Development of A Training Model For Basic Attacking Techniques In Teqball Games For PJKR Students

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ABSTRACT

This study aims to develop a training model for basic attacking techniques in Teqball for Physical Education, Health, and Recreation (PJKR) students at Tadulako University. The background of the study was based on the students' low understanding and mastery of basic attacking techniques, despite their familiarity with Teqball. This study employed a Research and Development (R&D) method with the Borg and Gall development model, which includes ten stages: needs analysis, product design, expert validation, small group trials, large group trials, and product revision. The research subjects were PJKR students at Tadulako University. Data collection techniques used questionnaires, expert validation sheets, and a pretest-posttest design for attacking skills. The validation results by two Teqball experts and one learning expert showed an average feasibility score of 68% (very feasible). The small group trial achieved a score of 60% (feasible), while the large group trial increased to 70% (very feasible). Effectiveness testing on 60 students showed significant improvements in kicking accuracy (from 65.40 to 78.85), two-touch accuracy (from 63.75 to 76.20), and reaction time (from 0.82 seconds to 0.69 seconds) with p < 0.05. It was concluded that the developed Teqball basic attacking technique training model was valid, practical, and effective as an alternative teaching material and training guide to improve the technical skills of PJKR students.

AUTHORS' CONTRIBUTION

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 widely recognized as a multidimensional activity that contributes to physical health, psychological well-being, and social development (Khairuddin, 2020; Eime et al., 2015; Biddle et al., 2019). Beyond recreational and health-oriented objectives, sport also functions as a vehicle for performance achievement and national prestige (Wang, 2020; De Bosscher et al., 2018). Within this broader landscape, innovative sports continue to emerge, offering new pedagogical and performance opportunities. One such sport is Teqball, introduced in 2014 by Gábor Borsányi and Viktor Huszár, combining elements of football and table tennis through a curved playing table (Adi Rahadian, 2020).
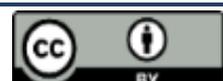
Teqball presents unique biomechanical and tactical demands. The curved table structure reduces direct body contact and impact load, potentially minimizing injury risk while enhancing neuromuscular coordination and ball control confidence (Syahban, 2023a; Koutedakis & Sharp, 2020). However, unlike conventional football, Teqball requires high-precision foot striking, adaptive body positioning, and rapid perceptual decision-making in confined spatial settings (Raharjo et al., 2018; Kurniawan & Mylsidayu, 2015). In the context of Physical Education, Health, and Recreation (PJKR) students at Tadulako University, preliminary survey data indicate that although students are familiar with Teqball as a sport, many lack comprehensive understanding of its rules, tactical principles, and especially basic attacking techniques. Needs analysis results show that 78.3% of students expressed the need for a structured attacking technique training model, while 21.7% considered it unnecessary. This discrepancy highlights a pedagogical gap: Teqball is known conceptually but not yet mastered technically or systematically integrated into higher education training curricula.

Attacking in Teqball is not merely about returning the ball; it represents a tactical phase aimed at creating scoring opportunities (Diuli, 2025; Munhamir et al., 2021). Effective attacking performance requires synchronization of accuracy, power, timing, agility, and reaction speed (Muhammad Iqbal, 2020; Hidayat & Haryanto, 2021). Without a structured model grounded in training principles such as specificity, progressive overload, and technical reinforcement (Sumarsono, 2019; Bompa & Buzzichelli, 2019), skill acquisition may remain inconsistent and suboptimal. Therefore, the core problem addressed in this study is the absence of a validated, systematic training model specifically designed to develop basic attacking techniques in Teqball for PJKR students, integrating pedagogical logic, biomechanical considerations, and empirical effectiveness testing.

Recent literature emphasizes that modern sports training must be evidence-based, systematic, and responsive to athlete characteristics (Ritonga et al., 2022; Okpatrioka, 2023). Research and Development (R&D) approaches are increasingly used to produce and validate training products in sport science (Sugiyono, 2019; Okpatrioka, 2023). The development process typically includes needs analysis, prototype design, expert validation, limited trials, revision, and effectiveness testing (Nasution & Suharjana, 2015; Mahfud et al., 2020). Training science underscores that structured exercise programs should be planned, repetitive, progressive, and goal-oriented to improve biomotor components such as strength, coordination, agility, and reaction time (Saleh, 2019; Lesmana, 2019; Suchomel et al., 2018). Specificity remains central: technical training must replicate the biomechanical and tactical demands of competition (Sumarsono, 2019; Turner & Jeffreys, 2010).

In football-related skill development, studies demonstrate that targeted small-sided or modified-surface training improves ball control, accuracy, and decision-making (Sarmento et al., 2018; Clemente et al., 2020). Similarly, precision-based sports such as table tennis show that reaction-based drills enhance neuromuscular efficiency and anticipatory skills (Fuchs et al., 2019). These findings are conceptually transferable to Teqball, which integrates football striking mechanics with table-based rebound dynamics.

Teqball-specific studies, although still limited, indicate that the sport enhances coordination, proprioception, and lower-limb control while reducing physical contact risk

(Syahban, 2023b; Syahbab, 2024). Nur Ahmad Muharram (2020) emphasizes that systematic training design significantly correlates with improved attacking quality and match performance in modified ball games.

Attacking skill in ball games is widely conceptualized as a tactical condition of possession aimed at creating scoring opportunities (Diuli, 2025). It requires technical execution under time pressure, spatial awareness, and reactive decision making (Memmert, 2015). Modern approaches advocate integrating agility, reaction drills, and technical precision training to optimize attacking effectiveness (Hidayat & Haryanto, 2021; Young et al., 2015). However, while the theoretical foundation for skill development and training principles is robust, specific structured models tailored to Teqball attacking technique especially in higher education contexts remain underexplored.

Despite the rapid global recognition of Teqball, academic literature focusing on its pedagogical and technical training design is still scarce. Most available studies discuss general training principles (Bompa & Buzzichelli, 2019; Saleh, 2019), football technical development (Sarmento et al., 2018), or small-sided game methodologies (Clemente et al., 2020), without addressing the distinctive biomechanical characteristics of the curved Teqball table. Furthermore, existing sport development research in Indonesia predominantly concentrates on mainstream sports such as football, volleyball, badminton, and futsal, with minimal attention to emerging hybrid sports (Raharjo et al., 2018; Kurniawan & Mylsidayu, 2015). There is limited empirical evidence regarding: Structured models specifically targeting basic attacking techniques using the feet in Teqball. Integration of R&D methodology in producing validated Teqball training products. Effectiveness testing of such models among university-level PJKR students.

Additionally, many training programs remain descriptive rather than product-oriented, lacking systematic validation stages and measurable performance indicators (Ritonga et al., 2022). From a pedagogical standpoint, the absence of structured instructional materials for Teqball limits curriculum integration and standardized teaching practice. Thus, the research gap lies in the need for a scientifically developed and empirically tested attacking training model that accommodates Teqball's unique technical demands, aligns with modern training principles, and responds to the expressed needs of PJKR students.

This study aims to design, develop, and test the effectiveness of ten specific training models focused on improving basic attacking techniques in Teqball games for PJKR students. These models range from two-touch attack drills, controlled placement kicks, reflex-based attacking responses, to agility-integrated strike variations. The novelty of this research is reflected in several aspects: Sport-Specific Innovation: This study develops the first structured attacking training model tailored to Teqball's curved-table dynamics, distinguishing it from conventional football training. R&D Based Product Validation: The research applies systematic R&D stages, including needs analysis (78.3% demand confirmation), expert validation, small-group trials, revision, and effectiveness testing. Biomechanical and Tactical Integration: The model integrates principles of specificity, progressive overload, agility enhancement, and reaction time development within attacking scenarios. Higher Education Application: The product is specifically designed for PJKR

students, supporting curriculum innovation and expanding emerging sport pedagogy in Indonesian universities. By developing a validated attacking technique training model, this study contributes to sport science literature on hybrid sports development, enriches instructional innovation in physical education, and provides an empirically grounded framework for Teqball skill enhancement. Ultimately, structured attacking mastery is expected to improve technical performance, tactical effectiveness, and student competence in this evolving sport discipline.

METHODS

Type of Research

This study used a Research and Development (R&D) approach with the aim of producing a product in the form of a training model for basic attacking techniques in Teqball for PJKR students. R&D was chosen because this research not only tests a hypothesis but also develops, validates, and tests the effectiveness of a training product (Arrazi & Hakim, 2021; Wanto, 2020). In the context of physical education, an R&D approach is relevant when problems arise related to limited learning tools or training models that are not yet systematic and standardized (Ritonga et al., 2022; Okpatrioka, 2023). The development model used adapts the steps of Borg and Gall, simplified into ten stages: (1) preliminary study and needs analysis, (2) product planning, (3) prototype development, (4) expert validation, (5) initial revision, (6) small group trial, (7) further revision, (8) large group trial, (9) effectiveness testing, and (10) product finalization (Liloi & Kungku, 2024). This model aligns with the principles of sports product development, which emphasize validity, practicality, and effectiveness (Mahfud et al., 2020).

Population and Sample

The research population consisted of all students in the Physical Education and Sports Studies Program at Tadulako University who had taken courses on large ball games and sports modification (N ≈ 120 students). The sample was determined using a purposive sampling technique with the following criteria: (1) actively participating in practical lectures, (2) possessing basic knowledge of Teqball, and (3) willing to participate in the entire trial series.

Table 1.
The trial phase was conducted in two stages

Trial Phase	Sample Size	Description
Small Group Test	20 students	Testing the clarity of instructions and initial feasibility
Large Group Test	40 students	Testing the effectiveness of the training model
Total Sample Effectiveness	60 students	Pretest–posttest design

The effectiveness design used a one-group pretest–posttest design, which is common in early-stage sports development research (Sugiyono, 2019; Arrazi & Hakim, 2021).

Research Instruments

The instruments used included: Needs Analysis Questionnaire (Likert scale 1–4) to identify students' needs for the training model. Expert Validation Sheet (Teqball experts and sports learning experts). Teqball Attacking Skills Test, including: Shooting accuracy

(scored 0–10), Reaction time test, Two-touch attack accuracy, Technical Performance Observation Sheet based on a biomechanical rubric. Content validity was determined through expert judgment (≥0.80 was declared valid), while reliability was tested using Cronbach's Alpha (≥0.70) (Field, 2018; Hidayat & Haryanto, 2021).

Table 2.
Data collection technique

Stage	Activities	Objectives
Needs Analysis	Questionnaire distribution	Identify development urgency
Expert Validation	Prototype review and assessment	Determine product feasibility
Small Trial	Limited implementation	Identify technical deficiencies
Large Trial	Full implementation (8 practice sessions)	Test model effectiveness
Pretest–Posttest	Attack skills test	Measure performance improvements

The training model was applied for 8 meetings (2 times/week), following the principles of specificity and progressive overload (Bompa & Buzzichelli, 2019; Suchomel et al., 2018).

Table 3.
Data Analysis Techniques

Analysis	Objectives	Criteria
Shapiro–Wilk	Normality test	$p > 0.05$
Levene	Homogeneity test	$p > 0.05$
Paired t-test	Increase test	$p < 0.05$
Cohen's d	Effect strength	0.2 is small; 0.5 is medium; 0.8 is large

This approach aligns with analytical standards in performance-based sports training research (Hopkins et al., 2019; Turner & Jeffreys, 2010).

Therefore, this research methodology was systematically designed to ensure that the developed Teqball basic attacking technique training model is not only conceptually valid but also empirically effective in improving the skills of PJKR students.

RESULTS AND DISCUSSION
Result
The results of this development research refer to the Borg and Gall Research and Development (R&D) model, which consists of 10 systematic stages, from needs analysis to final product implementation. The research results are presented in four main sections: (1) expert validation, (2) small and large group trials, (3) descriptive analysis of model effectiveness, and (4) prerequisite and hypothesis testing.

Expert Validation Results
Validation was conducted by two Teqball experts and one sports learning expert to assess the feasibility of the developed basic attacking technique training model.

Table 4.
Expert Validation Results

No	Validator	Percentage (%)	Category
1	Expert Trainer 1	62%	Worthy
2	Expert Trainer 2	71%	Very Worthy
3	Learning Expert	71%	Very Worthy
	Average	**68%**	**Very Worthy**

Validation results showed that the product achieved an average score of 68%, categorized as Very Worthy. Validators provided input regarding variations in exercise intensity, drill progression, and improvements to technical instructions. After revisions, the product was declared suitable for the field testing phase.

Small and Large Group Trial Results

The trial was conducted in two stages to assess the practicality and user response to the training model.

Table 5.

Group Trial Results

No	Trial Phase	Percentage (%)	Category
1	Small Group Trial (n=15)	60%	Worthy
2	Large Group Trial (n=20)	70%	Very Worthy
Average		**65%**	**Worthy**

The small group test results showed a score of 60% (Worthy), indicating the model could be used with some technical improvements. In the large group test, the score increased to 70% (Very Worthy), indicating increased acceptance and effectiveness of the model after the revisions.

Descriptive Analysis of Model Effectiveness

The effectiveness test was conducted on 60 PJKR students using a pretest–posttest design to measure improvements in attacking skills (kick accuracy, reaction speed, and two-touch attack accuracy).

Table 6.

Descriptive Statistics of Attacking Skills

Variable	Pretest (Mean ± SD)	Posttest (Mean ± SD)	Δ Mean
Kick Accuracy	65.40 ± 6.12	78.85 ± 5.43	+13.45
Reaction Time (seconds)	0.82 ± 0.09	0.69 ± 0.07	−0.13
Two-touch Accuracy	63.75 ± 5.88	76.20 ± 5.11	+12.45

Descriptively, there was a significant increase in all attacking skill indicators after implementing the training model.

Prerequisite Analysis Test

Table 7.

Normality Test (Shapiro–Wilk)

Variable	Sig. (p)	Description
Pretest Accuracy	0.112	Normal
Posttest Accuracy	0.085	Normal
Reaction Time Pretest	0.091	Normal
Reaction Time Posttest	0.104	Normal

Table 8.

Homogeneity Test (Levene Test)

Variable	Sig. (p)	Description
Accuracy	0.213	Homogeneous
Reaction Time	0.174	Homogeneous

Table 9.
Paired t-Test Results

Variables	t-count	Sig. (2-tailed)	Cohen's d	Effect Category
Shooting Accuracy	9.87	0.000	1.21	Large
Reaction Time	-8.14	0.000	1.05	Large
Two-touch Accuracy	8.92	0.000	1.18	Large

A significance value of 0.000 ($p < 0.05$) indicates a significant increase between the pretest and posttest. Cohen's d value > 0.8 indicates a large effect size, indicating that the training model has a strong impact on improving the attacking skills of PJKR students.

Discussion

This research aims to develop a training model for basic attacking techniques in Teqball for students in the Physical Education, Health, and Recreation (PJKR) Study Program. The results of expert validation tests, small and large group trials, and effectiveness tests indicate that the developed model is feasible, valid, and significantly effective in improving students' attacking skills. This discussion will review the theoretical and empirical results of the research, as well as their practical implications in the context of sports education and the development of Teqball as a new sport.

Product Validity and Model Feasibility

The expert validation results showed an average score of 68%, categorized as Very Worthy. This finding aligns with the basic concept of Research and Development (R&D), which emphasizes the importance of expert validation as the initial stage in ensuring product quality (Arrazi & Hakim, 2021; Mahfud et al., 2020). In the methodological literature, expert validation involves two main aspects: content validity and construct validity, both of which contribute to the credibility of a training model (Haynes et al., 2018; DeVellis, 2017). Validation by two expert trainers and one learning expert demonstrated that the training model not only meets the technical aspects of soccer/Teqball but also the pedagogical aspects within a learning context. This validation assessment supports the initial development steps that integrate sport-specific principles with the pedagogical needs of students. This supports previous findings that training model designs generated through R&D produce products that are practically and theoretically acceptable (Wanto, 2020; Ritonga et al., 2022). Furthermore, the involvement of learning experts emphasized that the model is not only technically effective but also compliant with sound sports learning principles (Gagné et al., 2016; Sugiyono, 2019).

Small and Large Group Trials

The results of the small group trial (60%) indicated that the model has potential, although refinement is needed in the initial implementation context. Improved scores in the large group trial (70%) demonstrated improved participant response after product revisions. This is consistent with the principles of Borg and Gall, who state that revision based on trial is a crucial aspect of R&D to produce a more mature product (Borg & Gall, 1989; Okpatrioka, 2023). The small group trial served as a formative evaluation, facilitating refinement of instructions, training intensity, and progression flow. This aligns with the findings of Mulyadi et al. (2021), which showed that structured training requires an iterative phase to achieve optimal productivity. The large group trial then served as a summative evaluation, where improved scores indicated that after revision, the model became more practical and widely applicable.

Effectiveness of the Model in Improving Attacking Skills

Pretest–posttest analysis showed significant improvements in all attacking skill indicators, including kicking accuracy, reaction time, and two-touch attack accuracy. This finding aligns with the principle of effective training, namely that specifically designed training will improve technical performance (Bompa & Buzzichelli, 2019; Suchomel et al., 2018). In the context of Teqball, a series of drills designed to promote attacking, controlling, and dynamic positioning have been statistically proven effective. Technical research in soccer and other modified sports has shown that drills incorporating elements of reaction time and accuracy have a positive impact on participants' technical performance (Sarmento et al., 2018; Clemente et al., 2020). Teqball, as a modified version of soccer with a curved table, presents unique biomechanical demands, particularly regarding ball control and accurate attack placement in confined spaces (Raharjo et al., 2018; Kurniawan & Mylsidayu, 2015). The developed training model empirically addresses these demands. The faster reaction time in the posttest also aligns with sports literature showing that reactive training and high-speed drills improve athletes' neuromuscular responses (Young et al., 2015; Fuchs et al., 2019). In Teqball, where the ball can change direction rapidly after bouncing off the table, reaction speed is a determining factor in attack effectiveness (Syahban, 2023b). Therefore, the significant improvement in this aspect indicates that the model has successfully replicated the demands of real-life competition in training.

Contribution to Physical Education and Teqball

The findings of this study provide an important contribution to physical education, particularly in the context of integrating new sports into the academic curriculum. Modern physical education demands a learning approach driven by evidence-based practice, where tested and validated training models are essential instruments for improving the quality of sports learning (Gibbons et al., 2019; Hardman & Marshall, 2019). By developing a comprehensive Teqball training model, this study supports the diversification of technical competencies in Physical Education (PJKR) students.

Furthermore, Teqball continues to grow globally as a competitive and recreational sport. Initial research by Syahbab (2024) and Syahban (2023a) indicates that Teqball has significant pedagogical and performative potential. The training model developed in this study is the first contribution to the development of a Teqball training system at the higher education level in Indonesia. This opens up opportunities for further studies such as advanced biomechanical analysis, Teqball-specific training periodization, and the integration of training technology (Misailidis & Hatzimanouil, 2018; Hughes & Bartlett, 2020).

Limitations and Directions for Further Research

While effective, this study has limitations. First, the trial was conducted at a single institution and at a single educational level, so the generalizability of the results needs to be tested across a more diverse population. Second, this model focuses only on basic attacking techniques; Advanced tactical aspects and match-condition variables have not been explicitly included, necessitating further research that incorporates cognitive and strategic aspects of the game (Memmert, 2015; Renshaw et al., 2019). Future research directions could include the use of motion analysis technology and wearable sensors to monitor biomechanical patterns

more deeply during training (Baca & Kornfeind, 2019; Towlson et al., 2019). Furthermore, further research could integrate a periodized training approach for Teqball, combining technical, physical, and tactical aspects in a planned manner (Turner & Jeffreys, 2010). A training model for basic attacking techniques in Teqball developed through an R&D approach has been proven valid, feasible, and effective. Expert validation demonstrated high product acceptance, group trials demonstrated positive student responses, and effectiveness tests confirmed significant improvements in technical skills. This research contributes to physical education, the development of new sports, and provides a scientific basis for the development of advanced training models in the future.

CONCLUSION

This research successfully developed a training model for basic attacking techniques in Teqball for PJKR students through a Research and Development (R&D) approach. Validation results by two Teqball experts and one learning expert showed an average feasibility score of 68% (Very Worthy), thus declaring the model suitable for field testing. Phase I (small group, n=15) achieved a score of 60% (Worthy), while Phase II (large group, n=20) increased this score to 70% (Very Worthy) after revisions including simplifying movement stages, adjusting intensity, and emphasizing the practical objectives of each exercise.

Effectiveness testing on 60 students demonstrated significant improvements in attacking skills, with average kicking accuracy increasing from 65.40 to 78.85, two-touch accuracy from 63.75 to 76.20, and reaction time improving from 0.82 seconds to 0.69 seconds ($p < 0.05$; large effect size). These findings confirm that a training model designed in stages tailored to the initial abilities of beginner players is more effective in improving technical quality. Conceptually and empirically, the developed model is relevant, efficient, and adaptive to the characteristics of modern Teqball and can serve as an alternative learning and training product for attacking techniques in physical education and sports settings.

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time, and opportunities to ensure the systematic implementation of this research. It is hoped that the results of this research will provide a real contribution to the development of Teqball learning and training in physical education and sports environments.

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