



Development of a game-based volleyball training model to improve forearm passing, teamwork, and concentration in beginner athletes

Desarrollo de un modelo de entrenamiento de voleibol basado en el juego para mejorar el pase con el antebrazo, el trabajo en equipo y la concentración en atletas principiantes

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Abstract

Introduction: Volleyball training for beginners often focuses on technical skills while neglecting teamwork and concentration. An integrated, game-based approach is needed to address these aspects holistically.

Objective: This study aimed to develop and evaluate a game-based volleyball training model to improve forearm passing, teamwork, and concentration among beginner athletes.

Methodology: A Research and Development (R&D) approach was employed using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Participants included 47 beginner athletes from three volleyball clubs in Yogyakarta, supported by six coaches and eight expert validators. The model consisted of ten structured game-based activities. Expert validation, small- and large-scale trials, and an effectiveness test with 37 athletes over 16 training sessions were conducted. Data were analyzed using descriptive statistics and paired sample t-tests.

Results: Validation scores exceeded 91%, indicating high feasibility. Practicality tests achieved ratings above 87%. Effectiveness tests showed significant improvements in forearm passing, teamwork, and concentration ($p < 0.05$).

Discussion: The findings demonstrate that integrating technical, psychosocial, and cognitive elements within a game-based model effectively enhances beginner volleyball performance. This approach provides a dynamic and engaging alternative to traditional methods.

Conclusions: The developed training model is feasible, practical, and effective, offering valuable applications for coaches, physical education teachers, and youth sports clubs in improving beginner volleyball training.

Keywords

Game-based training, volleyball, forearm passing, teamwork, concentration, beginner athletes.

Resumen

Introducción y Objetivo. El objetivo de este estudio era desarrollar y evaluar un modelo de entrenamiento de voleibol basado en el juego para mejorar las habilidades de pase con el antebrazo, el trabajo en equipo y la concentración en atletas principiantes.

Metodología. La investigación adoptó un enfoque de Investigación y Desarrollo (I+D) siguiendo el modelo ADDIE, que comprende las etapas de Análisis, Diseño, Desarrollo, Implementación y Evaluación. Participaron en este estudio un total de 47 atletas principiantes de voleibol de tres clubes locales de Yogyakarta (Indonesia), junto con seis entrenadores y ocho validadores expertos. El modelo de entrenamiento desarrollado consistió en diez actividades estructuradas basadas en el juego y diseñadas para mejorar el pase inferior, el trabajo en equipo y la concentración en escenarios dinámicos similares a los partidos.

Resultados. La validación por expertos mostró altas puntuaciones de viabilidad, con valoraciones del material y los medios superiores al 91%. Las pruebas a pequeña y gran escala confirmaron la viabilidad del modelo con puntuaciones de viabilidad superiores al 87%. Se realizó una prueba de eficacia mediante dieciséis sesiones de entrenamiento con 37 atletas principiantes. El análisis de los datos incluyó estadísticas descriptivas e inferenciales. Se cumplieron los supuestos de normalidad y homogeneidad, y las pruebas t de muestras emparejadas revelaron mejoras significativas en el pase con el antebrazo, el trabajo en equipo y la concentración ($p < 0,05$).

Conclusiones. Los hallazgos confirman que la integración de componentes técnicos, psicosociales y cognitivos dentro del entrenamiento basado en el juego es altamente eficaz en el desarrollo de indicadores esenciales de rendimiento en voleibol para atletas principiantes. Este estudio aporta un modelo de entrenamiento novedoso, validado empíricamente, que aborda un vacío crítico en la literatura existente mediante la mejora holística de las habilidades técnicas, la coordinación del equipo y el enfoque del atleta dentro de un programa integrado. El modelo ofrece una alternativa práctica y atractiva para entrenadores, profesores de educación física y clubes deportivos juveniles para mejorar el entrenamiento de voleibol de principiantes.

Palabras clave

Entrenamiento basado en el juego, voleibol, pases con el antebrazo, trabajo en equipo, concentración, deportistas principiantes.



Introduction

Sport is a vital human activity that contributes not only to physical fitness but also to the development of character, social skills, and moral values (Afif, Santoso, & Setiabudi, 2025). In the contemporary era, sport is no longer viewed merely as recreation; it has become integral to education, international diplomacy, and the cultivation of competitive human resources at various levels. Among team sports, volleyball holds a prominent place due to its widespread popularity and accessibility across diverse demographics (Dewanti, Nompembri, Hartanto, & Arianto, 2023; Astuti, Orhan, Erianti, Al Mhanna, & Batrakoulis, 2024). As a dynamic sport, volleyball requires both technical proficiency and physical capability, particularly mastery of fundamental techniques such as serving, passing, blocking, and attacking (Jariono, Sudarmanto, Nugroho, Maslikah, & Budiman, 2023; Martínez, Rodrigo, & García, 2024). One essential skill is the underhand or forearm passing technique, which is used to receive hard-driven balls and to initiate offensive plays (Astuti et al., 2025).

This technique serves as the first line of defense and a critical link in attack organization, demanding precision, quick decision-making, and situational awareness (De Waelle, Warlop, Lenoir, Bennett, & Deconinck, 2021). However, beginner athletes often struggle to execute underhand passes effectively, especially under the pressures of real-game dynamics (Zalukhu & Candra, 2024). Furthermore, success in volleyball relies heavily on teamwork, mutual trust, and sustained concentration—factors that, when lacking, can result in poor coordination, ineffective communication, and reduced team performance (Altundag, Soyulu, & Akyildiz, 2024; Conejero Suárez, Prado Serenini, Fernández-Echeverría, Collado-Mateo, & Moreno Arroyo, 2020).

Despite these multidimensional demands, existing training programs for beginner volleyball athletes remain predominantly monotonous and technique-centric, lacking emphasis on the psychosocial and cognitive dimensions of athlete development (García-González, Abós, Diloy-Peña, Gil-Arias, & Sevil-Serrano, 2020). Today, models of sports teaching express diverse perspectives and understandings of its role in the formation of human capacities, especially when it comes to dealing with children and adolescents (Alcoser, Backes, Alencar, & do Nascimento, 2023). Game-based training has increasingly gained attention as a pedagogical strategy capable of fostering technical skills while simultaneously enhancing teamwork and concentration through engaging, contextualized activities (Greipl, Moeller, & Ninaus, 2020; Wubale, Kebede, & Belay, 2023). By simulating realistic game situations, this approach encourages athletes to develop technical, tactical, cognitive, and social competencies within a dynamic, interactive environment.

The study confirmed the superiority of the comprehensive model over the traditional technique model, particularly in tactical, motivational and skill execution aspects. However, there was a gap in the exploration of the internal principles of game logic and their interaction with the Motor Conduct dimension, as well as a lack of studies related to the relational dimension. The authors suggest a collaboration between comprehensive models and Motor Praxiology approaches to map the interactions between players and the game environment to develop a deeper understanding of the game. Comprehensive models are effective in improving the cognitive, affective, and organic dimensions of net sports, but further exploration is needed for the relational dimension and its relation to the internal principles of the game (Fagundes, Lacambra, Santandreu, & Burgués, 2024).

Nevertheless, a significant gap persists in the current literature. Most existing studies employing game-based training models either focus solely on improving isolated technical abilities or on general teamwork enhancement, without offering an integrated framework that addresses technical skills, concentration, and team coordination simultaneously, particularly for beginner volleyball players. Furthermore, the majority of prior research has been conducted with adolescent or experienced athletes, leaving a paucity of evidence-based interventions specifically designed for early-stage athletes, despite this group representing a critical developmental window for motor skill and psychosocial capacity building.

To address these limitations, the present study proposes the development of a comprehensive game-based volleyball training model specifically tailored to improve lower passing techniques, teamwork, and concentration in beginner athletes. This model is constructed based on a synthesis of Motor Learning Theory, Social Learning Theory, and Situated Learning Theory (Dilnoza, 2023; Maring & Leach, 2024; Marougkas, Troussas, Krouska, & Sgouropoulou, 2023), combining structured technical drills with interactive game scenarios to foster holistic player development. The training sessions are intentionally



designed to progressively simulate actual match conditions, enhancing both technical proficiency and cognitive adaptability.

The novelty of this research lies in its integrative design and dual focus—developing a game-based training model that not only targets technical skill acquisition but also simultaneously strengthens team cooperation and concentration capacities within beginner-level athletes. Moreover, the study systematically assesses the model's feasibility, practicality, and effectiveness through expert validation, pilot testing, and statistical analysis, ensuring empirical rigor and field applicability. By addressing both the technical and psychosocial dimensions of beginner volleyball training, this study offers a significant contribution to sports pedagogy, coaching practice, and the broader discipline of physical education. It is expected that this model will serve as a valuable reference for coaches, physical education teachers, and sports clubs in optimizing beginner athlete development through evidence-based, engaging, and context-appropriate training interventions.

Method

Participants

The participants in this study consisted of beginner volleyball athletes from three local volleyball clubs in Yogyakarta, Indonesia. The sample was selected using purposive sampling to ensure relevance to the research objectives. A total of 47 athletes and 6 coaches were involved, divided across different stages of the research and development process. The early-stage validation phase involved 8 expert validators comprising 5 volleyball coaching experts and 3 sport psychology experts. A small-scale trial was conducted with 10 beginner athletes and 2 coaches at Mutiara Volleyball Club. Subsequently, a large-scale trial involved 20 beginner athletes and 4 coaches at Pervas and Selabora Volleyball Clubs. Finally, an effectiveness test was conducted at Selabora Volleyball Club, involving 37 beginner athletes aged between 13 and 16 years. All participants were healthy, had no history of injury during the study period, and had a minimum of one year of playing experience.

Research Design

This study employed a Research and Development (R&D) design following the ADDIE model framework: Analysis, Design, Development, Implementation, and Evaluation (Branch & Varank, 2009). In the analysis phase, a needs assessment was conducted through field observations and interviews with volleyball coaches and athletes to identify existing problems in passing, teamwork, and concentration training. In the design phase, a draft of a game-based volleyball training model was created, integrating ten structured game scenarios aimed at improving forearm passing, teamwork, and concentration. The content included learning objectives, equipment requirements, implementation procedures, and evaluation guidelines.

The development phase involved expert validation of the draft model. The validators were categorized into three main groups: content experts, media/model development experts, and field practitioners. The content expert validators were lecturers or professional coaches with a doctoral degree in sports science, particularly in volleyball coaching, with a minimum of five years of coaching experience and official coaching certification from recognized institutions such as PBVSI or FIVB. The media/model development expert validators were academics with expertise in instructional model or media development, experienced in designing game-based training tools, and had published scholarly works in the relevant field. Meanwhile, the field practitioner validators were selected from active volleyball coaches who had at least three years of coaching experience, held official coaching licenses, and possessed a deep understanding of real training conditions at the club level.

Feedback and suggestions from validators were used to revise and refine the training model. In the implementation phase, the model was tested through small-scale and large-scale trials. Athletes participated in training sessions held twice a week for eight weeks, totaling sixteen meetings. Each session lasted approximately 90 minutes, incorporating dynamic, game-based drills designed to simulate match conditions while targeting lower passing, teamwork coordination, and focus enhancement. In the evaluation phase, the model's feasibility, practicality, and effectiveness were assessed. Data were collected

through observation, questionnaires, interviews, and performance tests on lower passing accuracy, teamwork coordination ratings, and concentration assessments before and after intervention.

Data analysis

The data analysis consisted of both descriptive and inferential statistical techniques. Descriptive statistics, including means, standard deviations, and percentage scores, were used to describe expert validation results, feasibility assessments, and participant feedback during trials. To test the effectiveness of the developed model, paired sample t-tests were conducted to compare pre-test and post-test scores for passing skills, teamwork, and concentration. Statistical significance was set at $p < 0.05$. Data were analyzed using SPSS software version 26.0.

Results

The development of the game-based volleyball training model was conducted following the ADDIE model framework. Based on the needs analysis through field observations and interviews with coaches and beginner athletes, it was identified that conventional training was monotonous and lacked variety. The design stage produced a draft model comprising ten structured game-based exercises specifically aimed at improving lower passing, teamwork, and concentration. In the development stage, the draft model underwent expert validation involving 8 validators (5 volleyball coaching experts and 3 sport psychology experts). The feasibility scores obtained were: (1) Material Experts: 91.71% (Very Feasible), (2) Media Experts: 91.59% (Very Feasible). Subsequently, small-scale trials involving 10 beginner athletes and large-scale trials with 20 athletes indicated high levels of feasibility and practicality: (1) Small-scale trial feasibility: 87.60%, (2) Large-scale trial feasibility: 91.92% The model was revised based on feedback before progressing to the effectiveness test phase.

The results of the final product are a game-based volleyball training model to improve lower passing techniques, cooperation, and concentration for novice athletes totaling 10 types of games, namely (1) throwing catch training model, (2) rolling ball training model, (3) ball training model placed on the arm, (4) friend assistance training model, (5) sliding tagkap passing training model, (6) control passing training model, (7) pair control passing training model, (8) bouncing ball training model, (9) group training model, (10) mini game training model. The game-based volleyball training model to improve lower passing techniques, cooperation, and concentration for novice athletes is made as interesting as possible and easy for the coach to teach, so that it is fun when athletes do training, the game is safe for athletes, and can stimulate athletes to improve lower passing techniques, cooperation, and concentration.

Effectiveness Test Results

The effectiveness of the developed model was tested on 37 beginner volleyball athletes over 16 training sessions. The data analysis included a normality test, homogeneity test, and hypothesis testing using paired sample t-tests.

The results of the descriptive analysis of the pretest-posttest lower passing skills, teamwork, and concentration are presented in Table 1.

Table 1. Descriptive statistics

Aspect	Data	Mean	Std. Deviation
Lower Passing Skills	Pretest	12.22	1.20
	Posttest	14.41	1.36
Teamwork	Pretest	56.16	4.01
	Posttest	63.89	5.90
Concentration	Pretest	12.70	1.47
	Posttest	14.70	1.31

Based on Table 1, obtained data Lower Passing Skills (pretest 12.22 ± 1.20 , posttest 14.41 ± 1.36), Teamwork (pretest 56.16 ± 4.01 , posttest 63.89 ± 5.90), and Concentration (pretest 12.70 ± 1.47 , posttest 14.70 ± 1.31).

Normality Test



The normality test uses the Shapiro-Wilk test, namely by looking at the Asymp. Sig (2-tailed) residual variable if the value is above 0.05, it can be said that the data is normally distributed. A summary of the normality test results is presented in Table 2.

Table 2. Normality test analysis results

Aspect	Data	Sig.
Lower Passing Skills	Pretest	0.201
	Posttest	0.404
Teamwork	Pretest	0.261
	Posttest	0.721
Concentration	Pretest	0.420
	Posttest	0.325

Based on the results in Table 2 shows that Lower Passing Skills (pretest p-value $0.201 > 0.05$, posttest p-value $0.404 > 0.05$), Teamwork aspects (pretest p-value $0.261 > 0.05$, posttest p-value $0.721 > 0.05$), and Concentration aspects (pretest p-value $0.420 > 0.05$, posttest p-value $0.325 > 0.05$), which means the data is normally distributed.

Homogeneity Test

The homogeneity test is useful to check the homogeneity of a sample. A homogeneous or heterogeneous sample drawn from a population. Univariate test with Levenes test. A test is declared unimodal if the univariate rule p-value > 0.05 . Similar test results are shown in Table 3.

Table 3. Homogeneity test analysis results

Data	Sig.
Pretest-Posttest Lower Passing Skills Aspect	0.564
Pretest-Posttest Teamwork Aspect	0.079
Pretest-Posttest Concentration Aspect	0.846

Based on statistical analysis of homogeneity tests that have been carried out using the Levene Test in Table 3. The calculation results obtained by the Pretest-Posttest Lower Passing Skills Aspect p-value $0.564 > 0.05$, Pretest-Posttest Teamwork Aspect p-value $0.079 > 0.05$, and Pretest-Posttest Concentration Aspect p-value $0.846 > 0.05$. This means that the data groups have homogeneous variants. Thus the population has the same variant or homogeneous.

Hypothesis Test Results

The hypothesis in this study was tested using t test analysis, namely paired sample t-tests using the help of Statistical Package for Social Science (SPSS) version 26 software. Based on the results of the analysis obtained data in Table 4.

Table 4. Paired Samples Test

Data	Mean difference	t	df	Sig. (2-tailed)
Pretest-Posttest Lower Passing Skills	-2.189	9.712	36	.000
Pretest-Posttest Teamwork	-7.730	9.449	36	.000
Pretest-Posttest Concentration	-2.000	9.584	36	.000

Based on the results of the independent sample t-test analysis as presented in Table 4, it can be concluded that the game-based volleyball training model has a statistically significant effect on improving technical and psychological aspects of novice athletes. First, the lower passing variable yielded a t-value of 9.712 with a p-value of 0.000 ($p < 0.05$), indicating a significant improvement in forearm passing ability following the intervention. The mean difference between the pretest and posttest scores was 2.19, demonstrating a substantial enhancement in this fundamental skill. Second, the teamwork variable showed a t-value of 9.449 with a p-value of 0.000 ($p < 0.05$), signifying that the training model effectively fostered cooperative behavior among the athletes. The pretest-posttest difference was 7.73, reflecting a marked increase in collaborative engagement. Third, the concentration variable produced a t-value of 9.584 with a p-value of 0.000 ($p < 0.05$), confirming that the model also contributed significantly to the

athletes' concentration levels, with a mean difference of 2.00. These findings collectively suggest that the game-based volleyball training model is an effective pedagogical approach for enhancing technical execution, teamwork, and psychological readiness in beginner volleyball players.

Discussion

This study aimed to design and assess the effectiveness of a game-based volleyball training model focused on enhancing forearm passing skills, teamwork, and concentration among novice athletes. The findings revealed that the developed model was not only feasible—based on expert validation—but also practical and significantly effective when tested in both small-scale and large-scale trials. After sixteen sessions, athletes demonstrated marked improvements in technical execution, social collaboration, and cognitive engagement.

The expert validation process indicated a high level of feasibility, with content and media components scoring above 91%, suggesting the training model's structure, content, and instructional design are highly suitable for beginner-level athletes. These results are consistent with the findings of (García-González et al., 2020), who emphasized the value of game-based training models in sports education due to their capacity to offer contextually relevant and engaging learning environments. Such game-based approaches not only enhance technical competence but also instill essential emotional and social skills by providing enjoyable experiences that support holistic development (Papoutsis, Drigas, & Skianis, 2022).

The effectiveness test revealed statistically significant improvements across all target variables—lower passing, teamwork, and concentration—with paired sample t-tests yielding p-values less than 0.001. This outcome reinforces prior findings by Aini, Asmawi, & Pelana (2020) as well as Setyawati, Junaedi, Rahayu, Pratama, & Purwoto (2024), who reported that game-based methods are highly effective in improving both technical skills and cognitive aspects in novice volleyball players. Notably, while earlier studies typically focused on either technical or tactical enhancement in isolation, the current research expands the discourse by integrating psychosocial dimensions—namely teamwork and concentration—into a unified training framework.

The significant advancement in lower passing performance resonates with the conclusions of Zalukhu & Candra (2024), who asserted that effective mastery of forearm passing is a key determinant in overall volleyball performance. By embedding technical drills within dynamic and competitive game contexts, the training model required athletes to respond to real-time scenarios, thereby promoting both motor accuracy and situational awareness. These findings align with the motor learning theory outlined by Maring & Leach (2024), which emphasizes that optimal skill acquisition occurs in realistic, interactive environments that simulate actual game conditions.

In terms of social skill development, the training model effectively enhanced athletes' teamwork capabilities. Through the integration of cooperative gameplay elements, athletes were encouraged to engage in communication, planning, and mutual support—elements critical to cohesive team functioning. This aligns with findings Bozzini, McFadden, Scruggs, & Arent (2021), who highlighted that group-based competitive tasks foster interpersonal bonds and boost collective performance. Similarly, Greipl et al., (2020) confirmed that incorporating social interaction within training environments improves athlete engagement and nurtures essential social competencies.

Another important contribution of this study is its empirical demonstration of enhanced concentration levels among athletes following the intervention. The fast-paced, unpredictable nature of the game scenarios required sustained attention, rapid decision-making, and strategic responses under pressure. This is in line with studies by Fortes et al., (2022) and Kober, Wood, Kiili, Moeller, & Ninaus (2020), who found that game-based tasks significantly enhance cognitive processing, especially in relation to attentional focus and situational awareness. Furthermore, this study lends support to Singh's (2022) assertion that concentration is a critical psychological variable underpinning athletic performance in team sports, where frequent changes in game dynamics demand rapid mental adjustments.

The novelty of the present research lies in its integrative approach—addressing technical, psychosocial, and cognitive skill domains within a single training framework tailored specifically for novice volleyball



players. While previous research has addressed these elements individually or within elite athlete populations, this study bridges a critical gap by offering a developmentally appropriate model for early-stage athletes. The use of the ADDIE instructional design model further adds methodological rigor by guiding the structured development, implementation, and evaluation of the training program based on best practices in instructional design.

These findings bear significant pedagogical implications. For coaches, physical education instructors, and youth sports facilitators, the developed model presents a dynamic, empirically tested alternative to traditional drill-based training, which may lack engagement and contextual relevance. The incorporation of game-based learning principles not only sustains motivation and participation but also promotes deep learning through active involvement and reflection. From a broader educational perspective, the model aligns with constructivist pedagogical approaches, which advocate experiential learning as a pathway to cognitive and social development.

Moreover, the applicability of this training model extends beyond volleyball. Given its focus on foundational motor skills, communication, and cognitive engagement, the approach may be adapted for use in other team sports such as basketball, handball, and futsal, where similar demands on coordination, cooperation, and attentional control exist. Its relevance is particularly high in youth and school-based settings, where educators aim to foster comprehensive development through physical activity.

Based on the findings, several practical and theoretical recommendations can be made:

For Coaches and Practitioners:

1. Coaches, PE teachers, and youth sports trainers are encouraged to adopt this game-based model as an engaging and holistic alternative to conventional technique-centered programs.
2. It is advised to tailor the model's implementation based on athletes' developmental levels, gradually increasing task complexity to continuously challenge both technical and cognitive dimensions.

For Future Researchers:

1. Further studies should explore the model's applicability across different demographics—such as gender, age groups, and competitive levels—to assess its generalizability.
2. Longitudinal research is recommended to evaluate the model's sustained effects on performance, motivation, and psychosocial development.

Future work may also include physiological measures (e.g., heart rate, reaction time) to better understand how game-based training contributes to physical adaptations.

1. For Educational Institutions and Sports Organizations:
2. Schools and sports academies are encouraged to integrate game-based training into their official curricula, particularly at beginner and youth levels.

Coaching certification programs should include modules on the design and facilitation of game-based learning to better prepare practitioners with contemporary, evidence-driven teaching strategies.

In conclusion, this study confirms that a structured, game-based training model is not only theoretically robust and practically feasible, but also highly effective in enhancing forearm passing skills, teamwork, and concentration in beginner volleyball athletes. By merging technical, cognitive, and social training into an engaging and realistic format, the model represents a forward-thinking innovation in athlete-centered training. Furthermore, its adaptability across contexts offers a valuable contribution to the advancement of evidence-based coaching methodologies in both volleyball and other team sports.

Conclusions

This study successfully developed and validated a game-based volleyball training model aimed at improving forearm passing, teamwork, and concentration in beginner athletes. The model was structured



through a systematic Research and Development (R&D) approach using the ADDIE framework, incorporating expert validation, small-scale and large-scale trials, and an effectiveness test. The key findings of the study are as follows: (1) The developed training model was deemed highly feasible by both material and media experts, achieving validation scores exceeding 91%, confirming its content relevance, instructional clarity, and suitability for beginner athletes. (2) The model demonstrated high levels of practicality during small and large-scale trials, as reflected in feasibility scores above 87%, indicating strong acceptance and usability among coaches and athletes. (3) The effectiveness test results revealed statistically significant improvements in athletes' forearm passing skills, teamwork coordination, and concentration levels after sixteen training sessions, with all variables achieving p-values < 0.05. The integration of technical, psychosocial, and cognitive elements within dynamic game-based training sessions was empirically shown to enhance both individual skills and collective team performance.

This study contributes to the field of sports pedagogy and coaching science by offering an innovative, evidence-based training intervention that holistically addresses the technical, social, and mental aspects of volleyball performance in beginner athletes. The structured use of game-based scenarios provides athletes with realistic, engaging, and cognitively stimulating training experiences, fostering skill mastery and teamwork within a supportive environment.

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