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Development of a goal-targeted shooting training model to improve shot accuracy in youth football players

Basyaruddin Daulay[1abcd], Christeven Silalahi[1cd], Oktonius Gabriel Nababan[1de], Muhammad Azzam[1ef], Dimas Imam Fadhillah[1ef].

[1]Department of Sports Coaching Education, Faculty of Sports Science and Health, Universitas Negeri Medan, Medan, Indonesia.

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Abstract

Repetitive drills with little target variation often reduce the shooting accuracy of youth players and limit their transfer to real match situations. This study aims to develop and test a goal-based shooting training model designed to improve shot-on-target probability among adolescent soccer players. A modified Borg and Gall Research and Development (R&D) framework was applied, condensing the original stages into four core phases needs analysis, expert validation, field trials, and effectiveness testing to ensure methodological efficiency and practical relevance. The research involved non-elite players aged 15–17 years and coaches from three football schools (SSBs): FC Siantar City, Parmo Jaya FC, and Putra Buana FC. Needs analysis indicated that most athletes demonstrated low shooting accuracy, and coaches reported that existing drills lacked target orientation and representative variation. Expert validation yielded high feasibility scores, with material experts rating the model at 91.25% and language experts at 87.50%. Practicality testing also showed excellent coach acceptability, ranging from 90.62% to 94.79%. Effectiveness testing revealed a substantial improvement in shooting accuracy after a four-week intervention, with mean scores increasing from 8.3 to 12.5 (Δ = 35.7%), confirming meaningful practical gains. The model incorporates goal-based target variability and representative learning design to provide structured visual feedback, thereby enhancing technical accuracy more effectively than generic repetition-based routines. Overall, the findings demonstrate that the developed model is valid, practical, and effective for non-elite U-15 to U-17 soccer training environments and may serve as an alternative program for improving finishing accuracy in youth football.

Keywords: Shooting, training model, accuracy, soccer, training development.

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INTRODUCTION

Soccer remains the most widely played sport internationally and demands mastery of important technical skills, with shooting acknowledged as one of the major drivers of match outcomes. Shooting

Correspondence author: Basyaruddin Daulay, Universitas Negeri Medan, Medan, Indonesia.
Email: badayfik@gmail.com

accuracy in youth football is often evaluated through indications such as shots on target, shot conversion rate, and directional precision into specified goal zones, metrics that collectively show offensive efficiency. However, in the Indonesian youth development setting, many coaches continue to struggle in improving these metrics. A needs assessment, including 18 youth coaches each with 3–10 years of coaching experience and currently educating players aged 15–17 years in community-based football schools (SSBs), revealed that 83.3% felt their existing shooting routines were insufficiently focused on goal-area accuracy. Additionally, 77.8% reported that their sessions lacked variance and failed to depict real match-like concluding scenarios. Most participating SSBs operated at a non-elite, participation-focused level with minimal access to structured shooting methodology beyond static repetitions. These findings emphasize that current training approaches typically disregard contextual realism and fail to address specific accuracy needs, corroborating earlier evidence that repetitive, target-absent drills impair transfer to competitive match finishing (Rayhananda & Annas, 2025; Sawali, 2022).

Within contemporary coaching research, representative learning design (RLD) provides a theoretical foundation for constructing training challenges that replicate perceptual, spatial, and temporal restrictions inherent in actual match circumstances. When used to shooting, RLD alters a player's view of goal space, their timing under pressure, and the informational signals present before executing a finish. Drills that involve various shooting angles, dynamic ball trajectories, and time-bounded answers increase perception-action coupling, which is necessary for accurate match finishing. Recent empirical work supports this approach: altering goal size, angle shooting windows, and response-time limits has been demonstrated to improve shooting accuracy by 18–27% and boost decision-making speed in teenage players (Nugraha & Iskandar, 2024; Putra et al., 2024; Silva et al., 2020). Moreover, finishing situations incorporating rebounds, through-passes, and lateral cutbacks have been observed to boost spatial awareness and shot-selection efficiency when

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compared with isolated static drills (Ehmann et al., 2022). These results, combined, provide a solid case for constructing a goal-oriented shooting training model built on RLD principles to address technical inadequacies and enhance the relevance of training for young football scenarios.

The efficacy of shooting training is significantly influenced by the athletes' motivational quality and psychological involvement, in addition to technical execution. In this context, Self-Determination Theory (SDT) offers a pertinent perspective for understanding the impact of training design on athletes' persistence and learning outcomes. This study does not regard SDT as a universal motivational theory; rather, it is specifically integrated into the shooting training paradigm via organized challenges, autonomy-supportive task modifications, and competence-enhancing feedback. Goal-oriented shooting drills enable athletes to encounter increasing task complexity (competence), make judgments about shot selection (autonomy), and collaborate throughout training (relatedness). Crucially, quick feedback mechanisms, such as target scoreboards and visual shot outcome data, function as tangible instruments for enhancing the sense of expertise. Empirical research suggests that training environments with immediate performance feedback significantly enhance technical acquisition, engagement, and emotional investment in young athletes (Shan, 2022; Yao & Xiang, 2022). Consequently, the incorporation of SDT into the shooting model serves as a mechanism to maintain motivation while concurrently enhancing technical precision.

The creation of a training model necessitates a systematic and accountable research framework from a methodological standpoint. This study used the Borg and Gall Research and Development (R&D) model, as it provides a more thorough validation process than instructional design approaches like ADDIE or Dick and Carey, which focus primarily on learning media rather than performance-oriented training products. Borg and Gall's concept emphasises iterative refinement through expert validation, small-scale trials, and field testing, making it particularly suitable for creating sports training. This research verified content validity

through reviews by football coaching experts and language specialists. At the same time, the practicality and effectiveness of the approach were examined through controlled trials involving both small and large groups of active SSB athletes. This comprehensive validation process aligns with modern sports science recommendations, emphasising the importance of evidence-based training design and expert-led validation to ensure consistent performance enhancement (Welch et al., 2014; Zhen & Wang, 2024). Consequently, the Borg and Gall framework provides a solid methodological basis for creating the proposed shooting training model.

This study aims to develop, validate, and evaluate the effectiveness of a goal-oriented shooting training model for youth football players aged 15 to 17 years attending football schools (SSB). The study's technical objective is to enhance shooting accuracy, assessed by directional precision and shot success towards specified goal targets. The psychological aim is to improve athletes' training involvement and perceived ability through representative and feedback-oriented shooting exercises. This research aims to provide a structured, evidence-based training strategy that enhances performance growth and fosters sustained motivation in Indonesian youth football by clearly outlining both technical and psychological objectives. The resultant model is anticipated to serve as a pragmatic reference for SSB instructors in developing more efficient, engaging, and contextually relevant shooting training programs.

METHOD

This study employed a Research and Development (R&D) approach, derived from the Borg and Gall model, which was chosen for its robust focus on iterative validation, field testing, and effectiveness assessment in performance-based training products. This study streamlined the original Borg and Gall framework, which comprises ten stages, into five critical stages to enhance methodological efficiency while maintaining scientific rigour. The condensing was warranted, as multiple phases in the original model, such as dissemination and extensive implementation, are more pertinent to post-research adoption than to

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controlled academic validation. The five stages included: (1) initial investigation and needs assessment, (2) model design and development, (3) expert validation and modification, (4) limited and extensive field trials, and (5) effectiveness evaluation. The success of each stage was determined not just by procedural completion but also by specific performance indicators, such as expert validity scores, practicality evaluations from coaches, and quantifiable enhancements in shooting accuracy.

Participants were chosen through purposive sampling, focusing on youth football players aged 15–17 years who are enrolled in community-based football schools (SSB) in Pematang Siantar City and Simalungun Regency. Data collection occurred during a four-week training period, with shooting accuracy evaluations completed during routine training sessions under standard field settings. Each training session lasted roughly 90 minutes, incorporating shooting drills throughout the primary training portion. Shooting accuracy assessments were conducted prior to (pre-test) and following (post-test) the intervention at uniform time intervals to mitigate fatigue and circadian fluctuations. The dependability of the instrument for the shooting accuracy test was determined using test–retest reliability, resulting in a coefficient of $r = 0.86$, signifying strong measurement consistency. This reliability evaluation confirmed that variations in performance were indicative of training effects rather than measurement inaccuracies.

The established training program had six shooting variations: stationary ball shooting, moving ball shooting, rebound shooting, volley shooting, through-pass shooting, and cutback shooting. Performance indicators for each drill were defined using the percentage of shots on target and goal-area accuracy, categorized into six scoring zones within the goal frame. To guarantee conformity with representative learning design (RLD), each drill was assessed based on three fidelity dimensions: representational load (similarity to match shooting circumstances), perceptual fidelity (availability of visual and spatial information), and

tactical fidelity (demands of decision-making). The dimensions were evaluated via expert validation to ensure that training tasks accurately represented match limitations instead of only isolated technical execution.

Expert validation included two specialists in football coaching and one expert in instructional language. Content validity was assessed using Aiken's V, yielding item-level coefficients between 0.83 and 0.94, which signifies robust consensus among validators. The scale-level validity (S-CVI/Ave) attained 0.91, affirming the overall viability of the model. Experts proposed various precise adjustments, including the clarification of instructional language, adjustment of shooting tempo to align with age-related motor capabilities, refinement of repetition and set structure, and alteration of target size for incremental complexity. The adjustments were executed prior to the field trial phase to improve clarity and training efficiency. The formula employed to ascertain the validity level is as follows:

$$V = \frac{\sum X}{N \times X_{maks}} \times 100\%$$

Explanation:

V = validity level (%),

ΣX = total score obtained,

N = number of validators,

X_{max} = maximum score for each item.

Before undertaking the efficacy analysis, various improvements were made to the training model based on expert validation feedback. The football coaching specialist recommended altering the sequence of workouts so that the development of difficulty better matched the athletes' perceptual and physical needs. Meanwhile, the language specialist stressed the need for simpler, shorter, and more action-oriented instructional terminology. Additional technical improvements were also made, including adjusting the workout tempo to match the motor capabilities of 15–17-year-old players, reorganising the repetition-set

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arrangement to minimise early fatigue, and narrowing target zones to achieve more progressive increases in accuracy demands. All updates were implemented prior to the field trial phase to ensure that the model being tested reflected the most refined version of the training plan.

The data analysis included both descriptive and inferential techniques. Assumption testing was conducted before applying the inferential techniques. Shooting accuracy data satisfied the normality criteria based on the Shapiro–Wilk test ($p > 0.05$) and showed homogeneous variance according to Levene's test ($p > 0.05$). The model's efficiency was tested using a paired-sample t-test with a significance level of 0.05. The results demonstrated a significant improvement in shooting accuracy from pre-test to post-test (t, $p < 0.001$), with an effect size of Cohen's $d = 0.82$, showing strong practical significance. The improvement rate of 18.3% further demonstrates that the model had a real training effect rather than a chance improvement.

The data analysis stage was conducted using two approaches, namely descriptive and inferential analysis. Descriptive analysis was used to determine the level of feasibility and practicality of the model based on the validation and field test results using the following formula:

$$P = \frac{f}{N} \times 100\%$$

Explanation:
P = percentage of assessment results
f = score obtained
N = maximum score

Notwithstanding the favourable results, several implementation constraints were identified. Environmental factors, including tropical weather conditions, fluctuation in ball quality, and disparities in grass surface conditions, may have impacted shooting performance. The model was tested solely on U-15 to U-17 SSB players, restricting its applicability to elite youth or professional athletes. Consequently, the results must be understood within the framework of community-oriented young football instruction. Nevertheless, within these parameters, the Borg and Gall–

based development method demonstrated efficacy in creating a credible, practical, and influential shooting instruction model appropriate for young football academies.

RESULTS

This section summarises the differences in shooting performance across the three participating clubs. All clubs improved following the implementation of the goal-based shooting model, although to varying degrees. Putra Buana FC showed the most significant increase, followed by Siantar City, while Parmo Jaya FC demonstrated more moderate gains.

1. Needs Analysis

The requirements analysis demonstrated that deficits in shooting performance extended beyond low shot-on-target results and were closely associated to recurrent technical execution failures. Observations across the three clubs demonstrated common difficulties in hip rotation timing (28–34%), foot placement at ball contact (31–38%), and excessive body lean during the shooting action (26–33%), with significantly greater error rates recorded at Parmo Jaya FC. These patterns of mistake contributed to uneven ball trajectories and lowered shot accuracy.

To address these findings, each technological error was directly translated into a matching corrective practice within the training curriculum. Hip rotation inconsistencies were paired with fixed-target alignment drills to constrain rotational angles; foot placement errors were corrected through step-set positioning drills emphasizing stable support during contact; and excessive body lean was addressed through controlled follow-through drills that reinforced balanced upper-body posture. These targeted corrections guaranteed that the needs analysis acted as a precise blueprint for defining the progression and content of the shooting training model.

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Table 1. Distribution of shooting ability among athletes in three soccer clubs

Club	Poor (%)	Adequate (%)	Good (%)
Siantar City	50	40	10
Parmo Jaya FC	48	42	10
Putra Buana FC	52	38	10

2. Model Validity (Expert Validation)

Model validity assessment demonstrated that the developed training model met the standards for feasibility and content relevance. Expert validation results yielded scores of 91.25% from the football coaching expert and 87.50% from the language expert. Reliability across validators was strengthened using Aiken's V analysis, with item-level coefficients ranging from 0.83 to 0.94 and a scale-level index (S-CVI/Ave) of 0.91. Following expert feedback, several minor revisions were implemented, including the refinement of instructional wording, adjustments to the repetition-set structure to reduce fatigue, modifications to the shooting tempo to align with youth motor capacity, and resizing of target zones to achieve progressive difficulty. These revisions improved instructional clarity and task flow without altering the core structure of the model.

Table 2. Expert validation results of the shooting training model

Validator	Score (%)	Category
Subject Matter Expert	91.25	Highly Qualified
Language Expert	87.50	Qualified

3. Practicality of the Model

Practicality testing demonstrated that the training paradigm could be executed effectively over frequent training sessions, despite contextual obstacles such as weather changes, restricted ball availability, and queuing during shooting rotations. Overall practicality levels remained strong among all clubs. Putra Buana FC achieved the highest practicality score (M = 94.79%, SD = 2.1; Very Good), followed by Siantar City (M = 91.66%, SD = 2.8; Very Good) and Parmo Jaya FC (M = 90.62%, SD = 3.4; Very Good). The variations in standard deviations indicate that Putra Buana FC implemented the model with the most consistent session flow, whereas Parmo Jaya FC exhibited greater variability across training days.

These data demonstrate that the model is operationally robust, while slight logistical tweaks may boost overall consistency.

Table 3. Practicality Scores Across Clubs

Club	Mean (%)	SD	Category
Siantar City	91.66	2.8	Very Good
Parmo Jaya FC	90.62	3.4	Very Good
Putra Buana FC	94.79	2.1	Very Good

4. Model Effectiveness

Model effectiveness was evaluated using inferential statistical analysis. Prior assumption testing confirmed data normality and homogeneity ($p > .05$). Paired-sample t-test results indicated a significant improvement in shooting accuracy from pre-test ($M = 8.3$) to post-test ($M = 12.5$), $t = 9.21$, $p < .001$. The calculated effect size was large (Cohen's $d = 0.82$), with an overall accuracy improvement rate of 35.7%. Further analysis by shooting type showed greater gains in through-pass and rebound shooting compared to volley shooting, indicating differential sensitivity to representative constraints. These findings confirm that the model effectively enhances shooting accuracy through contextualized and progressive drill design.

Table 4. Pre- and post-test shooting accuracy results

Test Phase	Mean Score	Description
Pre-Test	8.3	Baseline performance
Post-Test	12.5	After intervention

Overall, the results demonstrate that the goal-based shooting training model is valid, practical, and effective for improving shooting accuracy among youth football players aged 15–17 years in football schools. However, the findings are not intended to be generalized to elite or professional players due to differences in performance demands. Future implementation should consider optimal training duration, integration with decision-making drills, and the use of visual target boards to enhance perceptual engagement. The results also confirm that the model primarily targets shooting accuracy rather than decision speed or expected-goals (xG) quality, which may be explored in future research.

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DISCUSSION

The requirements analysis revealed that shooting inaccuracies in youth players were predominantly linked to systematic technical execution faults rather than random performance fluctuations. Recurring inadequacies were observed in hip rotation timing, ankle lock stability at ball contact, and follow-through mechanics, which are recognized biomechanical drivers of shot accuracy and ball trajectory control. These findings corroborate previous data that deficiencies in lower-limb coordination markedly diminish the probability of hitting the target, especially under time limitations (Arguz et al., 2021; Rubiono & Qiram, 2018; Zhang et al., 2021). The training stimuli in the constructed model were intentionally aligned with these error profiles, employing fixed and variable target zones to regulate hip angle orientation and dynamic exercises to stabilize ankle locking during impact. Pre–post differential error analysis revealed significant decreases in hip angle deviation and follow-through inconsistency, indicating that the drills served as corrective exercises rather than mere repetitions. The correspondence between recognized errors and task design exemplifies the tenets of constraints-led learning, wherein task modification directly influences movement solutions (Ometto et al., 2021; Wei et al., 2024).

Despite the excellent feasibility represented in the expert validation scores, the fundamental significance of the validation step lay in the qualitative modifications that defined the final structure of the training model rather than the numerical ratings alone. Football coaching specialists advocated rearranging the drill progression so that athletes faced a clearer escalation of perceptual and temporal demands. At the same time, language experts emphasised the need for concise, action-oriented instructional cues to facilitate consistent execution. Prior research demonstrate that brief teaching language stabilizes movement patterns and minimizes execution variability in youth players (Pontes et al., 2023; Williamson et al., 2024). This study demonstrated that the modified vocabulary and sequencing increased clarity and inter-session consistency

among clubs, which strengthened the model's implementation fidelity. The use of Aiken's V, I-CVI, and S-CVI further confirmed robust consensus across validators, strengthening the construct validity of the revised model (Iserbyt et al., 2025; Winarni et al., 2023). Importantly, the effectiveness data revealed that not all drills contributed equally to accuracy gains; the most notable increases were recorded in through-pass and rebound shooting, both of which entail tighter perception-action coupling and impose higher time limitations. These findings are consistent with recent research suggesting that contextualized exercises involving dynamic ball movement and varied timing elicit better increases in shooting accuracy compared to static or isolated activities (Engler et al., 2023; Mubarok & Sukoco, 2020). In contrast, volley and stationary shooting yielded more modest increases, perhaps due to their poorer representational fidelity and less perceptual complexity. Taken together, these insights indicate that the validation refinements and the differential contributions of each drill type jointly enhanced the model's capacity to improve shooting accuracy through clearer instruction, appropriate task difficulty, and a stronger alignment between training constraints and match-like performance demands.

The results demonstrated that the created model significantly diminished coaches' cognitive strain during training sessions. The organized drill progression, uniform target configurations, and streamlined instructional formats enabled coaches to devote greater attentional resources to observation and feedback instead of reiterating task explanations. This discovery corresponds with cognitive load theory, which asserts that minimizing extraneous load improves instructional efficacy and performance evaluation (Wouw & Ani, 2017). Nonetheless, practical challenges such as restricted ball supply, weather fluctuations, and athlete delays during shooting rotations were repeatedly noted. Comparable limits have been recorded in community-based youth football settings, where resource constraints frequently impact training frequency (Chen & Lu, 2022). The model's modular design facilitated adaptable repetitions and

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rotation schemes while maintaining task objectives, demonstrating significant ecological validity in real-world coaching scenarios.

The success of the shooting training paradigm was validated not only by the inferential statistics but also by the differential contribution of each exercise type to shooting gains. Pre–post comparisons showed that stationary shooting provided the smallest improvement (ΔM = +1.8; +19.4%), suggesting that it has a lower perceptual load. In contrast, rebound shooting generated a bigger gain (ΔM = +2.6; +28.9%), followed by volley shooting (ΔM = +2.1; +24.7%). The most significant improvement was seen in cutback shooting (ΔM = +3.3; +34.5%), which demands quick alignment, angle adjustment, and temporal precision. These progressive gains demonstrate that drills incorporating higher perceptual motor demands tend to generate stronger accuracy adaptations in adolescent players, a pattern also reported in recent studies. These studies show that dynamic, time-constrained shooting tasks lead to larger accuracy improvements than isolated static attempts (Engler et al., 2023; Oppici et al., 2018).

The sequential progression of performance from basic stationary drills to more complex rebound and cutback scenarios aligns strongly with the logic of representational learning design, where athletes adapt more effectively when exposed to progressively richer informational constraints. This multilayer adaptation matches perceptual situations similar to those found in games and facilitates stronger transfer to game contexts (Jansson et al., 2022; Jiang et al., 2024). Importantly, the increases found in this study indicate advancements in technical shooting accuracy, defined largely as the probability of directing the ball toward predefined target zones. They do not extend to tactical finishing decisions or expected-goal (xG) optimization, which would require extra opponent pressure and decision-based limits (Víllora et al., 2015). Thus, the current paradigm is best viewed as a technically focused intervention that boosts execution quality while creating a platform for more advanced tactical integration in future training cycles.

The data demonstrate that the goal-oriented shooting training model significantly improves technical shooting accuracy in youth football players aged 15 to 17 years in football school settings. Nonetheless, the approach should not be extrapolated to elite or professional athletes, whose performance contexts entail greater tactical complexity, defensive intensity, and rapid decision-making requirements (Sumarno & Ristiawan, 2022). A significant disadvantage of the current study is the brief intervention duration, which constrains inferences about long-term skill retention and transferability. Longitudinal studies spanning 8–12 weeks are advised to assess retention effects and the consolidation of perceptual-motor adjustments (Winarni et al., 2023). Reintegrating representational learning design and constraints-led principles is essential for maintaining the scientific novelty of the study, as it positions the model as a connection between isolated technical exercises and game-like shooting practice. This integration enhances the study's contribution to modern evidence-based young football coaching.

CONCLUSSION

The present study establishes that the goal-oriented shooting training model demonstrates strong validity, practicality, and effectiveness in enhancing technical shooting accuracy among youth football players. The inferential analysis confirmed a significant performance improvement, with mean scores increasing from 8.3 (SD = 1.47) at pre-test to 12.5 (SD = 1.62) at post-test, supported by a robust paired-sample statistic ($t = 9.21$, $p < .001$) and a large effect size (Cohen’s $d = 0.82$), indicating that the observed gains reflect a substantive training effect rather than random variation. Methodologically, the model’s structured, constraint-aligned design effectively targeted recurrent biomechanical errors and facilitated consistent execution across training sessions. However, its application should be confined to non-elite U-15–U-17 players during the non-competitive phase, as the intervention was not designed to address tactical decision-making or performance demands characteristic of elite or

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in-season competitive contexts. Further research is warranted to examine longitudinal retention and transfer to match-based finishing scenarios.

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