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Vol. 11. No. 1. April, (2026)

A research and development study of a game-based learning model: Effects on basketball skills and engagement in physical education

Feby Elra Perdima[1abcde,*], Davi Sofyan[2bcd], & Agus Sulastio[3cde]

Universitas Dehasen Bengkulu, Indonesia[1]
Universitas Majalengka, Indonesia[2]
Universitas Riau, Indonesia[3]

Received 12 March 2025; Accepted 04 March 2026; Published 16 April 2026
Ed 2026; *11*(1): 31-43

ABSTRACT

Background: Traditional basketball education emphasises technical drills with little active game participation, which may lower student engagement and skill development. Limited research exists on structured game-based learning (GBL) methods for basketball in Indonesian higher education. **Objectives:** This study was conducted to create and design the development of a learning model that can improve technical basketball skills. **Methods:** This study adopted a modification of Borg and Gall's 10-step research and development (R&D) model, which covers requirement analysis, design expert validation, field trials, and revision. Effectiveness was evaluated in a one-group pretest-posttest design with purposefully selected physical education students. Data was collected via Likert-scale perception surveys, interviews and standardised basketball skill tests (dribbling, passing, shooting and ball handling). Paired-sample t-tests ($p < .55$) were applied to quantitative data, and theme analysis to qualitative data. **Results:** In a small study of 30 students, the average score increased from the pretest to the posttest by 23.9%, indicating an overall improvement in basketball skills due to practice on MIBO. Results from a paired-sample t-test indicated a statistically significant difference ($p < .05$) with a large effect size. A large-scale trial, involving 60 students, confirmed the model's efficacy as participants exhibited major skill enhancement ($t = 12.44$, $p < .05$) and a large effect size. Perceptions among students were extremely positive ($M = 4.68$, $SD = 0.411$), with strong engagement and acceptance of the game-based learning approach evident. **Conclusion:** Students show improvement in their basketball technical skills, as well as enhanced engagement and improved learning experiences with the Game-Based Learning (GBL) model. This suggests that the GBL model can be successfully applied in the instruction of basketball skills. Further studies should be conducted to evaluate the long-term impact of this instruction and the possible adaptations of this approach in various sports and Physical Education settings.

Keywords: Game-based learning; basketball education; skill performance; student engagement; physical education

https://doi.org/10.25299/sportarea.2026.vol11(1).21684

Feby Elra Perdima, Master's Program in Educational Management, Faculty of Teacher Training and Education, Universitas Dehasen, Bengkulu, Indonesia
feby.elra@unived.ac.id

How to Cite: Perdima, F. E., Sofyan, D., & Sulastio, A. (2026). A research and development study of a game-based learning model: Effects on basketball skills and engagement in physical education. *Journal Sport Area*, *11*(1), 31-43. https://doi.org/10.25299/sportarea.2026.vol11(1).21684

Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Physical education is a discipline that helps pupils develop their physical, mental, social, and emotional skills (Latino et al., 2024). Physical education is taught at all levels of education in Indonesia, from elementary to college. Basketball is a sport that must be taught in college physical education and sports courses (Sofyan et al., 2022). Basketball is more than just mastering technical skills like dribbling, passing, and shooting (Abdullah et al., 2022; Perdima et al., 2024), it also includes tactical aspects of playing (Souza et al., 2024) and can help students develop social skills like teamwork, communication (Sofyan & Budiman, 2022), and coordination (Prasetyo et al., 2024). However, many challenges must be solved in learning basketball, including finding an effective and efficient learning approach to attract students' attention and increase their motivation to be actively involved in the learning process.

One approach that is gaining increasing attention in physical education is games-based learning (GBL). GBL facilitates the development of essential skills such as critical thinking, problem-solving, and motor skills (Fizi et al., 2023), also showing higher levels of interest and motivation (Guedes et al., 2024), higher learning participation (Louk et al., 2024; Ningsih, 2024), and teamwork. Incorporating GBL into physical education has been linked to increased learning outcomes (Marcaida et al., 2024), including better conceptual comprehension and skill acquisition (Mahardhika et al., 2024). Dehasen University's Physical Education study programme was established to generate graduates who can teach a variety of sports, including basketball. Many challenges are faced in basketball learning, including a lack of student motivation and limited teaching methods. Traditional basketball teaching methods often fail to engage students in practice, tend to be passive, can decrease their motivation (Song & Khechornphak, 2024), and do not match theory and practice in learning (Yang, 2024). So, a learning strategy is needed to integrate theoretical and practical aspects effectively and efficiently to achieve better learning outcomes.

The GBL approach provides a solution to these difficulties. By making games the focal point of learning, GBL teaches fundamental basketball principles and encourages students to participate actively, developing a more significant grasp and application of tactics (Xuxia, 2024), which is critical for judging game circumstances and making sound judgements. GBL provides a real-time platform for students to practise these skills, enhancing their capacity to analyse and adapt to dynamic game situations (Zhang, 2024). Rodríguez and Córdoba (2024) stated that GBL can foster creativity towards tactical problems in basketball. GBL has been shown to improve cognitive skills, motivation, and acceptance of failure, making it a potential method for sports instruction, particularly basketball (Alduwairej, 2024). However, creating a GBL model tailored to basketball learning requires a methodical, strategic strategy, from needs analysis to implementation and evaluation.

The development of game-based learning (GBL) models for teaching basketball in physical education is still a growing field despite the substantial interest in GBL in other areas of PE. Most studies have focused on the use of games for the motivational, fun, and participatory aspects of learning. Most studies have focused on one isolated learning outcome as opposed to developing a comprehensive, structured learning outcome. Also, most GBL in PE research incorporates only the movement outcome of physical activity and the technical outcome of a particular sport. Most GBL in PE research does not integrate technical, tactical, and cooperative understanding and skills in a unified teaching/learning model. Therefore, there is still a lack of comprehensive, structured GBL models for teaching basketball in physical education.

Additionally, there is still limited empirical proof for the effectiveness and practicality of GBL models in learning basketball. A good number of studies have not offered detailed development procedures and extensive validation procedures. All these factors increase the model's real-world and universal applicability. Also, the gaps regarding the instrument's standardisation in assessing basketball skills and the lack of thorough ethical considerations have proven the need for more solid studies in this field.

Developing GBL for basketball learning involves integrating educational games into basketball skills teaching, leveraging the benefits of GBL to improve learning outcomes. This research explores practical strategies for developing a GBL model for basketball learning for physical education students at Dehasen University. This study is expected to contribute significantly to sports learning innovation at the college level and become a reference for other institutions that wish to implement a similar approach.

Filling this gap, this research aims to construct, validate, and test a structured GBL model for basketball learning among students in the physical education programme at Universitas Dehasen. Mainly, we strive in this study to (i) construct the developmental model according to basketball skill and teamwork requirements, (ii) verify the validity of the developed model using expert judgement, and (iii) test its effectiveness for enhancing students' technical performance, tactical understanding, and collaboration skills. The findings are expected to promote applied research and serve as a resource for universities seeking novel, attractive basketball teaching methods.

METHOD

Research Design

This study employed a research and development (R&D) approach to construct a game-based learning (GBL) model for basketball instruction in physical education (PE). The development process was adapted from the Borg and Gall model, which provides a systematic and comprehensive framework for designing and evaluating instructional models. This model has been widely modified in educational research to accommodate specific contexts and practical constraints (Aka, 2019; Untoroseto & Triayudi, 2023), ensuring both theoretical validity and practical applicability of the developed model.

The research began with a preliminary needs analysis involving students and lecturers to identify key challenges in basketball learning. Data were collected through interviews, questionnaires, and classroom observations. The analysis focused on issues related to technical performance, tactical understanding, and collaborative skills. The findings informed the development of the initial model, which integrates fundamental basketball skills, teamwork, and tactical decision-making within structured game-based activities. The overall R&D procedure adopted in this study is illustrated in **Figure 1**, which outlines the sequential stages of model development, including needs analysis, model design, expert validation, revision, and field testing. The figure provides a visual representation of the iterative and cyclical process, demonstrating how each phase contributes to the refinement of the model.

Figure 1. Flowchart The R&D Process

Participants

At each stage of this research and development study, participant groups were systematically aligned with the specific objectives of each phase. A purposive sampling technique was employed to ensure that participants met predefined academic and physical criteria relevant to basketball learning. The needs analysis phase involved 20 physical education (PE) students (mean age = 20.4 ± 1.2 years; 14 males and 6 females). The detailed characteristics of the participants are presented in **Table 1**.

Table 1. Research Participants and Key Characteristics

Stage	N	Age (Mean ± SD)	Gender (M/F)	Basketball Experience	Role
Needs Analysis-Students	20	20.4 ± 1.2	14/6	Basic course level	Identify learning needs
Needs Analysis-Lecturers	3	38-52 yrs	2/1	8-15 yrs teaching	Provide instructional input
Expert Validators	5	35-50 yrs	4/1	8-15 yrs professional	Validate model feasibility
Small-Scale Trial	30	20.7 ± 1.1	21/9	Recreational (2 yrs avg.)	Test practicality
Large-Scale Trial	60	21.1 ± 1.3	42/18	Recreational (2-3 yrs)	Test effectiveness

Instrument Development

Following a modified research and development (R&D) framework based on Borg and Gall, the game-based learning (GBL) basketball model was developed through three main stages: (i) needs analysis, (ii) model design, and (iii) expert validation prior to pilot testing. A preliminary needs analysis was conducted with three basketball lecturers and 20 physical education (PE) students to identify common instructional challenges in basketball learning. Data were collected through classroom observations and structured interviews. Key issues identified included limitations in teaching strategies, low student participation, inadequate tactical understanding, limited teamwork during gameplay, and misalignment between learning objectives and instructional practices.

These findings informed the development of core GBL components, including student-centred instructional strategies, tactical decision-making activities, and modified game formats. Based on the needs analysis, an initial prototype of the GBL model was developed, comprising: (i) learning objectives aligned with fundamental basketball skills, (ii) game-based activities incorporating tactical problem-solving, rule modifications, and small-sided games, (iii) structured lesson plans including warm-up, core activities, and reflective sessions, and (iv) assessment tools targeting technical skills, tactical understanding, teamwork, and student perceptions.

Technical performance was assessed using the Basketball Skill Performance Test (BSPT), adapted from standardised physical education assessment protocols, covering dribbling, passing, and shooting. Each component was evaluated using an analytical rubric with performance levels ranging from 1 to 5. To ensure objectivity, assessments were conducted by two qualified PE lecturers. Inter-rater reliability was calculated using the Intraclass Correlation Coefficient (ICC), with values above 0.75 indicating acceptable reliability.

Tactical performance was evaluated using the Game Performance Assessment Instrument (GPAI), which measures decision-making, positioning, and support during gameplay. Observations were conducted by trained raters during small-sided games, with prior calibration training to enhance scoring consistency. Teamwork was assessed using a behaviour checklist adapted for PE contexts, incorporating peer assessment to improve ecological validity. The instrument evaluated collaboration, communication, role fulfilment, and shared responsibility during gameplay.

Students' perceptions of the GBL model were measured using a Likert-scale questionnaire assessing engagement, motivation, instructional clarity, and perceived learning outcomes. Content validity was established through expert review, while construct validity was examined using exploratory factor analysis (EFA). Reliability was assessed using Cronbach's alpha, with values exceeding 0.70 considered acceptable. Following expert validation, revisions were made to produce a second version of the model, which was subsequently tested in a small-scale pilot study involving 30 students. After further refinement, the final model was implemented in a large-scale trial with 60 students. The results of the expert validation are presented in **Table 2**.

Table 2. Expert Validation Results (Aiken's V)

No	Validated Component	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Aiken's V
1	Clarity of learning objectives	4	4	3	4	4	0.90
2	Relevance of game tasks	4	3	4	4	4	0.88
3	Alignment with basketball competencies	3	4	4	4	4	0.88
4	Feasibility of implementation	3	4	3	4	4	0.82
5	Assessment suitability	4	4	4	3	4	0.88

Procedure

After gathering information, the following stage is to plan and create an initial product version. This entails creating the product based on the research findings (Ekawijana & Wisnuadhi, 2022). The original model is then verified by physical education specialists, basketball coaches, and GBL learning practitioners to confirm the content and construction validity (Putri & Wardoyo, 2018; Putri et al., 2023). Following validation, a restricted trial is done on a small group of students to assess the model's practicality. The data from the short trial is utilised to improve the model's suitability for student needs and learning objectives. The next stage is a broad trial involving a larger sample of students. At this stage, the model's effectiveness is tested using a pre-test and post-test experimental design. Quantitative data analysis is carried out to see the effect of the model on improving students' basketball skills. On the other hand, qualitative data is obtained through interviews and observations to obtain further feedback regarding the implementation of the model.

The final result of this study is a GBL model that has been validated and tested for its effectiveness. This model is expected to improve the quality of basketball learning, especially for students of the Physical Education Study Programme at Dehasen University, and be a reference for developing other sports learning.

Intervention

The intervention in this study was to develop and implement a suitable GBL model specifically for the learning of basketball among students in the PE study programme. The intervention design involved cycles of design, validation, revision, and testing of the learning model in an authentic classroom environment. So, to ensure the developed model focuses on identified learning needs, such as a lack of motivation/engagement, limited tactical understanding, and a lack of teamwork skills, there are three model versions: preliminary design, development model, and final design.

Each iteration is an enhancement based on expert validation, student feedback, and trial results. Comparing across these three stages shows the extent of change from a traditional, skill-oriented model towards a game-based learning environment that emphasises strategy, teamwork, and full engagement with the activity. The table below maps the development of formative and material instructional elements, including objectives, materials, methods, media, evaluation/feedback, and duration. **Table 3** explains the interventions carried out during model development and in the final model.

Table 3. Comparison of Initial Model, Development Model, and Final Model

Aspects	Initial Model	Development Model	Final Model
Learning Objectives	Focus on improving basic skills.	Adds collaboration and problem-solving aspects.	Emphasises game play, collaboration, and strategy.
Materials	Basic techniques such as dribbling, passing, shooting.	Integrating game situation simulations.	Combination of basic techniques and real game situations.
Methods	Lecture and demonstration.	Using games-based activities.	Interactive with role-playing and team games.
Learning Media	Standard ball and field.	Adding visual media such as game analysis videos.	Technology-based with digital applications or simulations.
Evaluation Individual test of basic skills	Individual test of basic skills.	Group assessment in game situations.	Holistic assessment: individual skills, teamwork, and strategy.
Feedback	Only from the instructor.	From the instructor and fellow students (peer review).	Using the instructor, peer review, and self-reflection.
Duration	90 minutes per session with no variations.	More flexible sessions with a focus on mini games.	Structured sessions: warm-up, games, and evaluation.
Description	Traditional approach oriented on basic skills without interactive or contextual elements.	Adding elements of collaboration, simulation, and interactive methods to increase student engagement.	The final product integrates aspects of technology, real-game strategy, and comprehensive evaluation.

Data Analysis

Descriptive and inferential statistics were used to analyse quantitative data at a significance level of p < .05. In both small- and large-scale trials, pretest and posttest scores for technical ability, tactical comprehension, and teamwork were compiled using descriptive statistics, such as mean and standard deviation. The Shapiro-Wilk test was used to check for data normality before hypothesis testing. The parametric analysis was used since the data satisfied the normality assumption (p > .05). Paired-sample t-tests were used to compare pretest and posttest results in order to assess the efficacy of the GBL model. The findings were presented using the degrees of freedom, t-value, mean difference, and significance level.

The effect size was computed using Cohen's d to ascertain the extent of improvement. Cronbach's alpha for questionnaire-based measures and the Intraclass Correlation Coefficient (ICC) for technical and tactical performance were used to evaluate the reliability of the instruments. Tables and standardised graphs with properly labelled axes and error bars showing standard deviations were used to display the results.

Research Ethics

All participants provided informed consent, participation was voluntary, and the principles of research ethics were followed (anonymity and confidentiality). The research ethics committee (Universitas Dehasen) approved the present study. The participants were informed about the purpose, procedures, potential risks and benefits of the study before taking part; they had the right to withdraw from participation at any time without penalty.

RESULTS AND DISCUSSION

Result

Expert Validation

Five experts participated in the validation process, comprising one game-based learning (GBL) practitioner, two licensed basketball coaches, and two physical education (PE) professionals. The validation aimed to evaluate the model's pedagogical alignment, clarity, content relevance, and feasibility for implementation in basketball education. Content validity was assessed using Aiken's V, based on expert ratings on a 4-point relevance scale. The results indicated that all items met the required threshold for content validity (V > 0.78 for five experts), confirming that the model was valid and appropriate for implementation. Furthermore, the experts confirmed that the model adequately addressed the three targeted learning outcomes: technical performance, tactical understanding, and teamwork. Several recommendations were provided to improve the model, including strengthening the integration of tactical decision-making tasks, enhancing collaborative game scenarios, and refining the structure of technical skill activities. These suggestions were incorporated into the revised version of the model prior to field testing. Overall, the findings indicate that the developed GBL model demonstrates strong content validity and practical feasibility for use in physical education settings. Consequently, the revised model was considered suitable for further evaluation in both small-scale and large-scale trials. The detailed results of the expert validation are presented in **Table 4**.

Table 4. Model Validation Results by Experts

Assessment Aspects	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Mean	Category
Model Clarity	4.8	4.5	4.7	4.6	4.7	4.66	Excellent
Material Suitability	4.7	4.6	4.8	4.7	4.6	4.68	Excellent
Implementation Feasibility	4.5	4.7	4.6	4.6	4.7	4.62	Excellent

Small-Scale Trial (n = 30)

A small-scale field trial involving 30 physical education (PE) students from Dehasen University was conducted to examine the initial effectiveness of the game-based learning (GBL) model across technical, tactical, and collaborative domains. Descriptive statistics indicated consistent improvements across all measured variables following the intervention. Technical performance (basketball skills) increased from 62.4 ± 8.2 (pretest) to 77.3 ± 7.1 (posttest), reflecting a mean gain of 14.9 points. Tactical understanding, assessed using the Game Performance Assessment Instrument (GPAI), improved from 2.78 ± 0.54 to 3.65 ± 0.49 (mean difference = 0.87). Similarly, teamwork scores increased from 3.01 ± 0.46 to 3.89 ± 0.42, with a mean difference of 0.88.

The Shapiro–Wilk test confirmed that all data were normally distributed ($p > .05$), supporting the use of parametric analysis. Paired-sample t-test results revealed statistically significant improvements in all domains: technical performance ($t(29) = 8.54$, $p < .001$), tactical understanding ($t(29) = 7.26$, $p < .001$), and teamwork ($t(29) = 8.11$, $p < .001$). The 95% confidence intervals further supported the robustness of these differences. Effect size analysis indicated large effects across all variables, with Cohen's d values of 1.52 (technical performance), 1.32 (tactical understanding), and 1.48 (teamwork). These findings demonstrate that the GBL model produced substantial improvements not only in technical skills but also in tactical awareness and collaborative performance. Overall, the results provide strong preliminary evidence of the model's effectiveness and support its progression to larger-scale implementation in physical education contexts. Detailed results are presented in **Table 5**.

Table 5. Small-Scale Trial Results

Variable	Pre-test (M ± SD)	Post-test (M ± SD)	Mean Difference	95% CI	t	df	p	Cohen's d
Technical Performance (Basketball Skills)	62.4 ± 8.2	77.3 ± 7.1	14.9	11.3 – 18.5	8.54	29	< .001	1.52
Tactical Understanding (GPAI)	2.78 ± 0.54	3.65 ± 0.49	0.87	0.64 – 1.10	7.26	29	< .001	1.32
Collaboration Skills (Teamwork Checklist)	3.01 ± 0.46	3.89 ± 0.42	0.88	0.68 – 1.08	8.11	29	< .001	1.48

As illustrated in **Figure 2**, the mean pretest and posttest scores show a clear upward trend across all measured variables, highlighting the overall magnitude of improvement following the intervention. The distinct separation between pretest and posttest means further confirms the consistency of gains identified in the statistical analysis.

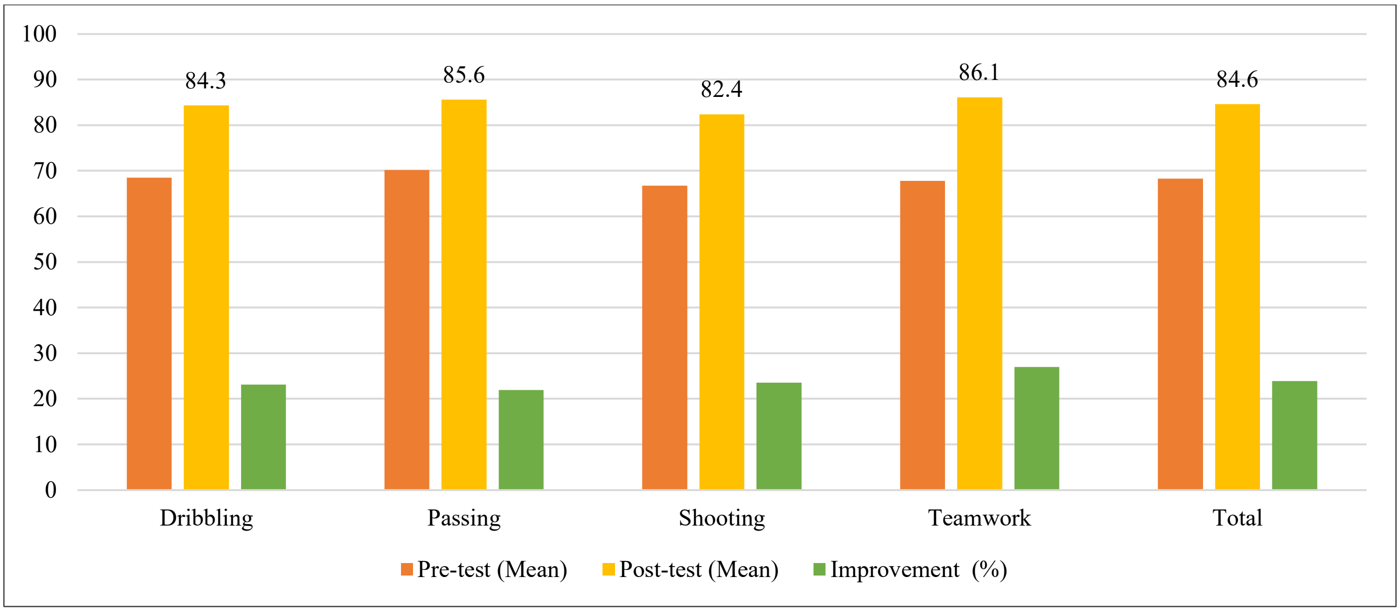

Figure 2. The Average Pretest and Posttest Scores

Furthermore, **Figure 3** provides a detailed view of individual performance trajectories, indicating that improvements were consistently observed across nearly all participants. This pattern suggests that the effectiveness of the GBL model was broadly distributed rather than driven by a limited number of high-performing individuals.

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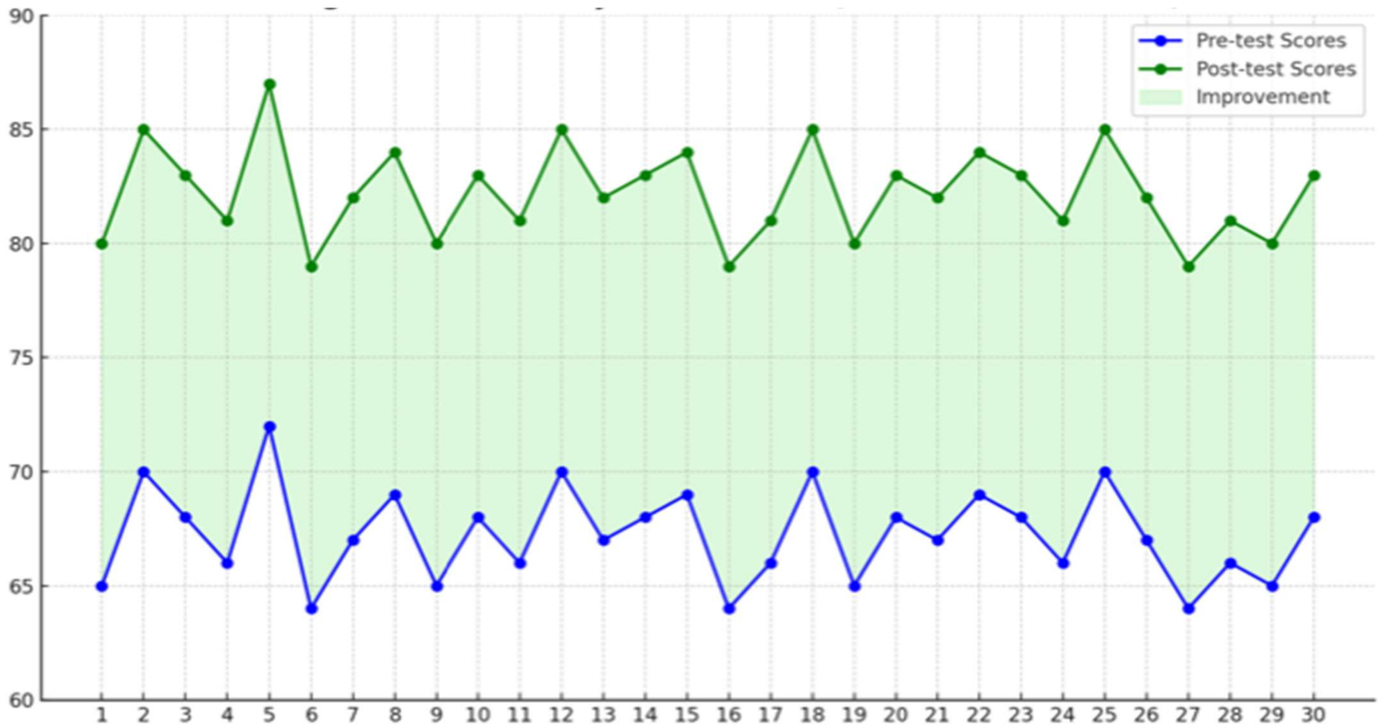

Figure 3. Improvement in Pretest and Posttest Results

Taken together, the statistical results (**Table 5**) and the visual evidence from **Figures 2** and **3** provide converging support for the effectiveness of the GBL model. These findings demonstrate that the intervention produced substantial improvements in technical performance, tactical understanding, and teamwork. Overall, the results offer strong preliminary evidence supporting the model's progression to larger-scale implementation in physical education contexts.

Large-Scale Trial (n = 60)

2 A large-scale field trial involving 60 physical education (PE) students was conducted to examine the efficacy and scalability of the game-based learning (GBL) model in improving domain-specific basketball skills. As presented in **Table 6**, substantial improvements were observed across all assessed skill domains, including shooting accuracy, dribbling control, and passing accuracy. Specifically, shooting scores increased from 61.8 ± 7.9 to 75.6 ± 7.0 (mean difference = 13.8), dribbling improved from 63.5 ± 8.4 to 78.1 ± 7.2 (mean
16 difference = 14.6), and passing increased from 62.9 ± 8.1 to 77.0 ± 6.8 (mean difference = 14.1). Paired-
26 sample t-test results indicated that all improvements were statistically significant ($p < .001$), with large effect sizes (Cohen's d ranging from 1.40 to 1.49), confirming strong practical significance. Among the three domains, dribbling demonstrated the greatest improvement, followed by passing and shooting.

Table 6. Results of The Large-Scale

7 Skill Domain	Pre-test (M ± SD)	Post-test (M ± SD)	Mean Difference	95% CI	t	df	p	Cohen's d
Shooting Accuracy	61.8 ± 7.9	75.6 ± 7.0	13.8	11.2-16.4	10.87	59	< .001	1.40
Dribbling Control	63.5 ± 8.4	78.1 ± 7.2	14.6	12.0-17.2	11.56	59	< .001	1.49
Passing Accuracy	62.9 ± 8.1	77.0 ± 6.8	14.1	11.6-16.6	11.02	59	< .001	1.42

The consistency of the mean differences, relatively narrow confidence intervals, and large effect sizes reported in **Table 6** indicate that the GBL model produced robust and reliable improvements in core basketball
19 skills. These findings provide strong empirical support for the model's effectiveness and scalability in university-level physical education settings.

In addition to performance outcomes, students' perceptions of the GBL model were assessed across five dimensions: model clarity, material relevance, learning effectiveness, student engagement, and social skills development. As summarised in **Table 7**, all dimensions received highly positive evaluations, with mean scores ranging from 4.60 to 4.75, categorised as "Excellent." The highest rating was observed for social skills development (M = 4.75, SD = 0.41), followed by model clarity (M = 4.70, SD = 0.45), student engagement (M = 4.68, SD = 0.44), material relevance (M = 4.65, SD = 0.47), and learning effectiveness (M = 4.60, SD = 0.49). The overall mean score of 4.68 (SD = 0.45) indicates strong acceptance and perceived effectiveness of the GBL model among participants.

Table 7. Students' Perceptions of the GBL Model

Measured Aspects	Mean	SD	Category
Model Clarity	4.70	0.45	Excellent
Material Relevance	4.65	0.47	Excellent
Learning Effectiveness	4.60	0.49	Excellent
Student Engagement	4.68	0.44	Excellent
Social Skills Development	4.75	0.41	Excellent
Overall Average	4.68	0.45	Excellent

Taken together, the objective performance gains (**Table 6**) and the consistently positive student perceptions (**Table 7**) provide converging evidence of the model's pedagogical value, supporting its broader application in physical education contexts.

Discussion

Indeed, the present work shows that, beyond motor skills, a Games-Based Learning (GBL) approach is pedagogically advantageous in basketball. Instead of reproducing the results, we discuss them in relation to a broader theoretical and empirical framework. GBL provided a learning context with cooperation, autonomy and scaffolded challenge-constructs which aligned well with the key principles of today's constructivist and socio-cultural learning theories. These features explain why students not only improved in three basketball skills but also had positive attitudes toward the learning situation. The findings of this study show that developing GBL for basketball learning in physical education students significantly increases learning outcomes, playing skills, and team communication. The GBL approach has been shown to provide a collaborative and interactive learning environment (Balaskas et al., 2023; Ramlan et al., 2024). GBL can also improve critical thinking (Román-Celi, 2023; Naatonis et al., 2024). These abilities are critical for team sports because players must collaborate to attain common goals (Kanwal et al., 2024). GBL has also demonstrated considerable benefits in learning outcomes, playing abilities, and team communication; nevertheless, specific problems and limits must be considered (Mikrouli et al., 2024). Therefore, these learning gains align with findings that GBL supports the deepening of procedural and conceptual understanding rather than superficial repetition of fragmented skills, as reported in the literature.

Furthermore, it can enhance motor abilities through interactive and repetitive practice of basketball tactics such as dribbling, passing, and shooting (Wijaya et al., 2023). This is especially significant in basketball, where high student enthusiasm is required for skill development. The increase in teamwork ratings demonstrates that this methodology is helpful for increasing individual talents and fostering collaboration. These findings are consistent with prior research demonstrating that game-based learning improves motivation (Setiawati et al., 2024) and student engagement (Mitchell & Co, 2024). Experts validated the model and reported good results, with an average score of 4.66. This demonstrates that the designed model satisfied the criteria for clarity, material compatibility, and execution feasibility. This finding is consistent with prior research demonstrating that involving experts in the model creation process can improve the validity of the learning model (Buitrago et al., 2023), and ensure model quality (Rizqi et al., 2020). Experts also stressed the need to tailor learning materials to students' requirements to make learning more relevant and engaging.

The 23.1% rise in pretest to posttest scores demonstrates that the program effectively improves students' basketball skills. The GBL approach enables students to learn by playing games that simulate real-world events to understand the game's concepts and techniques better. This is congruent with constructivist learning theory, which emphasises the role of active learning experiences in developing understanding. Furthermore, this rise highlights the value of a game-based learning strategy in raising student motivation. The GBL technique can make learning pleasurable for pupils, motivating them to participate actively.

The thorough trial results revealed that most students had a favourable opinion of the GBL model. High ratings for social skill development support the notion that game-based learning might improve interpersonal competence. Furthermore, high scores on the model's clarity and material relevance indicate its growth and success in meeting students' needs. Although the findings were quite favourable, students suggested improvements, such as adding different types of games and incorporating more interactive technology into instruction. These insights help refine the model before it is widely deployed. The questionnaire results showed that students rated the model positively, particularly in collaboration and involvement. The average score of 4.65 suggests that this program improves technical and social skills, such as teamwork and communication. This lends weight to the idea that game-based learning might help students build non-technical skills that are valuable in the real world. Students also valued the use of technology, such as game analysis films, in education. This shows that incorporating technology into the learning paradigm can help students better understand the topic.

Among the children, their feedback indicated numerous developmental elements. Consistent with this theme of pedagogical eclecticism in sports pedagogy, supported learning opportunities, including video analysis and app-based feedback, might enable greater agency in learners, contributing to greater reflective capabilities and more robust performance data. These results indicate that the model would have benefited from incorporating additional sophisticated technology scaffolding to support engagement and enhance learning. The results reconfirm GBL as a feasible and educationally sound concept for teaching in higher sports education, for both theoretical reflection and practical realisation. This model, developed in the context of this study, adds to emerging research showing that substantive game-integrated learning experiences can both promote successful play and provide scaffolding for mediated 21st--century skills such as collaboration, problem-solving, and reflective practice—skills increasingly recognised in current educational literature.

CONCLUSION

This study demonstrates that the GBL model effectively improves kids' basketball skills technically (dribbling, passing, and shooting). The GBL model is also effective in preparing for basketball teaching at the college students level. Through structured gameplay, skill development (dribbling, passing & shooting) is augmented by key social skills. The study's improvements and positive learning results show that the Games-Based Learning (GBL) paradigm offers a more relevant, engaging, and student-centred learning environment. These results imply that students engaged in learning activities that were seen as pertinent and inspiring, perhaps as a result of the teaching methodology's emphasis on real-world gaming scenarios and active engagement. These findings should be regarded with caution, though, as there was no control group in this study and no direct comparison with conventional teaching techniques. Therefore, in order to support causal interpretations and the generalisability of the results, it is advised that future studies use experimental or quasi-experimental methods to compare the efficacy of GBL with traditional treatments.

However, there are some limitations to address, although we found its utility. First, the sample was recruited only from one institution, which may limit generalisability to other learning environments or student populations. Second, the intervention was brief, with little known about its long-term retention and effects. Third, the research was almost entirely concerned with outcome behaviour and student perceptions, without "looking inside the head" to examine how cognitive mediators would manifest in this context—neither tactical understanding, nor learning motivation, nor cognitive load.

These limitations could be overcome in future studies with multi-institutional or cross-regional samples, longitudinal designs to examine long-term effects, and a range of assessment tools. Comparative research investigating GBL in relation to other instructional models—such as Sport Education or the Tactical Games Approach—would offer further insights into its relative effectiveness. What's more, further inclusion of digital analytics, gamified data monitoring, and tech-assisted reflection tools could provide richer evidence of how students learn and participate in GBL contexts. In sum, the findings provide support for further investigation and improvement of GBL as an auspicious framework for contemporary sports pedagogy.

ACKNOWLEDGEMENTS

9 I want to express my gratitude to everyone who contributed to the completion of this research. We would especially like to thank the instructors and students from Dehasen University's Physical Education Study Programme who participated and contributed. Additionally, I am grateful for the assistance provided by the institution, supervisors, and colleagues throughout my research. Finally, I would want to express my gratitude to my family and friends for their support and encouragement along this trip. 15

CONFLICT OF INTEREST

17 Clearly explain whether there are any conflicts of interest related to the reported research.

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