media in improving backward rolling skills among Physical Education students.

Method

This study employed a Research and Development (R&D) design using the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation, to develop website-based gymnastics learning media integrated with deep learning principles for backward rolling instruction. During the analysis stage, literature reviews and field observations were conducted to identify students' learning difficulties and instructional needs. The design stage produced the website architecture, learning scenarios, tutorial videos, formative assessments, and user interface by integrating the principles of meaningful learning, mindful learning, and joyful learning into a Flipped Classroom environment. The development stage focused on producing the initial prototype, which was subsequently evaluated by one material expert and one media expert. Their feedback was used to revise and improve the product before implementation. The implementation stage consisted of small-scale and large-scale trials involving undergraduate students from the Physical Education, Health, and Recreation Study Program, Faculty of Sports Science, Universitas Negeri Padang, selected through purposive sampling based on their enrollment in the gymnastics course. The evaluation stage examined the product's validity, practicality, and effectiveness to determine its feasibility for instructional use.

Data were collected using expert validation sheets, lecturer and student response questionnaires, and backward rolling skill assessment instruments. All instruments were developed based on the research objectives and reviewed by experts prior to implementation to ensure content validity. Product validity was analyzed using Aiken's V and interpreted according to established validity criteria, while practicality was determined from percentage scores obtained during the small- and large-scale trials. Product effectiveness was evaluated using a pretest–posttest control group design involving an experimental class (n = 30) that used the website-based learning media and a control class (n = 27) that received conventional instruction during the same learning period. Before hypothesis testing, the data were examined using the Shapiro–Wilk normality test and Levene's homogeneity test. Differences between groups were then analyzed using an Independent Samples t-test at a significance level of 0.05 to determine whether the developed learning media significantly improved students' backward rolling skills.

Results and Discussions

This study aimed to develop and evaluate website-based gymnastics learning media integrated with a deep learning approach to improve backward rolling skills among Physical Education students at Universitas Negeri Padang. The results are presented in four stages, including expert validation, product practicality testing through small- and large-scale trials, and effectiveness testing using an experimental design. Overall, the findings indicate that the developed learning media achieved high levels of validity and practicality and significantly improved students' performance in backward rolling techniques compared with conventional learning methods.

Table 1. Material Expert Validation Results

Aspect	Percentage (%)	Category
Content Feasibility	95.00	Feasible
Language Feasibility	91.67	Feasible
Average Score	93.34	Feasible

The results of the material expert validation demonstrated that the website-based gymnastics learning media achieved a high level of content validity. The content feasibility aspect obtained a score of 95.00%, while language feasibility reached 91.67%. The overall average score was 93.34%, indicating that the developed learning media met the required standards for content accuracy, clarity, and instructional suitability. These findings suggest that the material presented in the website effectively supports students' understanding of backward rolling techniques and is appropriate for implementation in the learning process.

Table 2. Media Expert Validation Results

Aspect	Percentage (%)	Category
Content Feasibility	90.00	Feasible
Language Feasibility	100.00	Feasible
Average Score	95.00	Feasible

The media expert evaluation showed excellent results, with content feasibility obtaining 90.00% and language feasibility achieving a perfect score of 100.00%. The overall average score was 95.00%, indicating that the website-based learning media possessed high-quality visual design, navigation structure, accessibility, and technical functionality. These results confirm that the developed product is suitable for practical application and can effectively facilitate learning activities in gymnastics courses.

Table 3. Small-Scale Trial Evaluation Results

Aspect	Percentage (%)	Category
Display	85.42	Feasible
Material Presentation	87.50	Feasible
Usefulness	87.50	Feasible
Average Score	86.81	Feasible

The small-scale trial was conducted to examine the practicality of the developed website-based learning media. The usefulness and material presentation aspects both obtained scores of 87.50%, while the display aspect achieved 85.42%. The overall average score was 86.81%, indicating that the media was considered feasible and practical by users. These findings demonstrate that the learning media was well received and capable of supporting the teaching and learning process effectively.

Table 4. Large-Scale Trial Evaluation Results

Aspect	Percentage (%)	Category
Display	85.42	Feasible
Material Presentation	86.46	Feasible
Usefulness	85.83	Feasible
Average Score	85.90	Feasible

The large-scale trial further confirmed the practicality of the developed learning media. Material presentation obtained the highest score (86.46%), followed by usefulness (85.83%) and display quality (85.42%). The average score reached 85.90%, indicating that the website-based gymnastics learning media maintained a high level of feasibility when implemented in a broader instructional setting. Therefore, the product was considered suitable for effectiveness testing and wider educational use.

Table 5. Descriptive Statistics of Backward Rolling Skills

Group	Variable	Test	Mean	SD
Experimental (n=30)	Backward Roll Angle	Pretest	6.71	1.05
Experimental (n=30)	Backward Roll Angle	Posttest	7.71	0.84
Experimental (n=30)	Backward Roll Round	Pretest	77.17	3.07
Experimental (n=30)	Backward Roll Round	Posttest	82.15	3.70
Control (n=27)	Backward Roll Angle	Pretest	6.79	1.17
Control (n=27)	Backward Roll Angle	Posttest	6.82	0.83
Control (n=27)	Backward Roll Round	Pretest	76.76	3.27
Control (n=27)	Backward Roll Round	Posttest	79.00	4.11

Descriptive statistical analysis revealed substantial improvement in the experimental group after the intervention. For backward roll angle performance, the mean score increased from 6.71 to 7.71. Similarly, backward roll round performance improved from 77.17 to 82.15. In contrast, the control group demonstrated only marginal improvement, with backward roll angle scores increasing from 6.79 to 6.82 and backward roll round scores increasing from 76.76 to 79.00. These findings indicate that the website-based learning media contributed positively to students' gymnastics performance.

Table 6. Shapiro–Wilk Normality Test Results

Group	Variable	Sig.	Interpretation
Experimental	Backward Roll Angle Pretest	0.200	Normal
Experimental	Backward Roll Angle Posttest	0.200	Normal
Experimental	Backward Roll Round Pretest	0.160	Normal
Experimental	Backward Roll Round Posttest	0.200	Normal
Control	Backward Roll Angle Pretest	0.102	Normal
Control	Backward Roll Angle Posttest	0.124	Normal
Control	Backward Roll Round Pretest	0.120	Normal
Control	Backward Roll Round Posttest	0.200	Normal

The Shapiro–Wilk test indicated that all datasets were normally distributed, as all significance values exceeded the threshold of 0.05. The significance values ranged from 0.102 to 0.200 across all variables and groups. Therefore, the assumption of normality was satisfied, allowing the use of parametric statistical procedures for hypothesis testing.

Table 7. Homogeneity Test Results

Group	Variable	Sig.	Interpretation
Experimental	Backward Roll Angle	0.064	Homogeneous
Experimental	Backward Roll Round	0.520	Homogeneous
Control	Backward Roll Angle	0.175	Homogeneous
Control	Backward Roll Round	0.240	Homogeneous

The homogeneity test results showed that all significance values were greater than 0.05, ranging from 0.064 to 0.520. These findings indicate that the variances between groups were homogeneous. Consequently, the data met the homogeneity assumption required for conducting an Independent Samples t-test.

Table 8. Independent Samples t-Test Results

Variable	t-value	p-value	Mean Difference
Backward Roll Angle	4.721	0.000	0.89
Backward Roll Round	3.586	0.001	3.15

The Independent Samples t-test demonstrated significant differences between the experimental and control groups. For backward roll angle performance, the obtained t-value was 4.721 with a p-value of 0.000, indicating a statistically significant difference between groups. Likewise, backward roll round performance showed a significant difference with a t-value of 3.586 and a p-value of 0.001. The mean differences were 0.89 and 3.15, respectively. These results confirm that the website-based gymnastics learning media integrated with a deep learning approach and implemented through the Flipped Classroom model was effective in improving students' backward rolling skills compared with conventional instruction.

The expert validation results indicate that the developed website-based gymnastics learning media achieved high instructional quality, with material and media validity scores of 93.34% and 95.00%, respectively. These

findings demonstrate that the product met pedagogical, technical, and linguistic requirements through the systematic implementation of the ADDIE model, which aligned learning objectives, instructional content, multimedia features, and continuous expert evaluation. The integration of tutorial videos, formative assessments, and structured learning materials enhanced instructional quality and supported students' understanding of backward rolling skills. These findings are consistent with previous studies emphasizing that systematically developed instructional media improve learning quality and implementation effectiveness (Akbar & Ali Yassin, 2024; Gatia, 2024; Ghorbel, Romdhani, et al., 2025). Likewise, multimedia integration facilitates conceptual understanding and independent learning in physical education (Fahmi et al., 2025; Khataybeh & Khasawneh, 2024).

The practicality results further confirmed that the developed media was feasible for classroom implementation, with average scores of 86.81% in the small-scale trial and 85.90% in the large-scale trial. Although a slight decrease occurred during broader implementation, the consistently high scores indicate stable usability across different learning settings. The highest ratings for material presentation suggest that students perceived the instructional content as systematic and easy to understand. These findings support previous research highlighting that accessibility, usability, and clear instructional organization are essential factors influencing user engagement and learning motivation in digital learning environments (Starzak et al., 2022).

The effectiveness analysis showed that students using the website-based learning media achieved greater improvement than those receiving conventional instruction. In the experimental group, backward roll angle improved from 6.71 ± 1.05 to 7.71 ± 0.84, while backward roll round performance increased from 77.17 ± 3.07 to 82.15 ± 3.70. Conversely, the control group demonstrated only marginal improvement. These differences were statistically significant for backward roll angle ($t = 4.721$, $p < 0.001$) and backward roll round performance ($t = 3.586$, $p = 0.001$), indicating meaningful practical benefits. The findings are consistent with previous studies showing that multimedia instruction and technology-enhanced learning improve motor skill acquisition through repeated observation and independent practice (Fan et al., 2025; Ghorbel et al., 2026; Korichko et al., 2022; Susilowati et al., 2024).

The effectiveness of the developed media can be explained by the integration of deep learning principles with the Flipped Classroom approach. Meaningful learning connected theoretical concepts with practical demonstrations, mindful learning promoted reflection and self-regulated practice, while joyful learning created an engaging learning environment. Studying instructional materials before classroom practice enabled students to maximize face-to-face sessions for movement correction and feedback. These findings support previous research demonstrating that flipped learning and technology-enhanced instruction strengthen active learning, independent practice, and motor skill development (Fitriliyanto et al., 2022; Ghorbel, Trabelsi, et al., 2025; McVeigh & Waring, 2023). Furthermore, the fulfillment of normality (0.102–0.200) and homogeneity (0.064–0.520) assumptions confirms the robustness of the statistical findings.

Overall, this study demonstrates that integrating website-based learning media with deep learning principles provides an effective instructional model for gymnastics learning. Compared with previous studies that primarily focused on media feasibility, this research offers more comprehensive evidence through validity, practicality, and effectiveness evaluations. The findings contribute to technology-enhanced learning in physical education while providing lecturers with an evidence-based model for student-centered gymnastics instruction. Nevertheless, the study was limited to a single university and a relatively small sample. Future research should involve more diverse participants, evaluate long-term learning retention, and compare this website with other digital learning platforms to strengthen evidence for technology-supported motor learning in higher education (Chen & Jacques, 2024; Fauzi et al., 2026).

Conclusions

This study concludes that the website-based gymnastics learning media integrated with a deep learning approach was successfully developed and met the criteria of validity, practicality, and effectiveness for backward rolling instruction among Physical Education students. The product demonstrated high validity based on material and media expert evaluations, achieved practical implementation outcomes in both small- and large-scale trials, and significantly improved students' backward rolling performance compared with conventional learning methods. The integration of structured learning materials, tutorial videos, independent learning activities, and the Flipped Classroom approach provided a flexible and engaging learning environment that facilitated meaningful skill acquisition. Therefore, the developed website-based learning media can be utilized as an innovative instructional tool to support gymnastics learning and enhance students' mastery of backward rolling skills in higher education settings.

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