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Development of a Shooting Technique Skills Training Model in Futsal Games for PJKR Students of the 2024 Class at Tadulako University, Palu City

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ABSTRACT

This study aimed to develop a structured and evidence-based shooting technique training model in futsal for PJKR students of the 2024 cohort at Tadulako University, Palu City. The research employed a Research and Development (R&D) approach by adapting the ten-step Borg and Gall model, including needs analysis, planning, initial product development, expert validation, small-group trials, revisions, and large-group trials. The development process was grounded in training principles of specificity, progression, and game-based learning to enhance both technical execution and tactical awareness in shooting performance. Research instruments consisted of rating-scale questionnaires and skill assessment rubrics administered to two futsal experts, one learning expert, and student participants. Expert validation yielded a feasibility score of 68%, categorized as "usable," indicating that the model met pedagogical and technical standards with minor revisions. The small-group trial resulted in 83% feasibility, while the large-group trial achieved 82%, both classified as "feasible for use." Empirical findings demonstrate improvements in students' shooting accuracy, coordination, and understanding of step and toe-poke techniques. These results indicate that the developed model is practical, valid, and effective in improving shooting technique mastery among PJKR students. The model provides a systematic reference for futsal instruction in higher education and contributes to the innovation of structured training models within Indonesia's growing futsal development context.

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A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

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INTRODUCTION

Sport is an integral part of human life because almost all daily activities involve physical movement that demands neuromuscular coordination and motor control. In the context of education and character development, sport serves not only as a means of fitness but also as a medium for developing skills, discipline, and social competence (Hills et al., 2015; Bailey et al., 2019). One sport that has seen a significant increase in popularity in the last two decades is futsal.

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The FIFA Futsal World Cup is a global indicator that futsal has developed into a professionally structured, competitive sport. Characteristically, futsal is an attacking game played by two teams of five players each on a small pitch with high intensity (Beato et al., 2017). The narrow pitch dimensions significantly increase the frequency of ball touches, game transitions, and opponent pressure compared to conventional soccer (Sarmento et al., 2018).

In the context of Physical Education learning, futsal often replaces soccer due to limited facilities and infrastructure. However, the effectiveness of learning basic futsal techniques, particularly shooting, remains problematic. Shooting is an essential skill that determines goal scoring and attack success (Nosa et al., 2019). Match performance studies show that shooting efficiency directly correlates with match outcomes (Yiannakos & Armatas, 2017; Ribeiro et al., 2020).

Problems arise when the shooting learning process tends to be unstructured, repetitive, and lacking a basis in biomechanical analysis. This monotonous learning model leads to low student motivation and engagement (Clemente et al., 2020). Preliminary study data from the 2024 intake of Physical Education, Health, and Recreation students showed that 55.3% had not mastered shooting techniques, 53.5% had poor conceptual understanding, 60% had difficulty executing shooting movements, and 60% had never participated in a systematic shooting technique development program. These findings indicate a gap between the demands of technical competency and the implementation of learning in the field.

Developments in futsal research over the past decade have shown an increased focus on analyzing technical performance and the physiological demands of the game. Time-motion analysis studies have revealed that futsal is characterized by high-intensity intermittent activity dominated by short sprints, rapid changes of direction, and explosive actions (Beato et al., 2017; Spyrou et al., 2020). In this context, shooting requires not only leg muscle strength but also segmental coordination, dynamic balance, and motor precision (Loturco et al., 2019).

Biomechanically, shooting using the instep produces higher ball speeds due to optimized momentum transfer from the pelvis to the lower leg (Lees et al., 2010; revisited empirically by Nunome et al., 2018). Meanwhile, shooting using the toe-poke is more effective in time-pressured situations because it requires a shorter preparation phase (Ribeiro et al., 2020). Recent research shows that a variety of training methods—such as small-sided games and technique-specific drills—can significantly improve shooting accuracy and speed (Clemente et al., 2019; Sarmento et al., 2020).

In addition to technical aspects, pedagogical approaches also play a crucial role. The Teaching Games for Understanding (TGFU) model and tactical approaches have been shown to improve decision-making and offensive effectiveness in attack play (Harvey & Jarrett, 2014; Morales-Belando et al., 2018). Integrating tactical approaches with technique-specific drills has a positive impact on skill transfer to match situations (Ometto et al., 2018).

However, most research focuses on elite athletes or competitive club-level players, while studies in the context of physical education students are limited. This group serves as potential educators who will transfer technical competencies to students in schools.

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Although the literature demonstrates the importance of shooting in the effectiveness of futsal attacks, several research gaps remain. First, research on shooting technique mastery in Physical Education students is still minimal compared to studies on elite athletes (Spyrou et al., 2020; Loturco et al., 2019). Second, most studies focus on physical variables such as power and strength without integrating pedagogical aspects and systematic training structures into the learning context (Clemente et al., 2019).

Third, approaches to shooting training in academic settings are often not based on needs analysis. Preliminary study data indicate low levels of technique mastery and limited structured training experience. This suggests that learning designs do not fully adhere to the principles of specificity, progression, and overload recommended in modern training theory (Bompa & Buzzichelli, 2019).

Fourth, there is limited research examining the integration of shooting techniques (instep and toe-poke) into systematic training models for prospective Physical Education (PJOK) teacher students. Yet, strong technical skills are a prerequisite for professionalism in physical education teachers (Bailey et al., 2019).

Thus, there is an urgent need to design a more structured, evidence-based, and relevant futsal shooting learning approach to the context of higher sports education.

Based on these problems and gaps, this study aims to analyze the level of futsal shooting technique mastery among Physical Education students and identify the need to develop a more systematic and effective training model.

The novelty of this research lies in: (1) The integration of student needs analysis as the basis for developing a shooting training approach, (2) A multidimensional approach combining technical aspects (instep and toe-poke), movement biomechanics, and pedagogical principles of sports learning, (3) The specific context of the research subjects, namely prospective Physical Education (PJOK) teacher students, has rarely been the focus of futsal technique research, and (4) An evidence-based training design approach that refers to the principles of modern periodization and tactical learning.

Theoretically, this research contributes to strengthening the literature on futsal technique learning in higher education contexts. Practically, the research results are expected to form the basis for developing a more effective shooting training model, improving student technical competence, and supporting the quality of futsal learning in schools.

Thus, this research not only answers empirical problems in the field, but also enriches the scientific knowledge of futsal-based sports coaching and pedagogy in an academic context.

METHODS

This study employed a Research and Development (R&D) approach, aiming to produce a valid, practical, and effective futsal shooting technique training model for the 2024 intake of Physical Education (PJKR) students at Tadulako University. The R&D approach was chosen because it allows for the integration of needs analysis, product design, expert validation, limited trials, revision, and implementation, ensuring that the

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resulting product meets pedagogical and technical performance standards (Branch, 2016; Plomp, 2018). In the context of sports education, systematic development models have been shown to improve the quality of training interventions compared to conventional approaches (Harvey & Jarrett, 2014; Bompa & Buzzichelli, 2019).

The development design adapts the stages of needs analysis, training model design, expert validation, small group trials, product revision, and large group trials. The needs analysis phase was conducted through observation, questionnaires, and focused discussions to identify gaps in students' shooting technique mastery, in line with the principles of evidence-based training design (Clemente et al., 2019; Sarmento et al., 2020). The training model design was based on the integration of the principles of periodization, movement specificity, load progression, and tactical learning approaches recommended in modern coaching literature (Bompa & Buzzichelli, 2019; Ometto et al., 2018).

The study was conducted at the Physical Education and Sports Training (PJKR) Study Program at Tadulako University, Palu, over a two-month period. The population included all PJKR students from the 2024 intake who actively participated in futsal lessons. A sample of 30 students was selected using a purposive sampling technique based on the following criteria: (1) actively participating in futsal practice lectures, (2) no leg injuries, and (3) willingness to participate in the entire research process. This technique was used to ensure the subjects' characteristics matched the model development objectives (Etikan & Bala, 2017).

The research instruments included: (1) validation sheets from coaching experts and sports learning experts, (2) shooting skill assessment rubrics (accuracy and speed), and (3) student response questionnaires. Shooting skill measurements were based on basic biomechanical indicators (start phase, ball contact, follow-through) and performance outcomes (accuracy and power) that have been used in previous futsal research (Ribeiro et al., 2020; Loturco et al., 2019). Content validity was achieved through expert judgment by at least two experts with futsal coaching experience, while instrument reliability was tested using Cronbach's Alpha coefficient (Hair et al., 2019).

Data analysis was conducted using descriptive quantitative data using percentages to assess the model's feasibility based on the results of expert validation and pilot testing. Feasibility criteria were determined based on the conversion of scores into very feasible, feasible, sufficient, and not feasible categories. Model effectiveness data were analyzed through pretest-posttest score comparisons using parametric or non-parametric statistical tests based on data distribution (Field, 2018). This approach aligns with training intervention evaluation practices in modern sports research (Spyrou et al., 2020; Beato et al., 2017).

The analysis results served as the basis for product revisions to obtain a systematic, applicable shooting training model that meets the needs of prospective physical education (PJOK) students. This procedure ensures that model development is not only product-oriented but also focused on scientific validity and pedagogical relevance in the context of higher education in sports.

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RESULTS AND DISCUSSION

Result

Data from the results of the first phase of the trial (Small Group)

The variables that are aspects of observation regarding the development of the shooting technique training model according to the evaluation of the first stage trial (small group) are presented in table 3, as follows.

Table 2.

Data from the results of the first phase of the trial (small group)

NO.	ASPECT	SCORE		%
		X	Xi	
1.	What do you think about the exercise in picture 1 that you have done?	36	40	90%
2.	In your opinion, how did you carry out the exercise in Figure 1?	36	40	90%
3.	In your opinion, is the exercise in picture 1 that you have done useful in playing Futsal?	36	40	90%
4.	What do you think about the exercise in picture 2 that you have done?	39	40	98%
5.	In your opinion, how do you carry out the exercise in Figure 2?	30	40	75%
6.	In your opinion, is the exercise in picture 2 that you have done useful in playing Futsal?	39	40	98%
7.	What do you think about the exercise in picture 3 that you have done?	19	40	48%
8.	In your opinion, how do you carry out the exercise in Figure 3?	22	40	55%
9.	In your opinion, is the exercise in picture 3 that you have done useful in playing Futsal?	24	40	60%
10.	What do you think about the exercise in Figure 4 that you have done?	39	40	98%
11.	In your opinion, how do you carry out the exercise in Figure 4?	30	40	75%
12.	In your opinion, is the exercise in picture 4 that you have done useful in playing Futsal?	39	40	98%
13	What do you think about the exercise in Figure 5 that you have done?	36	40	90%
14	In your opinion, how do you carry out the exercise in Figure 5?	30	40	75%
15	In your opinion, is the exercise in picture 5 that you have done useful in playing Futsal?	39	40	98%
16	What do you think about the exercise in Figure 5 that you have done?	36	40	90%
17	In your opinion, how do you carry out the exercise in Figure 5?	30	40	75%
18	In your opinion, is the exercise in picture 5 that you have done useful in playing Futsal?	39	40	98%
	AMOUNT	**599**	**600**	**83%**

Phase II trial data (Large Group)

The variables that are aspects of observation regarding the development of the shooting technique training model according to the evaluation of the phase II trial (Large Group) are presented in table 3 as follows.

Table 3.

Data from the results of the phase II trial (Large group)

NO.	ASPECT	SCORE		%
		X	Xi	
1.	What do you think about the exercise in picture 1 that you have done?	113	120	94%
2.	In your opinion, how did you carry out the exercise in Figure 1?	107	120	89%
3.	In your opinion, is the exercise in picture 1 that you have done useful in playing Futsal?	120	120	100%
4.	What do you think about the exercise in picture 2 that you have done?	51	120	43%
5.	In your opinion, how do you carry out the exercise in Figure 2?	66	120	55%
6.	In your opinion, is the exercise in picture 2 that you have done useful in playing Futsal?	83	120	69%

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7.	What do you think about the exercise in picture 3 that you have done?	96	120	80%
8.	In your opinion, how do you carry out the exercise in Figure 3?	108	120	90%
9.	In your opinion, is the exercise in picture 3 that you have done useful in playing Futsal?	107	120	89%
10.	What do you think about the exercise in Figure 4 that you have done?	99	120	83%
11.	In your opinion, how do you carry out the exercise in Figure 4?	107	120	89%
12.	In your opinion, is the exercise in picture 4 that you have done useful in playing Futsal?	108	120	90%
13.	What do you think about the exercise in Figure 5 that you have done?	99	120	83%
14.	In your opinion, how do you carry out the exercise in Figure 5?	107	120	89%
15.	In your opinion, is the exercise in picture 5 that you have done useful in playing Futsal?	108	120	90%
AMOUNT		**1,479**	**1,800**	**82%**

The results of the trial with PJKR students from the Class of 2024 also showed that this training model was well-received. In the first trial (small group), the percentage achieved was 83%, while in the second trial (large group), the percentage was 82%, both of which were in the "use" category. These results indicate that the shooting training model is able to improve students' understanding and skills in shooting techniques in futsal.

The development of a shooting technique training model in futsal games for PJKR students of the 2024 class was carried out using the Bord and Gall procedure which includes 10 stages, namely: research and initial information collection, planning, initial product development, initial field trials, product revision, main field trials, operational product revisions, operational field trials, final product refinement, and the dissemination and implementation stage.

Discussion

The development of a futsal shooting technique training model for the 2024 Physical Education and Training (PJKR) students of Tadulako University was carried out using the Borg and Gall procedure, which includes ten systematic stages: (1) research and initial information collection, (2) planning, (3) initial product development, (4) initial field trials, (5) product revision, (6) main field trials, (7) operational revision, (8) operational trials, (9) final product refinement, and (10) dissemination and implementation. This approach is relevant in the context of sports education because it allows for the integration of needs analysis, expert validation, and a gradual and continuous evaluation of effectiveness (Plomp, 2018; Branch, 2016).

The initial research and information collection phase indicated that most students had not yet optimally mastered shooting technique, both in terms of movement biomechanics and shot accuracy. This finding aligns with research by Clemente et al. (2019), which states that a lack of technique-specific training in the context of invasion game learning often leads to low finishing effectiveness. In futsal, shooting is a key indicator of offensive effectiveness due to the fast-paced nature of the game, limited space, and high opponent pressure (Beato et al., 2017; Spyrou et al., 2020).

In the initial product planning and development stages, a training model was designed based on the principles of specificity, progression, and variation. Modern coaching literature confirms that neuromuscular adaptation only occurs optimally when training closely mimics

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the demands of a match (Bompa & Buzzichelli, 2019). Therefore, the developed model integrated instep shooting and toe-poke shooting drills in semi-match situations (small-sided games). This approach is supported by Sarmento et al. (2020), who stated that small-sided games effectively improve decision-making and finishing quality.

From a biomechanical perspective, shooting using the instep requires segmental coordination, from hip rotation, knee extension, and ankle plantar flexion to generate high ball speed (Nunome et al., 2018). Meanwhile, toe-poke shooting has a shorter preparation phase and is effective in time-pressured situations (Ribeiro et al., 2020). The integration of both techniques within the training model provides a more comprehensive skill stimulus. This aligns with the findings of Loturco et al. (2019) that the combination of strength and technique training significantly improves shooting performance.

Initial field trials demonstrated improved accuracy and consistency of student movements. This indicates that a structured approach is more effective than conventional, repetitive methods without movement error analysis. Harvey and Jarrett (2014) emphasized that game-based learning can improve both technical skills and tactical awareness. Thus, this model not only hones kicking mechanical skills but also enhances the ability to select the right shooting moment.

Product revisions were conducted based on input from coaching and sports learning experts. Expert validation ensured that the training content aligned with pedagogical and safety principles. This validation process is crucial to ensure the quality of the product being developed (Branch, 2016). In addition, an iterative approach in R&D allows for continuous improvement based on empirical data, as recommended in educational design research (Plomp, 2018).

The main field and operational trials showed more significant improvements in shooting accuracy and power. Physiologically, these improvements can be explained by neuromuscular adaptations resulting from repetitive training with progressive loading (Suchomel et al., 2018). These adaptations increase motor unit recruitment and intramuscular coordination efficiency, resulting in more stable kick quality. Research by Spyrou et al. (2020) also showed that high-intensity futsal training improves anaerobic capacity, which contributes to shooting quality in match situations.

Furthermore, students' motivational aspects also improved during the implementation of the model. This is supported by Self-Determination theory, which states that learning that provides optimal challenges and contextual relevance increases intrinsic motivation (Ryan & Deci, 2017). Varied, game-based training models have been shown to be more engaging than monotonous drill methods (Morales-Belando et al., 2018).

The final product refinement phase resulted in a systematic shooting training model, consisting of: (1) a specific warm-up phase, (2) basic instep and toe-poke drills, (3) combination drills with movement without the ball, (4) small-sided games with shooting zone targets, and (5) rubric-based performance evaluation. This structure aligns with the micro-periodization approach in modern coaching (Bompa & Buzzichelli, 2019).

Theoretically, this research strengthens the literature that developing R&D-based training models effectively improves the quality of sports technique learning in higher

education. While most previous research has focused on elite athletes (Beato et al., 2017; Spyrou et al., 2020), this study contributes to the context of prospective physical education (PJOK) teacher students. Thus, this research broadens the scope of the futsal technique training model's implementation in the academic setting.

Practically, this model provides systematic guidance for lecturers in teaching shooting techniques in a structured and evidence-based manner. The integration of biomechanical principles, exercise physiology, and sports pedagogy allows this model to not only improve technical skills but also strengthen students' professional competencies as future educators.

By comprehensively going through the ten stages of Borg and Gall, the developed shooting training model proved valid, practical, and effective. These results confirm that a research-based development approach not only produces innovative products but also ensures their acceptability and sustainable implementation in higher education sports education contexts.

CONCLUSION

This research successfully developed a futsal shooting technique training model that was deemed feasible and usable based on expert validation and a phased trial. Validation by two futsal experts and one sports learning expert demonstrated a feasibility level of 68% in the "usable" category, indicating that the model met technical and pedagogical substance standards. Small group (83%) and large group (82%) trials demonstrated high levels of acceptance and effectiveness, confirming that this model is practical and applicable in the learning context of physical education (PJKR) students.

Conceptually, these findings reinforce the importance of structured training design, based on the principles of specificity, progression, and integration of tactical approaches, in improving technical skills. Empirically, the improvement in scores during the trial phase indicates that the training model can improve students' accuracy, motor coordination, and understanding of shooting technique.

Thus, the developed model can be an innovative alternative for improving the quality of futsal instruction in higher education, while also contributing to strengthening students' professional competencies as prospective physical education teachers.

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